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# Impact from the blockchain technology on the Nordic capital market

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## Abstract

### **Impact from the blockchain technology on the Nordic capital market**

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*Victoria Karlsson Lundström*

This master thesis explores how the blockchain technology might affect the capital market, a market with an established role in our current society. This exploration is conducted by a literature study and an interview study with participants within the capital market, in order to gather several opinions and experiences of the technology. The blockchain technology is a registration technology that provides a high degree of security and the possibility to cut of intermediaries. These are two suitable features for the capital market and especially those sections currently in need for development, for example the post trade area. The blockchain technology will likely develop the capital market but not change its foundation. Within the capital market there are a lot of aspects to consider, regulations are one of them. Currently there are only minor initiatives launched using the blockchain technology, what it will be used for in the future is not determined but all participants in this study agreed on that the technology will affect the capital market in some manner. Even if the technology itself will not succeed it has started a mental process for the actors within the capital market and highlight that they need to develop.

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## Popular scientific summary in Swedish

Denna studie har som syfte att undersöka hur den nya blockkedjetekniken kan komma att påverka den etablerade kapitalmarknaden. Blockkedjetekniken är sammantaget en teknik för registrering som lagrar sin information i olika block. En ny teknologi har som möjlighet att påverka områden utanför tekniken själv och konsekvenserna av att ersätta en beprövad teknik men en ny teknik kan vara större eller mer omfattande än förutspått. Detta har i denna studie undersökts genom intervjuer med olika aktörer på dagens kapitalmarknad som har insyn i utvecklingen av teknologin. Det för att undersöka deras tankar kring hur tekniken kan komma att användas och påverka. Denna studie innefattar också en litteraturstudie där tidigare arbeten som berör teknologin sammanställts för att undersöka blockkedjetekniken vidare. Det insamlade materialet analyseras med avseende på kapitalmarknadens nuläge och hur marknaden tillsammans med teknikens funktioner kan komma att påverkas och förändras.

Blockkedjetekniken har möjlighet att påverka och utveckla kapitalmarknaden, vilket bland annat innefattar värdepappershandel och bankernas verksamhet. Generellt så verkar kapitalmarknaden vara i behov av en förändring, framförallt gäller detta den så kallade post trade delen, alltså den delen av till exempel en aktieaffär som sker efter det att själva handelsöverenskommelsen är fastlagd. Blockkedjetekniken har inbyggda möjligheter till höga säkerhetsnivåer och hastigheter som är önskvärda och nödvändiga för att utveckla dagens kapitalmarknad. Specifikt vad tekniken kommer att användas till är i dagsläget okänt men möjligheterna är många. Det har redan lanserat mindre initiativ inom branschen. Större initiativ ser dock ut att dröja ytterligare några år innan full lansering. Även om tekniken inte kommer att användas i större utsträckning så har den initierat en mental process hos kapitalmarknaden. Denna mentala process uppmärksammar att de nuvarande arbetssätt och processer som tillämpas behöver uppdateras och förbättras för att i sin tur utveckla marknaden. Denna process benämns som ett stort steg för marknaden.

Det är många delar att ta hänsyn till för att möjliggöra en stor teknisk förändring, i detta fall handlar det framförallt om lagar och regelverk. Dessa har en central funktion på kapitalmarknaden. Regelverken tycks ha en avgörande roll för om tekniken kommer att implementeras eller inte och det finns vissa områden där blockkedjetekniken och regelverken skiljer sig åt. En annan aspekt som påverkar är förtroende från kunderna på marknaden. Det är viktigt att kunderna på dagens kapitalmarknad upplever ett fortsatt förtroende för marknaden. De ska fortsätta vara kunder oberoende av förändringar i nätverksstrukturer eller teknologi. Det är komplext och svårt att byta ut någonting existerande som fungerar mot någonting nytt och obeprövat, detta är ett hinder för blockkedjetekniken. Sammantaget finns det en stark tilltro till blockkedjetekniken och att den i framtiden kommer att påverka kapitalmarknaden på något sätt, frågan som kvarstår är hur.

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# 1. Introduction

The effect of technical progress on the welfare of workers has been a matter of controversy for a long time (Saint-Paul, 2008). During the centuries new technical innovations have arose and they have affected the society in many ways. Historically the “Spinning Jenny” is one example; in 1768 a spinning device was invented and it performed the job previously performed by 8 people. This made spinners break into the inventor’s home and destroyed his machines (Saint-Paul, 2008). In the more recent years the Internet is one of the largest technical novelties. The Internet has enabled a lot of different services and changes in living for a lot of people. Technical progress has affected a lot of areas in our society like for example, nature, interaction between workers, segregation in society, distribution of income and also the overall living standard (Saint-Paul, 2008).

Many areas are affected by technological innovations but how is never set on beforehand. The blockchain technology is one of the new technical innovations currently emerging. Briefly it is a technique providing registration of any kind into a distributed database architecture referred to as a ledger (Pinna & Ruttenberg, 2016). The blockchain technology enables networks to become more decentralised and it can shorten transaction times. It is likely that the blockchain technology will affect the capital market, a large global industry.

## 1.1 Problem discussion

The capital market has been doing business electronically for many years. But the businesses within the market also involve many information transfers manually and paper-based. There are several reasons for the continued adherence to traditional paper-based method; both aversion from customers and regulatory statues affects the usage (Mulligan & Gordon, 2002). In the work of Mulligan & Gordon (2002) they state that the capital market needs to transfer to a more digitalised environment. This should enable new channels and communication opportunities but it also creates a threat of disintermediation for others. The study of Mulligan & Gordon (2002) is not brand new but the capital market seems to still struggle with the same issues. One possible solution to those issues might be the blockchain technology. When implementing new technology impacts from the implementation is not always clear on beforehand and it might affect more areas than ever imagined (Saint-Paul, 2008). This implies that change is not easy, the impacts might be extensive and the consequences might be others than intended. The capital market is an important industry in the current society, it is important to not interfere with its function and not expose it to unnecessary risks but at the same time it needs to be developed. The capital market is also highly regulated and it is important that changes within the market do not interfere with the regulations. The problem of interest in this thesis is how the blockchain technology might affect the capital market in the future. It will probably take some time until the blockchain technology is fully implemented and it requires several changes to make an extensive

implementation possible (Van de Velde et al, 2016). However, this new technology opens up for a lot of new features and possibilities. How this might affect the established capital market without interfere with its function is investigated in this thesis.

## 1.2 Objective and research questions

Given the problem discussion above this master thesis aims to highlight issues and possible impacts with the blockchain technology limited to the capital market. The technology is investigated and how it might affect areas separated from the technology but related to the capital market.

The research questions used to fulfil the objective for this thesis are the following:

- What are the possible future implementations for the blockchain technology within the Nordic capital market?
- What is the possible impact from a new technology like the blockchain technology?
  - What areas might be most affected?

## 1.3 Delimitations

This thesis only focuses on the capital market and how this market might be affected by introducing a brand new technology into an established system. Other segments and markets might also be affected by this technology but in order to gain a deep knowledge only the capital market is studied.

Payments or money transfers are not included in this thesis due to the different regulations and workflows applied to it. This means that a current use of the blockchain technology, the Bitcoin (crypto currency) is only mentioned as background of the blockchain technology since it is the origin of the blockchain technology.

In a geographic perspective the Nordic region is in focus, this in order to only study a limited area and how their capital market is composed. Since Sweden, Denmark and Finland are members in the European union (EU) it is included in the thesis.

## 1.4 Methodology in brief

The procedure chosen to gather information for this thesis is a literature study and an interview study. The literature study contains information about the blockchain technology; how it works, features and impact on primary actors. The literature study aims to gather what has been written about the blockchain technology in order to get an extensive perspective. The interview study is a result of several interviews with market participants from the capital market. The interview study aims to gather insights from the participants on the blockchain technology and how it might affect the capital market

in the future. Due to the geographic location in Sweden, this country is the origin for regulatory studies and all of the individuals interviewed are mainly operating in Sweden. Read more about the methodology in section 4.

## 2. Background

The purpose with this background section is providing a foundation for further reading. All terms explained in this section is necessary to have a brief understanding of. This section is divided into two parts, one technical section and one financial section.

### 2.1 Technical background

To fully understand the blockchain technology and technical terminology basic information is presented in this section. The technical background consists of an introduction to cryptography, centralised and decentralised network, peer-to-peer network and finally information about Bitcoin.

#### 2.1.1 Cryptography

The reason to use cryptography is to provide confidentiality by encryption methods. By using cryptography the message or the file a user would like to send to another user can be protected from eavesdroppers or intruders, aiming to get information about the content of transfer. Cryptography is also used to ensure integrity, which implies that the message transferred is not modified during the transaction. User authentication is another reason why cryptography is used; it ensures that the message is sent from the right user (Delfs & Knebl, 2007; Buchmann et al, 2013).

Currently many Internet services are highly security-sensitive, such as online banking or online shopping. This makes the Internet an important application domain of cryptography and especially one kind of cryptography, the public-key cryptography (Buchmann et al, 2013). The idea of public-key cryptography is a pair of keys, a public key for encryption available to everyone and a private-key for decryption only available to its owner (Segendorf, 2014; Delfs & Knebl, 2007). The private-key can only be used to decrypt a message and not to encrypt a message and the opposite applies on the public-key (Buchmann et al, 2013). This means that when a message is transacted the sender uses the public-key of the receiver and sends the message encrypt. The encrypted message is only shown as a ciphertext and it is impossible to read the real content. Then the receiver uses the private key to decrypt the message and is then able to read it (Segendorf, 2014). A visualisation of this procedure is shown in figure 1 below.

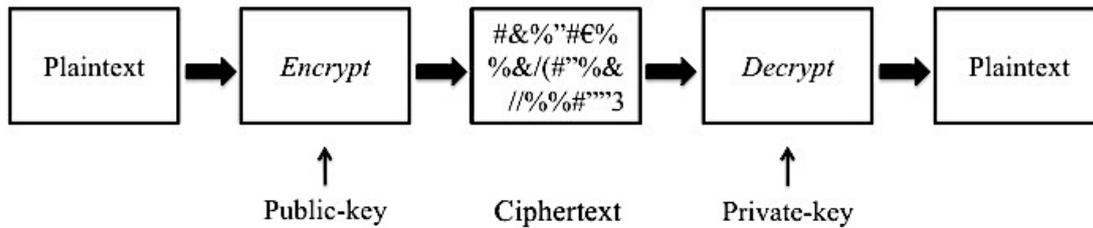


Figure 1 – The process of secret key usage (Inspired by Buchmann et al, 2013, p. 6)

### 2.1.2 Centralised and decentralised network

A centralised network implies that the decision-making power is concentrated into a single person, a small group or a single point. This keeps performance in line with organisational protocols and standards; it also allows close monitoring and adjustment of work activities. Centralisation can also mean that the physical location is the same for all functions. Decentralisation implies that decisions are made at various levels in the organisation hierarchy. This requires a close cooperation between the units. The units in a decentralised organisation are spread physically around a region, a country or around the world (King, 1983). A visualisation of the different kinds of network is displayed below in figure 2.

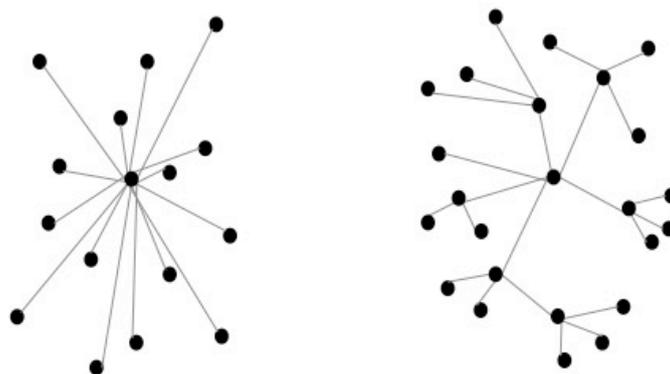
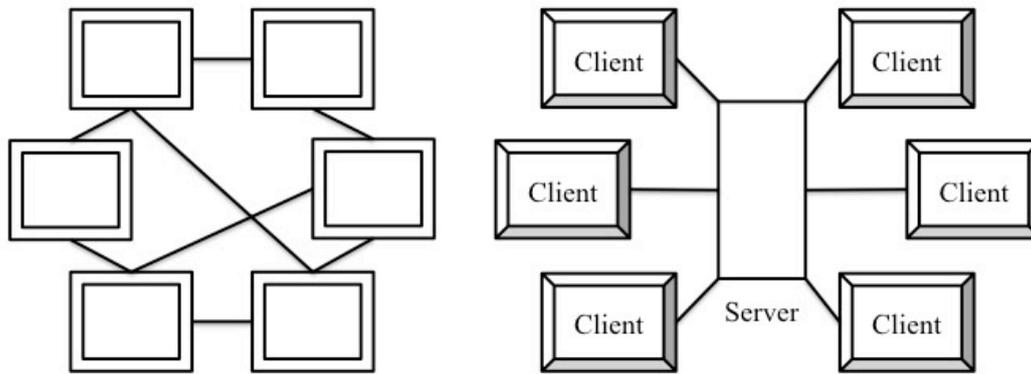


Figure 2 - Illustration of a centralised network (left) and a decentralised network (right) (Inspired by Swanson, 2015, p. 1)

### 2.1.3 Peer-to-peer network

The peer-to-peer network concept is a computational system consisting of a number of peers (also referred to as nodes or agents). Together the peers perform mutual tasks and they are connected to their neighbours through links in a network (Aberer, 2011). A peer-to-peer network is in direct contrast to the traditional client-server model where the roles are symmetrical and one node is either a client or a server; in a peer-to-peer network each peer is both a client and server at the same time (Pacitti et al, 2011). A visualisation about the difference is shown in figure 3 below. The connection between the peers is typically the Internet, but other wireless communication networks are also

used. The control in this network is decentralised and that implies equivalence among all the peers, no one has any special authority (Aberer, 2011). A peer-to-peer network is mostly used to share and provide access to a set of resources such as documents, media or data (Aberer, 2011). Kelly (2015) describes that the peer-to-peer network idea has revolutionised several businesses like the file sharing service Napster as one example of how the intermediary was cut off as a way to reduce costs in the sharing industry.



*Figure 3 – Peer-to-peer network (left) and client-server network (right)*

#### **2.1.4 Bitcoin**

Bitcoin is a crypto currency and was released in 2009 by a person or entity using the name Satoshi Nakamoto. The individual or group behind Satoshi Nakamoto is still unidentified (Swan, 2015; Kelly, 2015). The Bitcoin is built upon a peer-to-peer network allowing the users to transfer value (Kelly, 2015). The users are pseudonymous and they do not have to trust each other. There is no central authority within the Bitcoin network; instead there is an automated consensus protocol where all users verify transactions (Swan, 2015). Bitcoin enables users to store their Bitcoins in digitalised bank accounts called wallets, which can be set up by anyone with Internet access. The Bitcoin network does not know your name or gender and it does not require any contact with a bank (Vigna & Casey, 2015). Bitcoin can be bought online and exchanged to a local currency, the rate of exchange is related to supply and demand and the rate has varied a lot since its release (Segendorf, 2014). Payments in Bitcoin are not instantaneous deals; it might take about 10 minutes for a payment to be verified (Segendorf, 2014).

The Bitcoin is in the technical aspect depending on three parts: (1) the blockchain, (2) the private-public key cryptography and (3) the miners (Kelly, 2015). The blockchain is the technique in focus within this master thesis and the public ledger of all Bitcoin transactions that ever been executed. Vigna & Casey (2015) argues that the blockchain is Satoshi Nakamotos main achievement. The chain is constantly growing as miners add new block to the chain by solve mathematical equations (Swan, 2015; Kelly, 2015). The solutions of the mathematical equations are a part of the verification of payments; each solved equation represents a successful transaction (Segendorf, 2014). The miners

add new blocks to the chain about every 10 minutes, as a way of recording the most recent transactions (Swan, 2015). The miners also have the function to ensure no duplicate use of a Bitcoin (Kelly, 2015). A transaction is not completely anonymous since the transaction is added into the blockchain with the pseudonym displayed. This makes it possible to identify the wallets the transaction has occurred between, but it is very hard to tie a wallet to a specific user and this implies that a transaction is anonymous in practice (Segendorf, 2014). The private key cryptography is the security system within the network; it allows users to safely conduct transactions (Kelly, 2015).

Vigna & Casey (2015) argues that crypto currencies like Bitcoin are not without any flaws and risks. Bitcoin have been associated with criminal activities, one example of this is the Silk Road case where users took advantage of the anonymity of Bitcoin and used the network to sell drugs and launder money.

## **2.2 Financial background**

This study focuses on the capital market, which includes trading with securities. The term securities include a lot of different types of value-based investments. In this section a short description of the most common securities are presented.

### **2.2.1 Stocks**

A stock is an ownership share within a corporation. If one person, a family or a holding company holds all the stocks of the company it is called a private company. If instead the stocks can be traded on stock exchanges the company is called a public company (Byström, 2014). Stocks from a public company are traded with on a certified stock exchange (more information in section 3.2.2). Stocks can pay a dividend to its owners; the dividend depends on decisions taken at the annual stock meetings. Those annual stockholder meetings are mandatory to arrange each year for public corporations. The revenue of stocks is dependent on the dividend and the value on the stocks; therefore the revenue is unsecure and can vary for each year (Andersson, 2010).

### **2.2.2 Funds**

Another kind of securities is a fund, which consists of capital from its shareowners. A fund company administers a fund; one fund company can administer several funds. The fund can include all kinds of securities paper as long as it fits the framework for the fund (Andersson, 2010). The framework can be for example a certain country, ethical aspects or environmental (Nationalencyklopedin, 2016a).

### **2.2.3 Debts**

A debt extends over a defined time and will get repaid when expired. This means that the owner of a debt has a claim on the borrower, which most often is a company. The

debt has a predefined interest rate, which can be set or floating. Trades with debt are being held at the stock exchanges debenture market (Andersson, 2010).

#### **2.2.4 Options**

Options are a financial instrument where the emitter has promised that on a decided time buy or sell an underlying asset; for example stocks or currencies, to the owner of the option. The owner of an option can then decide if they want to carry out the agreement or not. The option contract has a maturity date and a predetermined price when selling the option. The seller of an option contract has the obligation to sell or buy the underlying asset if the buyer of the option decides to finalize the agreement. The option can be a subscription right, a warrant or a standardised option (Andersson, 2010; Byström, 2014).

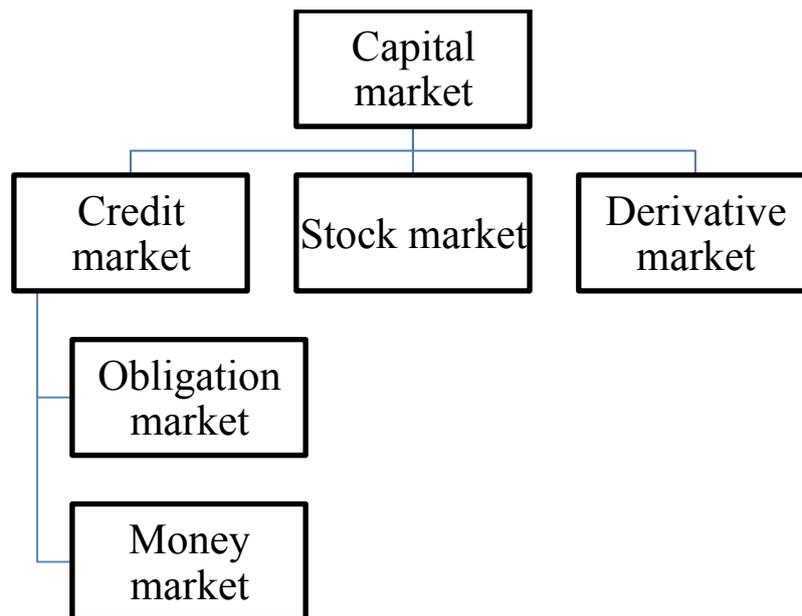
### **3. Theory**

The blockchain technology is a new innovation and how it might affect the capital market is still unknown; as always when a new technology is launched. This section describes the areas related to the blockchain technology in the capital market. The section also defines the capital market and the areas within. The theory section is the foundation of further analysis and exploration.

#### **3.1 The capital market**

The main task of the capital market is to mediate capital between those who has a surplus of money to those who has a shortfall of it, as effective and cheap as possible (Byström, 2014; Andersson, 2010). This is a fundamental role in a developed society and it enables people to distribute their income over time, by save money to for example their pension. Companies can get necessary resources to invest with through the capital market (Nationalencyklopedin, 2016b). The alternatives making investments possible to organisations in need for more capital is to borrow cash from banks, selling a part of their existing business, selling part of ownership in the company or borrowing cash from investors (issuing debentures) (Simmons, 2002). Both shares of ownership and debentures are securities. The efficiency of the capital market has become stronger through rise of the multiple alternatives possible to invest in (Andersson, 2010).

The capital market can be divided into three parts; the credit market, the stock market and the derivate market, as visualised below in figure 4.



*Figure 4 - Visualisation of the capital market*

The first part of the capital market is the credit market. The credit market can be divided into the obligation market and the money market. The money market implies trades with securities with a maturity of at most a year. The obligation market implies trades with securities with a maturity of more than a year. During the last years the distinction between these segments have become more diffuse. The loaning functionality of the banks is also included in the credit market (Andersson, 2010).

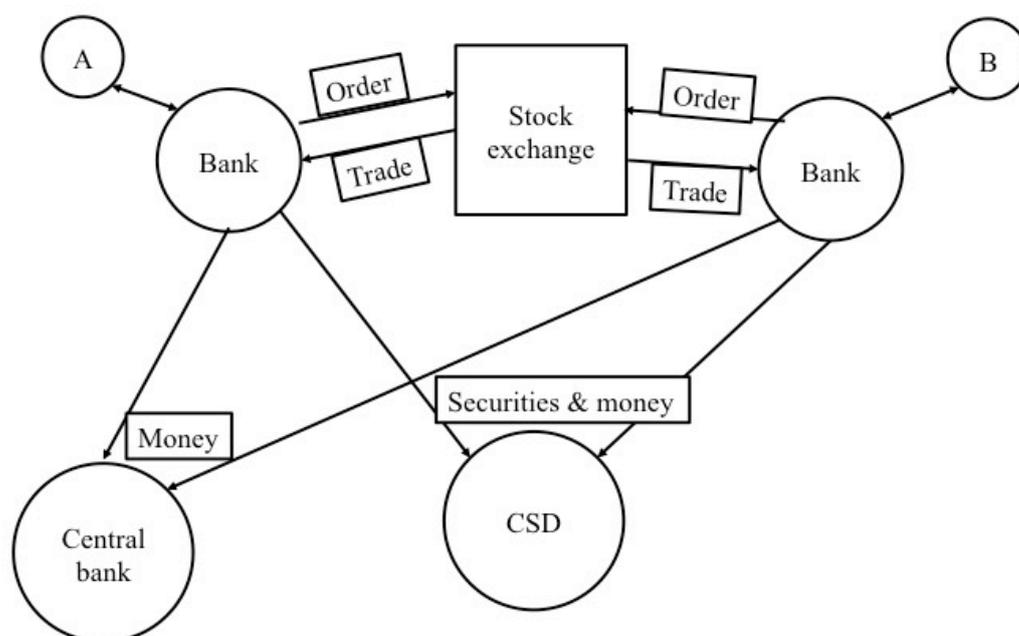
The stock market is where you buy and sell owner rights to a company. The stock market is mostly a second-hand market where you buy stocks from a current owner, since the numbers of new primary stocks are far lower than the numbers of existing stocks. A functioning second-hand market is necessary in order to have an effective primary market. The stock market enables investors to invest their money and change their investments when needed. The stock market also creates signals about the companies within the stock market situations in an economic perspective, those signals are important to identify (Nationalencyklopedin, 2016b; Byström, 2014).

The third part of the capital market is the derivate market. The most common activity on the derivate market is buying or selling options. The derivate market has the trading venue as its counterpart instead of another company member, which is the same as within the stock market (Byström, 2014). The derivate market is also responsible for liquidity and monitors different companies to ensure that they have enough resources to manage an eventual trading loss (Nationalencyklopedin, 2016b).

### 3.2 Main market participants

Around the world there is a market for different securities papers, the securities are originating by organisations outside the marketplace. The transactions are conducted at

different stock exchanges that exist in most of the countries around the world. The exchanges are marketplaces, which provides the infrastructure to allow trades within a regulated environment. When trading with securities it is most common that the individual investor never has direct contact with the counter part; instead investors buy or sell their stocks through a bank or a stockbroker. The bank or the stockbroker has contact with the counter part, which for example is the stock exchange when trading with stocks. All transactions made are then reported to a central securities depository. On top of all a central authority is established to supervise all actors and that they are operating according to existing regulations. There are a lot of companies involved in one trade and also in the capital market (Andersson, 2010; Simmons, 2002). A simplified visualisation is presented below in figure 5. General descriptions of the main companies are presented in this section. The purpose is to explain their function and responsibilities together with a summarisation of the specific actors in each Nordic country.



*Figure 5 – A simplified visualisation of the participants in a trade. A and B represents issuers. The connection to the central bank is not included in this master thesis.*

### **3.2.1 Financial supervising authority**

A financial supervising authority for financial markets is established to monitor that companies are operating according to the existing regulations. In all Nordic countries the central authority is an independent organisation but they all work closely with the national central bank (Finansinspektionen, 2016a; Finanstilsynet (NO), 2016; Finanstilsynet (DK), 2016; Finanssivalvonta, 2016). The supervising authority and the central bank are together responsible for the financial stability in each country (Byström, 2014). The regulations to consider for the authority are emanating from the parliament in each country together with international standards. The authority monitors

for example banks, credit institutions, securities companies, authorised marketplaces and insurance companies. The authority also takes action to penalise companies that do not follow the regulations (Finansinspektionen, 2016a; Finanstilsynet (NO), 2016; Finanstilsynet (DK), 2016; Finanssivalvonta, 2016; FME, 2016). The name of the financial supervising authority for each Nordic country is specified below in table 1.

*Table 1. The name of the financial supervising authority in each Nordic country*

Denmark	Finland	Iceland	Norway	Sweden
Finanstilsynet	Finanssivalvonta	Fjármálaeftirlitid	Finanstilsynet	Finansinspektionen

### 3.2.2 Stock exchange

The main objective of a stock exchange (also known as trading floor or trading venue) is to be a central marketplace for listing and trading financial instruments. The stock exchange has members, which are the only ones permitted to conduct trades. Those members can be banks or other securities brokerage companies (Finansinspektionen, 2016b; Oslo Børs, 2016; Nasdaq OMX, 2016). All the members are obligated to have a permission to run their business from the financial supervising authority (Andersson, 2010; Finansinspektionen, 2016b). The main stock exchange for each Nordic country is specified in table 2 below.

*Table 2. The name of the main stock exchange in each Nordic country, the name of the responsible company is written in parenthesis*

Denmark	Finland	Iceland	Norway	Sweden
Københavns Fondsbørs (Nasdaq OMX)	Helsinki OMX (Nasdaq OMX)	Kauphöll Islands (Nasdaq OMX)	Oslo Børs (Oslo Børs ASA)	Stockholm OMX (Nasdaq OMX)

### 3.2.3 Bank

The banks are financial institutions and one of the main actors in the capital market. Banks can exist in different varieties such as commercial banks, merchant banks, investment banks or savings bank; but many banks are a combination of the mentioned varieties. When investors want to buy or sell securities they can compel that through banks, since they are most often members of the stock exchange (Byström, 2014). Banks can also act as a custodian bank, which means that the bank provide safekeeping services in trading. The custodian takes care of the delivery and receipt of securities against the agreed amount of cash when securities are bought or sold. The custodian holds securities in an investor's portfolio and this attracts benefits, right and obligation.

In each market there are a number of local custodian banks that provide custody services (Chan et al, 2007).

### 3.2.4 Central securities depository

A central securities depository (CSD) keep a record of all proprietorship of securities, they also systematise registration of trades with securities. Actual trades are not conducted at the CSD; they are only keeping this record of the trades. CSDs are also maintaining a register of the individual people owning stocks in a public company; this register is used to verify who has the right to vote at the annual stockholder meetings (Andersson, 2010; Verdipapirsentralen, 2016; Euroclear, 2016; Nasdaq CSD, 2016; VP Securities, 2016). The specific CSD for each Nordic country is presented below in table 3.

*Table 3. The name of the company running the central securities depository in each Nordic country*

Denmark	Finland	Iceland	Norway	Sweden
VP Securities	Euroclear Group AB	Nasdaq CSD	Verdipapirsentralen ASA	Euroclear Group AB

### 3.2.5 Issuers of securities

Those who raise capital through the creation and distribution of securities to investors are known as issuers. Issuers can be companies or corporations, which typically raise cash through selling shares or debentures to investors. Issuers can also be local governments, government agencies or supranational organisations, selling debentures to investors. Issuers operate outside any marketplace (Simmons, 2002).

### 3.2.6 European union

All countries in the Nordic region except Norway and Iceland are members in EU. Instead they are both members in the European Economic Area (EEA) and through EEA EU affect Norway and Iceland.

EU has an important function for all capital markets since they present regulations, directives and other acts, some of them are binding but others are not (European union, 2016). More details of them can be read in section 3.4.1. The European Securities and Markets Authority (ESMA) is an authority of the EU, its objective is “to enhance investor protection and promote stable and orderly financial markets” (ESMA, 2016). They design frameworks of monitoring; enabling a similar usage of EU regulations among financial supervising central authorities in different countries. ESMA is also working with enabling cooperation among such authorities (Finansinspektionen, 2016c). ESMA also completes a single rulebook for financial markets within EU by

developing technical standards and provide advice to EU institutions on legislative projects (Finansinspektionen, 2016c).

### **3.3 Activities in trading**

When regarding trading with securities there are a lot of activities that needs to be conducted before a trade is fully performed. In this chapter an introduction to all those activities are given; the activities are divided into either trade or post-trade activities. This section also includes information about foreign trading.

#### **3.3.1 Trade activities**

The trade activities are the incitement for a transfer of securities between two parties. Once a security has been brought to the marketplace supply and demand are used to set the price. When the demand for the securities is high the price of those securities increases and vice versa when the demand is low. Trades are requests placed by an individual with an agent, those requests are called orders and they include the quantity of a specified security and maybe also a specified price. The agent is then recording the order and sends it to the stock exchange. The stock exchange then performs the execution and returns a receipt to the agent, which then sends the receipt to the investor. Sometimes the request cannot be performed since it might be no counterpart accepting the price or quantity (Simmons, 2002).

It is important for a stock trade organisation to prove that their records are accurate, this is done by an external sources; like the central securities depository. The accurate recording of every trade executed enables organisations to track the securities that are due to be received or delivered from or to counterparties or cash due to be paid or received. If a stock trade organisation fails to control the adequacy of the business, operational costs can become excessive with the on-going viability of the organisation at risk (Simmons, 2002).

Investors are able to transact foreign securities and not only securities within a country. A bank or a stockbroker usually conducts the mediation (Hansson, 2005). Securities trade organisations typically require delivery on the foreign market instead of transfer the assets into the origin market, which extends delivery time and related cost. If the asset is transferred into the origin market the seller likely demands payment for the asset before conducting the transfer. If the buyer agrees to pay in beforehand there is a risk of being without both asset and cash. This is a risk most securities trade organisations are not willing to deal with; instead a custodian or a local agent is used (Simmons, 2002).

#### **3.3.2 Post-trade activities**

When the trade conditions are agreed upon there are still a lot of post-trade activities to occur in order to fully conduct the transaction. One of those operations are the trade book, this one has only internal impact. The purpose of a trade book is to assign internal

responsibility and ownership for the trade, resulting in an update to the trading position within the specific securities. If the incorrect trade book is applied to a trade the trade will have no external impact. It is also important to register the trade date and time, which are important for example monitoring and calculation of the accrued interest (Simmons, 2002).

The value date of a trade is the intended date of exchange of securities, known as the actual settlement date. The period between trade date and value date is commonly referred to as settlement cycle since they does not need to occur on the same date. It is common that the business applies T+2, which means that the standard settlement cycles are 2 workdays and T+3 in the United States (a 3 day settlement cycle). The greater number of days between trade date and value date, the greater is the potential risk of one of the parties to defaulting the trade. This is a risk because a buyer might execute a trade but is not required to make payment for that purchase for many days or even weeks. A lot can happen in days or weeks and the market price might change as well, making it tempting to default a trade for the buyer in order to get the better price instead. The successful trades should result in the trade details being sent to the back office immediately (Simmons, 2002).

Settlement is the exchange of securities and cash. The act of settlement can be compared to buy or sell regular goods. Most individuals pay for goods when it is delivered or the opposite. It is an obvious risk in pay for goods before its delivery or hand over sold goods before the payment is conducted. Securities organisations are risk averse and they try to avoid these situations. There are two methods of settlement the first one is Delivery versus Payment (DvP) and this is the most efficient and risk-free method. This implies a simultaneous exchange of securities and cash through custodians. In this process a custodian is used to hold the assets until the cash has reached the custodian, and then the custodian performs the transfer of assets to the buyer and cash to the seller. The second option is Free of Payment (FoP), in this case one or both parties' needs to arrange delivery of securities or payment to taking possession of the other asset. FoP is avoided when possible due to the risks involved. The securities trade organisation and counterpart decides upon the method of settlement at the time of trade execution (Simmons, 2002).

As soon as the back office receives a trade, validation should be performed to confirm that the necessary data is known (Simmons, 2002). In the post-trade process the trade has to be validated, either manually or automatically, depending on available systems. Once a trade is validated, a number of actions can commence. The action that is typically regarded as the most urgent to complete is the act of gaining agreement of the trade details with the counterpart. Trade agreement is necessary in order to reduce the stock trade organisations risk. This can be achieved through trade matching, trade affirmation, issuance of outgoing trade confirmations or receipt of incoming trade conformations from the counterpart. Within each marketplace a regulatory environment

exists, this requires a number of facets of operation relating to stock exchange such as transaction reporting, trading rules and capital adequacy (Simmons, 2002).

After all necessary trade confirmations or trade matching messages is transmitted focus is on the generation and transmission of settlement instructions. Settlement instructions are the only mechanism by which trade settlement is initiated between seller and buyer. For each trade a stock trade organisation issues a settlement instruction to the relevant custodian. The generation and transmission of settlement instructions can be achieved in a controlled fashion. The settlement instruction can either be DvP or FoP as described earlier. The next step after the transmission of settlement instruction is the custodian attempts to match the counterpart's instructions, without matching instructions the settlement cannot occur. When the value date is reached a trade will either settle successfully or it will fail to settle. A successful settlement implies that the seller is able to deliver the securities and the buyer is able to pay the cash. Non-matching settlement instructions, insufficient securities or insufficient cash can cause unsuccessful settlements (Simmons, 2002).

When all operations are performed the actual trade settlement can be conducted. It is important for a stock trade organisation to be aware of the characteristics of settlement in each geographic location in which it settles. Once a trade has settled at the custodian it is essential for the stock trade organisation to update its internal books and records with the detail of securities and eventual cash movements. This is important for a stock trade organisation to remain in control of its assets (Simmons, 2002).

### 3.4 Government regulations

On the website Finansinspektionen *Lagar för värdepapper, börs och clearing samt kreditvärdering* (in English; laws for securities, stock exchanges and clearing; and credit valuation) the most important laws and regulations are listed in a 20 line long list, and this only regards the most important law and regulations in Sweden (Finansinspektionen, 2016d). This implies that the capital market is highly regulated and it also implies that there is a lot to consider when entering or operating at the capital market. In this section a brief summarisation of the government regulations regarding privacy and anonymity is explained, these regulations are chosen because they are related to the blockchain technology and its potential effects. An explanation of the regulations regarding the actors operating on the capital market is also included in this section. The European Union has an important role as mentioned above; their regulatory role is further explained in this section.

#### 3.4.1 The role of the European union

European union (EU) can publish regulations, directives or other acts with different implications for the members of the union. A regulation is a binding legislative act; this is mandatory to apply in its entirety across all members. A directive is a legislative act that sets out a goal, which all EU countries have to achieve. Directives are applied into

the individual countries depending on how they want to reach the goals. Regulations and directives affect all members but the EU can also publish other files that are more individual adjusted. A decision is binding on those to whom it addressed, this might be a EU country or a company and the decision is directly applicable. Recommendations are not binding but it allows the EU institutions to make their views known and suggests a line of action without imposing any legal obligations. EU can also use opinions as an instrument allowing the institutions to make a statement in a non-binding way (European Union, 2016).

### **3.4.2 Regulations about actor on the capital market**

It is defined what requirements a company operating on the capital market has to achieve. In the law it is defined that permission from the financial supervising authority is mandatory to operate at the capital market and the requirements to get permission is also specified. The different kinds of approved additional services are also defined in the regulations, which means that it is specified what services a company on the capital market are allowed to provide (SFS, 2007).

In the Swedish law it is defined that one central securities depository has to be established. This CSD has to conduct its business to manage demands on safety and efficiency (SFS, 1998). It is also defined in SFS 1998:1479 that the society should be able to trust the registration work from the CSD. In the law text there are defined how the CSD should operate and what requirements needed to be fulfilled (SFS 1998:1479).

### **3.4.3 Know your customer**

According to SFS 2007:528 the stock exchange are beholden to share information about individual's relations to a company, if it is a legal investigation. This is one reason why an operating businesses need to know its customers. Know Your Customer (KYC) is an established framework to fulfil this purpose. One goal with KYC is to identify money laundering or financing of terrorism. According to the Swedish law SFS 2015:274 a bank need to control a customer's identity through an identity document or another secure way and they also need to gather information about the purpose and type of each transaction. Through these controls the operational businesses are able to decide whether the customer is a person in a political exposure or not, which is important within the framework for KYC. Special attention should be paid to products or transactions, which might enable anonymity. Special attention should also be paid to new products or business methods and also usage of new technology. This special attention is necessary because of the tangible risk exposure towards money laundering or financing of terrorism. If the special attention is not a proof of the opposite the risk exposure should be considered high when a business connection establishes or when a single transaction between a counterpart on distance or a credit institute outside EEA occurs (SFS, 2015). Security measures used when there is a risk for money laundering or financing of terrorism are also applied on family members to political exposed people as well as the political exposed people. The KYC procedure should be finalised before

any business or transaction is conducted. This is a continuous procedure for the operational business and not a one-time control. The operational business should deny transactions that they suspect (SFS, 2015).

#### **3.4.4 Privacy protection law**

The purpose with the Swedish privacy protection law, SFS 2010:1969, is to protect people against violating usage of their personal integrity through their personal record. The law affects autonomous usage, partly or fully, the law does not affect usage of a physical person. Personal records can only be gathered for special purposes and they are not allowed to be stored during a longer period than necessary for the purpose of the usage. Personal records is only allowed to be used if the registered person approves the usage or if it is necessary because of for example a contract is going to be conducted. It is not legal to store sensitive personal record information such as ethnical background, political views or religious affiliation. A written contract is mandatory for usage of personal records between the registered and the responsible ones. The contract includes approve of usage according to the instructions from the registered one. The responsible one is forced to apply technical and organisational measures to protect the records. It is forbidden to transact personal records to a third part without an acceptable level of protection for the records. The level of protection is demanded due to other circumstances of the transaction, which might be the purpose of the treatment, duration or origin country. The prohibition also includes treatment in a third country (SFS, 2010).

### **3.5 Ethical aspects on new technology**

Ethical aspects are related to the justification of human activity, according to norms that can be based on principles that might have a universal form (Gonzalez, 2015). De George (2006) argues that what defines ethics is largely determined by the appropriate laws in each jurisdiction, what might be ethically permissible in one jurisdiction might not be it in another one (De George, 2006).

Technological innovations change society and these changes also shape ethical values, on the other hand technology is human made and its content direct the users into a style of life chosen according to social objectives (Gonzalez, 2015). Introduction of new technologies may introduce harmful consequences because the lack of a full spectrum perspective on beforehand. According to Neelke et al (2016) potential impacts and hazards that the new technology might bring out are hard to know about before the technology is implemented. There might also be a lack of risk governance because conventional approaches are not directly applicable to new technology due to uncertainty and ignorance. The risks and dangers are often present awhile after implementation; therefore the authors argue that there seems to be a need for flexible approaches that are adaptive to new information about the impact of technologies (Neelke et al, 2016).

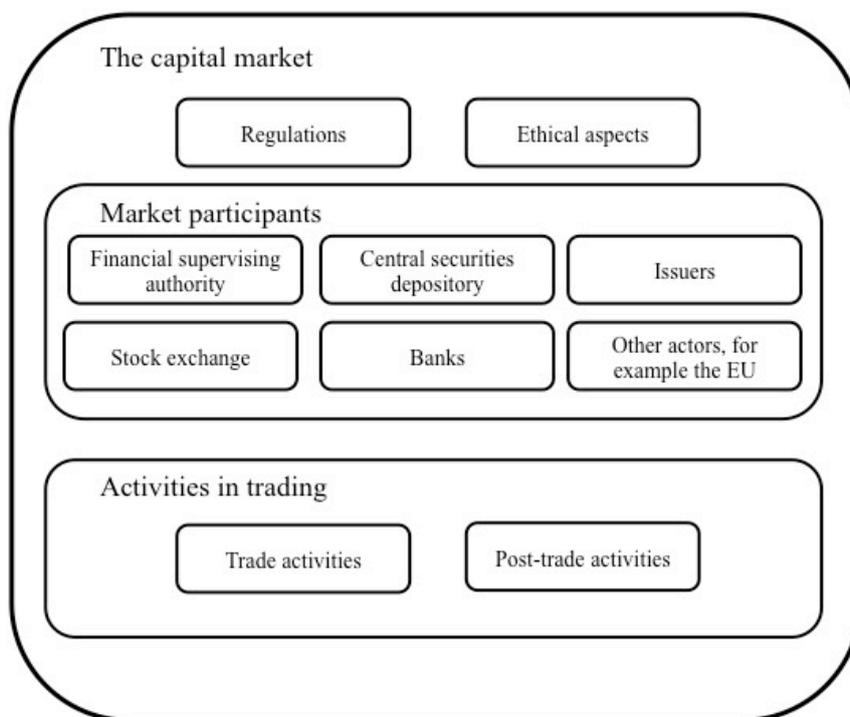
De George (2006) discusses that information materials are currently infinitely sharable and this makes it possible to transfer information from individuals instead of from centralised distributors, those centralised distributors have earlier been able to control what is transferred but without them the control decreases. From an ethical point of view there is nothing unethical about this technology shift itself, but there are many complaints about its development because of the usage of the new technology. Computers and information technology have enabled the globalisation of business into an unprecedented scale and even if some current technologies are abused and used for unethical purposes, the technology itself is not unethical and therefore developing it is not unethical (De George, 2006).

The current existence of the globalisation includes that dynamic changes in technology are more intense now compared to the past. Organisations and institutions are operating under conditions that should have an ethical foundation, such as respect for people, avoidance of damage to communities (Gonzales, 2015). In this changing world Kavathatzopoulos (2012) argues that there is an increasing lack of moral guidance and a greater need for knowing how to do the right thing, ethical competence is therefore important to focus on. Ethical competence is defined as the ability of a person to use a suitable problem solving and decision-making method when facing a moral problem, focus is on the processes and not their result. The ethical competence is important for leaders as well as for whole organisations, due to the ability to handle moral problems that rise up during the work. Failures of addressing moral problems might have an impact on the organisation and business, for example affecting profits, relations or work environment (Kavathatzopoulos, 2012).

Values have according to Gonzalez (2015) an important role for the structure of technology for its dynamics over time. Gonzalez (2015) argues that technology has changed into something value-laden instead of being considered as value-free, which enables new ethical analyses of technology as a human undertaking. Gonzalez (2015) divide values into internal and external values. Internal values are those characteristic of technology itself and external are those surrounding this human undertaking. There are values regarding the aims with the technological process, these values can be internal (such as realising a goal) and external (social or political). These values establish the conditions of viability of the possible technology and its alternatives. According to this argument the technology is supported by social human actions, which are based on a transformation of the surrounding reality. Technology can be seen as human activity oriented to obtain a creative and transformative domain of the reality on which it is working. This technological domain is present in new designs and in effectiveness; it requires the users to consider other aspects related to this human activity such as ethical, economic, political or cultural aspects to mention a few (Gonzalez, 2015). New technology can change the values accepted in a particular society, which has been the case with the Internet as one example. The Internet oriented new values, internal as well as external; this change of values is based on new demands in the societies as a combination of cultural elements (Gonzalez, 2015).

### 3.6 Model of analysis

This model of analysis summarise the previous theory section and defines how it will be used in further analyses. The capital market is in main focus with its market participants and its activities in trading. Ethical aspects and regulations are important areas for the capital market but also applicable on other areas. All areas are of interest when implementing a new technology and all areas require careful consideration when implementing the blockchain technology. The model of analysis is visualised in figure 6 below.



*Figure 6 – Model of analysis for this master thesis*

## 4. Methodology

The methodology for the master thesis is described in this section, descriptions about how the literature study is performed and the interviews is explained in this section. At last there is a discussion about the methodology and its reliability and validity.

This master thesis uses an exploratory study method; this is defined as a study seeking new insights and clarifies an understanding according to Saunders et al (2009). This is connected to the objective of the study, in this case presented in section 1.2; the objective highly affects the chosen method for this study, stated by Trost (2010).

This master thesis is written in co-operation with the company Visigon Nordic. Visigon Nordic contributes with supervision and valuable experience and this has not affect the result of this master thesis.

## 4.1 Literature study

This master thesis starts with a literature study. When the literature study is performed early in a research process it builds an important understanding, which creates a foundation of latter steps in the process according to Saunders et al (2009). The literature study reflects upon work related to the chosen phenomena of study already performed by others, what is undertaken and what is not (Saunders et al, 2009; Bryman & Bell, 2013). The literature study also provides a foundation on which the research is build upon (Saunders et al, 2009). The material from the literature study is mostly documents and they are analysed considering what they contain, defined by Bryman & Bell (2013). In this thesis the literature study focus on the blockchain technology and gathers information about what has been written about the technology from multiple sources and combine their information. Since the blockchain technology is relative new little has been written about the phenomenon. This limitation is one reason why a complementary interview study is conducted within this study. Together the literature review and the interviews create the foundation for further analysis.

## 4.2 Interviews

The interviews involve nine participants from seven different companies or organisations, specific information about the participants can be found in section 6.1. The main reason why several participants are interviewed is the possibility to establish whether the findings of one case occur in others or not, multiple cases also enable a possible generalisation from all the cases and this is stated in the work by Saunders et al (2009). The objective is to gather information about the participants' attitude of approach to the blockchain technology and related topics. This is according to Alvehus (2013) an important way to deepen the knowledge about a subject. When conducting interviews the executional process have been divided into three different steps presented in the work of Trost (2010):

- 1) Collect data, in this case through the interviews
- 2) Analyse data, read the interview notes and listen to the recordings
- 3) Interpret data through the theoretical background

Those three steps are not clearly distinguished; one reason is that analyses and interpretation automatically occur even during the interviews (Trost, 2010). It is an interactive process when collecting and analysing data together with development and verification of the material this is defined by Saunders et al (2009) and highly influences this study. The data from the interviews are transcribed and then codified, the next step is to identify patterns, themes and categories; the purpose is to join together

similar information from different sources this is justified in the work of Carlsson (1991); Bryman & Bell (2013).

The questions asked in the interviews are all originating from the same question areas (represented in Appendix A) but applied differently depending on available time and the participants' technical knowledge. Some participants have a deeper technical knowledge than the others and this affected the interview questions. The interviews have different settings and framing. The study included follow-up questions both during the interview time and afterwards. The interview questions asked are based on the theory framework and how it might be affected of the blockchain technology. The literature study is conducted before the interviews and the questions asked about the technology are based on the knowledge achieved through the literature study.

#### **4.2.1 Different medias**

Within this study the interviews are conducted through telephone or face-to-face. Follow up questions after the interviews have been sent through e-mail. The medias have different characteristics according to Brinkmann (2013). E-mail interviews imply an asynchronous interaction since the interviewer writes questions and then await a response. Telephone interviews are often held in a very structured format, the effect of the interviewer reduces since there is no visual contact, but it enables a greater standardisation. Face-to-face interviews enable a transfer of not only the responds but also body language and gestures. But a challenge lies within keeping the interview productive and not to conversation like (Brinkmann, 2013).

#### **4.2.2 Sampling**

Saunders et al (2009) states that for all research question where it would be impracticable to collect data from the entire population, a sample selection is necessary. The sample of the interviewed companies in this study is a product of a combined strategic and convenience sample method. The objective is to interview different actors within the financial industry and collect their opinions. The companies are therefore chosen from their position within the industry. Through a strategic sampling it is possible to reach the parts of an organisation or a field, which on beforehand assumes to be interesting (Alvehus, 2013). Trost (2010) states that the sampling should be heterogeneous within a given framework; it should be variation but not an extreme kind, only a heterogeneous variation within the homogenous framework (Trost, 2010). The individuals representing the companies have not been strategically chosen, instead the sampling of the individuals are based on convenience and availability. To combine strategic chosen companies and convenience chosen individuals is a common method according to Alvehus (2013) and Trost (2010), which enables a strategic sampling with variation and available resources.

### 4.3 Methodology discussion

The literature study and the interviews are together creating a foundation of analysing the blockchain technology and its impact on related areas. The fact that little has been written about the blockchain technology makes it preferable to further deepen the knowledge about the technology through information from the interviews. The interviews provide the participants' personal opinions and experiences connected to the blockchain technology. This is valuable since it creates an extension of the literature study. One aspect that is excluded in the interviews is the customers or users of the blockchain technology, this is excluded since the customers of for example a bank are not aware of what specific technique they use. All participants' in the interviews have knowledge on an expertise level and this makes their opinions currently more interesting than customers or people not aware of the technology. It is also important to remember that the blockchain technology is relatively new and at this point there are limited knowledge about what the technology will bring out.

This research is based on existing literature and opinions from interview participants, the literature is partly changeable but it would bring out a similar result if restudied in another project. The interpretation of the literature of course depends on the researcher but the material remains the same. The opinions from the participants might change if the individual change its opinion or not. If the study is repeatable or not is defined as external reliability according to Bryman & Bell (2013). The social context of the interviews also complicates if the interviews bring out the same result or not, humans do not give the same answer twice; it will differ. Reliability can also be discussed in terms of internal reliability, this is defined as if the member within a research team can agree on how the result should be interpret, since this research team only consists of one individual, this is not applicable. Through the interviews with a number of actors it is more likely that a generalisation is possible than it would be if only one actor was interviewed. The ability to generalise a result into other social environments and situations is called external validity (Bryman & Bell, 2013). The ability to generalise into other social environments is hard to predict since the capital market is quite a unique environment. The blockchain technology is possible to implement in other areas but the context will be different from the capital market. The result from the literature study and the interviews are consistent with the theoretical material, which is the definition of internal validity (Bryman & Bell, 2013).

## 5. Literature study

The literature study gathers what is written about the blockchain technology on a technical level, its features and how it might affect the main actors. This section aims to explain the blockchain technology and how it works.

## 5.1 The blockchain technology

The blockchain technology is a process of adding blocks of cryptographically signed data into a chain, which creates permanent and immutable records. A blockchain is a distributed ledger, which is a database architecture where all the nodes within a system can store and access information related to a given set of assets and their holders in this shared database. When a transaction is going to be executed all the nodes within the network collaborate to reach a consensus on the correct state of a shared data resource and then the transaction can be executed (Pinna & Ruttenberg, 2016; Van de Velde et al, 2016; UBS, 2016). The main idea with the blockchain technology is that the decentralised transaction ledger functionality of the blockchain can be used to register, confirm and transfer all kinds of contracts and properties without any intermediary to be needed (Swan, 2015).

Financial services are the primary area for future implementations (Swan, 2015; Van de Velde et al, 2016). The financial industry is interesting because the blockchain technology have the potential to create safer, more reliable and more efficient post-trade processes. Innovation is welcome in the financial market wherever it can bring safety and efficiency (Pinna & Ruttenberg, 2016). But the blockchain technology might be used not only for transactions within the financial markets but also as a registry tool and inventory system of all assets, both real ones like physical property and intangible assets like votes, ideas or health data (Swan, 2015).

### 5.1.1 How blockchain works

The blockchain technology provides the computers within the network with the information they need to operate and verify transactions (Vigna & Casey, 2015). The blockchain stores all transactions and information about the transactions; the chain is public within the network and it is made available to the network instantaneous. No one can identify which individual performing the transaction because the technology uses the private-public key cryptography; the users are only presented by a pseudonym (Kelly, 2015; Vigna & Casey, 2015). The cryptographic keys are not revealed to any person or institution, only the owners have access to them. The blockchain uses the nodes within the network to get a consensus on the validity of each transaction. This validation method is based on comparing historical data from the chain with the specification of the current transaction (Vigna & Casey, 2015). The validators need to check that the assets involved in a transaction are available to the transaction originator according to the most recent information (Pinna & Ruttenberg, 2016). Once that consensus has been reached the receiver knows that the sender has valid funds. The signed transaction is then brought into the distributed ledger to be validated and recorded in the next update of the blockchain (Van de Velde et al, 2016).

### **5.1.2 Novelties with the blockchain technology**

The blockchain technology is built upon a number of new innovations regarding either technology or efficiency. The new innovations combined arise the blockchain technology, a summarisation of all innovations can be found in table 4 below. The blockchain technology includes new methods and applications of encryption technologies that enable security and anonymity of sensitive data, even in the distributed and shared-access environment like the blockchain network (Van de Velde et al, 2016). The new encryption methods and applications allow the users to selectively reveal information depending on their needs. The mutual consensus verification protocol that the blockchain uses is another new innovation; it allows a network to agree on updates to the database collectively instead of using a central part that perform updates. The consensus verification protocol also secures that the overall dataset remains correct. Another innovation is the smart contracts, which is programme or code uploaded to a ledger instead of passive data entries (Van de Velde et al, 2016). Smart contracts are a way of transposing contracts imposed on users into the digital distributed ledger. Smart contracts can have access to a number of accounts and can transfer assets according to the terms of the contract, as soon as an event trigger the application of these terms. This provides an opportunity for automatic transactions to occur in response to a specific event. Smart contracts are written in the ledger and they follow the same validation method as any other blockchain transaction (Pinna & Ruttenberg, 2016; Swanson, 2015). Smart contracts might be the innovation that causes real change within the capital market since it can perform a number of tasks currently executed by intermediaries according to Pinna & Ruttenberg (2016).

All new innovations mentioned above are technological innovations that the blockchain technology is built upon, but blockchain also includes innovations that improve efficiency (see table 4). Current methods of storing and agreeing datasets within the capital market are highly complex, using fragmented IT and data architectures. The current applied methods also suffer from a lack of common standards. This enforces a need of reconcile data with massive systems and process duplication. All this brings out high costs and long execution times. Each company has its own accounting view, this is very inefficient but with the blockchain everyone in the network are able to use the same account view and this reduces unnecessary risk (Van de Velde et al, 2016). Van de Velde et al (2016) states that blockchain has been able to make the use of data more efficient by enable a group of independent members to work with a universal data source, any stored data record are represented on a blockchain and it is the same for every member. By new encryption methods a multitude of data types can be entered into the ledger and therefore create a richer dataset than the currently applied. The last effective related new innovation within blockchain is that participants store the distributed records locally and this is their information source. This new technique removes the need of interrogate centralised databases or send messages to other participants to ensure aligned data. It also prevents data losses because every participant in the network has their own record stored locally (Van de Velde et al, 2016).

*Table 4 - All new innovations included in the blockchain technology*

Technology innovations	Efficiency innovation
<ul style="list-style-type: none"> <li>▪ Encryption methods and application</li> <li>▪ Mutual consensus verification protocol</li> <li>▪ Smart contract</li> </ul>	<ul style="list-style-type: none"> <li>▪ Universal data sources</li> <li>▪ Richer datasets by hashing</li> <li>▪ Distributed records stored locally</li> </ul>

### **5.1.3 Permissioned or permissionless system**

The blockchain technology can either be used as a permissioned or a permissionless system (Swanson, 2015; Pinna & Ruttenberg, 2016). A permissioned system is a network where the members are identified and accountable; at least the governance body knows the real identities. Because of the possibility to identify each member within the permissioned blockchain it is possible that entities can be held responsible and legally accountable. Only the permitted members can perform and validate transactions. By authenticate validators it is possible to lower the probability of reversal risk. A permissioned system reduces the need of extensive validation methods. A permissioned blockchain is better suited to the needs of financial institutions (Pinna & Ruttenberg, 2016; Swanson, 2015).

A permissionless system is a network where the identities of the users are either pseudonymous or anonymous. Everyone can access the database and depending on chosen validation method also validate transactions. It is also possible for everyone to submit spam transactions to cause a denial of service. Within the permissionless network it is not possible to hold someone accountable or responsible outside of the network. The permissionless system is the original idea of Bitcoin (Pinna & Ruttenberg, 2016; Swanson, 2015).

### **5.1.4 Network model**

The blockchain technology enables an intermediary free network. The economic efficiency and cost savings gained by this decentralisation are reasons to use the blockchain technology according to Swan (2015). Van de Velde et al (2016) also argues that the decentralised network model is beneficial because without any central authority there is no single point of failure, neither is any demand placed on an authority and this reduces risk of failure. Vigna & Casey (2015) argues that a decentralised system solution needs to be trustworthy, it is important to keep everything established in order without loose the efficiency or security that is build into the centralised system currently applied. The authors further discuss that the Internet has enabled an implementation of a decentralised system but it still requires a mechanism to maintain integrity even when the permissionless system is used. The system should also provide the right incentives

to upkeep the ledger (Vigna & Casey, 2015). Pinna & Ruttenberg (2016) argues that sharing a database without any central validation system can create difficulties when different users have conflicting incentives. Swan (2015) states that blockchain uses a decentralised network structure and this is a potential issue of however the users are willing to store their personal data into a database, which no one controls or not. This is an issue because the users might not feel secure of how their data will be exposed to others or not (Swan, 2015).

The traditional business network model is challenged by the blockchain technology, since it cuts out the intermediary in its decentralised peer-to-peer network. Many organisations that currently are intermediaries make their profit from fees connected to the intermediating tasks, which will likely disappear with this new technology (Swan, 2015). Van de Velde et al (2016) argues that a high level of conservatism and regulations characterises the capital market industry among the few but large actors. This affects the market and the possibilities to adopt new technology (Van de Velde et al, 2016).

#### **5.1.5 Cryptographic identities**

Anonymity or privacy protection is an important requirement for many processes in the capital market. Van de Velde et al (2016) argues that cryptography can protect anonymity in a blockchain for everyone of the participants and it will require extensive key management to decrypt and reference back the entries they hold an invest in. To enable an implement on the capital market the cryptographic identity needs to be connected to a real identity because of the KYC requirements. A user should be able to stay anonymous to other users and at the same time be identifiable and able to hold responsible (Van de Velde et al, 2016). The cryptography used in the current network includes usage of private keys; currently it is not clear what will happen if someone loses a private key or if it gets stolen (Swan, 2015).

#### **5.1.6 Regulatory aspects**

Van de Velde et al (2016) states that how each country will regulate about the blockchain structure is crucial if the technique will flourish or not. In order to implement the blockchain technology regulations and standardisations are in need for updates and alignment. A considerable number of regulations will need to be reinterpreted or changed. This includes for example the legal definition of the finality of settlement, which presupposes existing market processes and CSDs in their current format (Van de Velde et al, 2016).

According to King (2014) two of the most problematic regulation aspects with the blockchain technology are that the original Bitcoin network enables money laundering and anonymity. Van de Velde et al (2016) are arguing that the KYC process will become easier through the updated transparency in data as the technology provides. Automatic reporting and more transparent supervision for market authorities together

with higher anti-money laundering standards are something possible to implement in future usage of blockchain technology in trade related areas of the business according to Van de Velde et al (2016).

### **5.1.7 Impact on market participants**

In the current society information technology has transformed how people interact with each other but this change have not reached the capital market yet. The capital market still uses intermediaries and databases that do not communicate with each other. The blockchain technology allows users to share a database. Through this change into a shared database it is possible to develop how companies communicate with each other (Pinna & Ruttenberg, 2016). The blockchain technology forces the actors on the capital market towards a change and this is needed because the market is currently a legacy of earlier market infrastructures and little has changed in the recent years (Pinna & Ruttenberg, 2016; Van de Velde et al, 2016).

The financial markets will be especially affected by the new blockchain technology; many modern securities contracts are already codified, digitized and automated but they are run by banks and litigated by lawyers (Vigna & Casey, 2015). If the securities contracts were integrated with blockchain the third-party intermediaries could be removed from the process (Vigna & Casey, 2015). Vigna & Casey (2015) has an idea that blockchain and its possible implementations can result in several job roles that loose power or the demand of their services will be reduced. Lawyers, investment bankers and stockbrokers that are most threatened by the new blockchain technology according to Vigna & Casey (2015). Contracts could be drawn up without lawyers or courts getting involved, digitalised property could be transferred and verified. It is also possible that financial securities could be traded directly between investors without any central stock exchange or clearinghouse. It is important to remember that institutions will still need to perform some functions in the post-trade market, even after a possible blockchain implementation. These are functions like the notary function and the clearing function, especially when trading with derivatives. This limit the potential disruption mentioned earlier in this section according to Pinna & Ruttenberg (2016).

Currently internal costs of IT systems are high due to redundant and duplicative systems and operational overheads applied. These costs are possible to reduce with the blockchain technology (Van de Velde et al, 2016). But the blockchain technology will require huge investments to achieve changes in the core of the capital market. This investments need to come both from the actors creating the infrastructure and tools necessary and from participants within the future network (Van de Velde et al, 2016).

### **5.1.8 Changed settlement time**

The blockchain technology provides a united data source for each actor; this can be used to make more efficient settlement of transactions and processing (Van de Velde et al, 2016). UBS (2016) describes that settlement time is possible to reduce from two or

three days as the current until instantaneous with the blockchain technology. Van de Velde et al (2016) adds that this is possible since a trade is completed when a block is uploaded to the chain and this speeds up the end-to-end process. This also reduces the need of post-trade affirmation or confirmation and central clearing during the settlement cycle, which also contributes to the reduced settlement time (Van de Velde et al, 2016). Instantaneous settlement time requires that both cash and securities are available when conduct the trade this would eliminate liquidity and credit risk from any trade executed (Pinna & Ruttenberg, 2016). But the market has chosen the time for a settlement cycle to two days as a standard. This implies that settlement time can be reduced without the blockchain technology; it only requires an updated standardisation (Van de Velde et al, 2016).

### **5.1.9 Remaining issues**

The current standards of blockchain technology are a bit behind the levels required to support adoption in the capital market, according to Van de Velde et al (2016). Much larger datasets will need to be handled if any core part of the capital market system should be replaced. Vigna & Casey (2015) compares that the Bitcoin network can currently process about seven transactions per second, which is far more less compared to the credit card company Visas' ten thousand transactions per second. A node in a Bitcoin network is limited to 1 MB of data per ten-minute block, the system needs to process much larger set of information if future implementations should be realised (Vigna & Casey, 2015).

Pinna & Ruttenberg (2016) mentions three issues that need a solution before the blockchain technology is realised. These are:

- 1) The technology is not yet mature
- 2) Legal, operational and governance issues will take time to clarify
- 3) Even after an implementation some functions will continue to be necessary and cannot be replaced by the blockchain technology

## **6. Interviews**

In this master thesis nine individuals have been interviewed about their opinion on the blockchain technology, how it might affect their role both individually and their organisation or companies role on the capital market. First in this section a background about the participators are presented and then the result from the interviews. The result is based on five main areas: (1) each companies perspective, (2) technical aspects, (3) regulatory aspects, (4) ethical implications and finally (5) technical change both in general and with the blockchain technology in mind. Notate that the participants opinions is their own and not the companies or organisations official opinions.

## 6.1 Participants

Table 5 contains information about the participating individuals in the interviews within this study. The table contains information about their name, their company or organisation and the kind of media used to perform each interview. The interviews are conducted as described in section 4.2 and the questions asked are based on the ones shown in Appendix A. The companies or organisations are more thoroughly described below together with their approach to the blockchain technology.

*Table 5. Information about the interview participants*

Name	Company	Media of interview
Gustafsson, K.	Visigon Nordic	Face to face
Mild, M.	Finansinspektionen (Swedish financing supervising authority)	Telephone
Norlin, R.	Finansinspektionen (Swedish financing supervising authority)	Telephone
Nyqvist, A.	SEB	Face to face
Stenkrona, A.	Cryex	Face to face
Strömberg, P.	Avanza Bank	Face to face
Toll, J.	Nasdaq	Face to face
Troedsson, V.	Swedish Securities Dealers Association	Face to face
Tullila Persson, L.	Nasdaq	Face to face

## 6.2 Results from interviews

The results from the interviews are presented in this section. The section is divided into five main areas, each company's view on the blockchain technology and how it might affect them, technical aspects, regulatory aspect, ethical opinions and finally technical changes.

### 6.2.1 Approaches towards the blockchain technology

The Swedish financing supervising authority, Finansinspektionen

The Swedish financing supervising authority, Finansinspektionen, supervise almost 2 000 companies in Sweden (Finansinspektionen, 2016a). Finansinspektionen follow the current debate and discussion about the blockchain technology, both on a national

and an international level (Mild, 2016). A technical implementation of the blockchain technology affects the authority in many ways and mainly their work with regulations. New technology enforces a review of existing regulations; how they are affected and new regulations might have to be produced. The blockchain technology might also help the authority to gather information without delays or need for demands. Precisely what it will bring to the authority depends on the information stored in the blockchain (Mild, 2016).

The current status of the blockchain technology within the authority is to thoroughly understand what the technology is and what it will be applied for on the market. This understanding is necessary to be able to regulate about something. New innovations are often reviewed in collaboration in the EU and under the authority ESMA for topics related to securities and markets. Such a review is performed for the blockchain technology but also for other innovations. When performing this review a group of representatives from each EU country meet with a common agenda to assess risks and opportunities with financial innovations and also to elaborate on how to share any result. Commonly, the results are treated as working material used for information sharing among the national authorities. The group identify risks and possibilities rather than solving large questions or issues. All countries in the EU agree that the blockchain technology is going to be applied in the future but the current main question is how (Norlin, 2016).

## Nasdaq

Nasdaq is the main stock exchange in for example Sweden and Finland. Nasdaq operates both in the trading section and the post trade section, since they both operate as a stock exchange and as a clearinghouse. The trading sections are allowing businesses to trade shares of the companies into capital (Toll, 2016). The post trade section increases transparency in trades and adds security, which is the main purpose with all regulated markets and clearinghouses (Tullilla, 2016).

In Nasdaq about 40-50 people work with the blockchain technology on a daily basis. There is a core team in the development department and they work with the technology and then support the different business units. It is up to the business units to figure out how they could use the blockchain technology in the best manner possible (Toll, 2016). Nasdaq has already launched products based on the blockchain technology and one of them is Nasdaq private market Linq. This product enables un-noted private companies to register their stocks and keep track of the register. The blockchain is the only display of which individuals are the real owners. The launched products are minor initiatives and they are a way for Nasdaq to learn about the blockchain technology and then improve and gain experience for further implementations. The launched initiatives are also new business opportunities for Nasdaq. The technology is already implemented and therefore Nasdaq talks more about size of initiatives to come rather than if an initiative will go live or not (Toll, 2016).

## Avanza

Avanza bank focuses on savings and investments; in 2016 they are not aiming to be a full-scale bank. Avanza is a digital bank with IT as 1/3 of the company. The IT development is mostly performed in-house, they purchase some software but the objective is to develop in-house instead of outsource (Strömberg, 2016).

Avanza have currently a role as an observer in the development of the blockchain technology, they are not an active developer of the blockchain technology but are still open for ideas and experiments on the technology. They regard the technology as something with potential to contribute to a development of the post trade sector. Even if the technology itself is not used in the future it has started off an important mental process within the industry to improve. Avanza do not want to change all database technology into blockchain, since a kind of distributed database is possible to initiate with their current technology. This is their current standpoint because their technology is highly modern compared to other companies (Strömberg, 2016).

## SEB

SEB is a bank and one of the largest within the Nordic region. SEB develop and maintain all IT in-house, they cooperate with external companies but the main IT work is conducted internally (Nyqvist, 2016).

SEB is currently in a phase of exploring the blockchain technology and learn about its features. The current approach is to explore possible applications of blockchain technology, such as the smart contracts. Currently crypto-currency applications are not top of priority. The interesting parts with the blockchain technology for SEB are the possibilities to make processes more effective and create new values. When launch a new technology it is important to be carefully prepared. It is a balance between time-to-market and ensuring security together with stability and trust. In general banks are extensive users of technology but the strategy of how they embrace novelties differs among the banks. SEB identifies new technology through multiple functions within the organisation and they also have people responsible for emerging technologies who coordinate initiatives. Exploration of new technology is also spread over different functions and there is an innovation lab where employees can explore new ideas and build prototypes as one tool of exploration (Nyqvist, 2016).

SEB is since 2015 a member of the Distributed Ledger Group (DLG), a cooperation that consists of 42 banks from around the world driven by the company R3. In the DLG the blockchain technology is explored to investigate future possibilities within the bank and financial sector. They perform studies and lab work and also create prototypes. For example, the DLG explore the possibility of create a method for communication between banks globally through the blockchain technology. Another purpose with the cooperation is to try out the technical aspect to gain experience. DLG is divided into sub

groups depending on geographic position to enable physical meetings. Globally updates are performed digitally on a regular basis (Nyqvist, 2016).

In general, banks will need to change along with new technology but still cope with risks and consequences together with capital processes, which is their foundation and this will probably remain for a long time. Banks are currently important market participants when it comes to expertise in financial risk management and customer relationship management. These parts are hard to replace with machines or a technology. Changes in work processes will emerge; processes will change, develop or disappear and this makes the banks face multiple alternatives. Banks can in the future serve the community with the financial infrastructure like accounts or payments. They can also take the role as an aggregator; which means that the banks are the contact towards customers and offer services connected to the information gathered around the bank sector. Another option for the banks is to completely change and seek new offers based on extensive knowledge about customers and their behaviour. There is also the alternative to become the expert in for example risk management or advising services (Nyqvist, 2016).

#### The Swedish Securities Dealers Association

The Swedish Securities Dealers Association (SSDA, the original name is Svenska fondhandlare föreningen) is an association with 29 members (number from July 2015); the members are banks and other investment service firms operating in Sweden. The associations' main focus is the regulations and directives originating from the EU. They participate in the process of new and changed regulations through responds on consultations and discussions. The SSDA also interpret the new material and analyse how it might affect the Swedish market. Their mission is to promote the members' views in order to keep a sound, strong and efficient securities market within Sweden (Troedsson, 2016).

The SSDA find that the competition on the market is worsening because of extensive regulations and higher demands on the companies within the capital market. Even large market participants might not be Swedish in the future; they might be international. This is the case because companies who are able to distribute their costs among many transactions are more likely to cope with the developments than national smaller companies who cannot distribute their costs at the same extent. A possible implication of this is that in the future new establishments on the market might become more rare. Members of the stock exchange are facing a more complex environment and they are forced to adjust their systems frequently since new demands are introduced often due to new regulations. To cope with all changes an actor needs to have large IT infrastructures. New products are also facing difficulties due to those changes. At the same time companies have a lot of experience from different products, assets or stocks, which implies that the knowledge or experience are not the issue here (Troedsson, 2016).

## Cryex

Cryex aims to be an exchange for currencies with a central clearing function, which do not exist for currency trading. Cryex is in a start up phase and the company awaits permission to facilitate clearing in a central exchange from the Swedish financing supervising authority (Stenkrona, 2016).

Cryex aims to create an order driven market where the investors and sellers meet just like in a stock exchange. This kind of market is different from the current state in the currency market since the market is a peer-to-peer quote driven market where investors ask for price and then settles the affair bilaterally. Cryex has prepared for an expansion of their service to include blockchain-based currencies since it believes that blockchain based currencies will have an important role in the future (Stenkrona, 2016).

## Visigon

Visigon is a Nordic consulting firm that specializes in IT solutions in finance. Visigons consultants work with roles in technology, business development, and testing and project management. Visigon always aim to learn more about the future technology of the financial market. In collaboration with Uppsala University, Visigon have investigated the impact the new distributed ledger technology might have on the financial industry in the Nordic region, both from an organizational perspective and a technical perspective (Gustafsson, 2016).

### **6.2.2 Technology**

New technology and large technology shifts like the blockchain technology arises about every 10 years. The demands placed on new technology are floating since they depend on application and area of impact (Norlin, 2016). Before an implementation of a new technology is made, when regarding the financial industry, it is important to prove security and how it will work (Mild, 2016). The blockchain technology have three interesting areas it might affect, those are (1) speed, (2) trust and (3) cost, with speed as the main one. However the technology is persistent or not and what the technology will bring out is still to be proven (Strömberg, 2016). The blockchain technology compared with the existing can be illustrated by a comparison of scaling Kebnekaise (the largest mountain in Sweden). Using the current technology would be like scaling Kebnekaise with the best shoe soles, walking staff and a jacket that can endure an avalanche. Blockchain technology can be compared to scale the mountain with a helicopter. The old technology with the best shoe soles is good but it still requires a walk up and down and it might take 2 days. Compared with the blockchain technology and its helicopter the ride takes probably less than 10 minutes (Stenkrona, 2016).

The post trade area of the capital market industry is often regarded as the most interesting area for a blockchain technology implementation. This is connected to the high demands on safety that the technology provide a solution to; one example is the

difficulty of changing already recorded records, called immutability (Tullila, 2016; Nyqvist, 2016). Immutability is the feature that makes it difficult to change anything in the blockchain after it is recorded. Hackers have put a lot of effort into hacking the cryptography of the blockchain technology since it was introduced without any proven success. This implies that the cryptography of the technology is trustworthy. This is an advantage for the blockchain technology since the impossibility to tamper with the information when it is recorded is a useful feature (Nyqvist, 2016). Immutability together with the opportunity that the blockchain provides a fully recorded history of all changes ever been made are two important features when ownership is regarded as an implementation. Those two features make the blockchain technology more beneficial to use than other techniques. (Toll, 2016; Nyqvist, 2016).

The blockchain technology creates a golden record, one united database that all participants within a network use. This reduces the need of database reconciliation and synchronisation, which currently requires a heavy workload. If it is possible to reduce the need of reconciliation and synchronisation it is also possible to reduce the costs connected (Toll, 2016; Nyqvist, 2016). This golden record requires a design where all participants have access to their own clients' information but only their own clients and not every ones else's clients (Stenkrona, 2016).

Capacity and speed are two important features within the capital market but they are often highlighted as issues with blockchain. The original idea with the blockchain technology, as used in the Bitcoin network is a permissionless network where no trust for another node is needed (Stenkrona, 2016). The permissionless network can be implemented as the one within the Bitcoin network or through a technical firm like IBM (large global IT firm) as one example (Nyqvist, 2016). The permissionless implementation requires a method to gain consensus, which is very heavy to compute and this method reduces speed. But it is necessary to have a robust method to verify all transactions between users that do not trust each other. At the same time the capacity needed to verify transactions increases exponentially (Stenkrona, 2016). The permissionless version is currently the most developed, this is a result of several enthusiasts driven by develop the society without receiving any payment. Instead of money the result is an open source code available for everyone (Nyqvist, 2016). The issue with speed and capacity in the permissionless alternative can be solved by other techniques and one alternative is a case that uses a permissioned ledger where all nodes can be trusted since the nodes are identifiable. This reduces the need of validation because all nodes in the network are familiar and have an approved access. Instead of heavy computational validations only a simple verification that the keys are correct and that the asset are not double spend is required (Toll, 2016). This kind of implementation can either be global, national or internal; which alternatives chosen depends on ambition and objective. The blockchain technology enables sharing information among a large number of companies and it opens up for collaborations (Nyqvist, 2016). Depending on the application it is possible to choose if all participants within a network validate a transaction or if it is limited to one or a few participants. Another validation technique is

to use a voting principle where the validation depends on votes from the participants within the network. The usage will depend on the application and the need of decentralisation or a more central validation (Toll, 2016). The permissioned alternative is probably most suited for the capital market since the market requires a fast method to establish consensus in order to process a large number of transactions each second (Nyqvist, 2016).

One of the new technical innovations within the blockchain technology is the smart contract. The smart contracts enable automation in many processes that currently are executed manually. The usage of smart contracts will make a lot of processes more efficient and highly affect the capital market (Toll, 2016; Nyqvist, 2016). This is possible since smart contracts allow code to be stored in the ledger and it is automatically executed when its conditions are met (Toll, 2016). It uses if-then-else triggers and they are programmable and open up a number of possible usage areas (Nyqvist, 2016).

The blockchain technology is a technique for registration and transfer ownership between two parts. Blockchain can be used in other areas outside the financial sector. The registration feature can be used in all kinds of registration areas such as cars, tickets, real estate or votes (Strömberg, 2016).

### **6.2.3 Regulatory aspect**

Regulations are important but do not decide what specific technique a company uses, the name of the technology is not the focus (Toll, 2016). But at the same time regulations have an important role since it supports companies to control that what they do is correct and nothing is forgotten. Regulations also protect the customers and ensure their perspective (Strömberg, 2016).

New technical innovations do not have suited regulations immediately; it takes time to review existing regulations and apply new ones. This can make companies wait a while to observe what changes in regulations will be made or not, it is a risk to develop a product which then are prohibited by changed regulations (Tullilla, 2016). New regulations can both develop a market or limit it; in general regulations encourage use of technology but it depends on the application if the regulations limit or promote it. Regulations can also enable a higher prioritisation of new technology (Nyqvist, 2016). New regulations can also limit a market depending on how the regulations are framed and the area of interest (Mild, 2016). This have been seen in the case when there is a predefined date for implement a change; this date can enforce less optimal solutions to be chosen in order to be able to implement the change in time (Nyqvist, 2016). The focus on regulations increases and many companies put a lot of effort adjust technology into new regulatory demands. The adjustments are possible into a certain point then whole systems are in need for a change (Troedsson, 2016).

When new innovations occur the EU or the national regulator needs to consider if the new innovation suits into existing regulation or if it requires new regulations to be made. The European union has a central role in the regulatory aspect among their members through admittance of regulations and directives. Organisational demands or the central rules about securities trade are always essential for new technology and a foundation for different controls, revision and compliance. But with the blockchain technology new risks occur. Those risks make existing regulations and the foundation not perfectly aligned. New regulation admittances are generally not preferable since a lot of new regulations have been published the last years, it is more preferable to harmonise existing regulation and adjust new innovations into the regulations (Norlin, 2016). The implications of new regulations cannot always be predicted but many analyses are performed to prevent unintended consequences. When new regulations are produced they originate from a framework created by politicians with directions about what should be done. In EU the process to create new regulation follows a certain framework and procedures and the politicians have the final decision in their hands but public consultations are often used and a very important tool to collect opinions from the market. Those consultations paper are optional to answer and they are handed out by ESMA (if it concerns the capital market) (Mild, 2016). Many market participants like the SSSA put their main work in provide input to the regulations with insights and opinions from the members of the association. It is very important to provide the regulators with insights in order to fulfil the purpose with the regulations. This input enables cross-boarder cooperation in order to discuss question areas and interpret new information (Troedsson, 2016).

The current regulations might increase the difficulties of large changes compared to earlier in history, like the digitalisation of the Swedish stock exchange as one example, then the regulations where lighter compared to the current more extensive regulations. The regulations might lock the system up into a behaviour affected of how the trading is currently formed (Troedsson, 2016). The new demanding regulations contribute to the reduction in competition; only large actors can afford to invest in necessary technology (Gustafsson, 2016). A large share of the annual investments in IT is used to stay compliant and keep up with the regulatory demands (Nyqvist, 2016). This is a trend already emerging since the smaller actors on the market are not always members of the stock exchange, it is more efficient for to send their orders to another member who conduct the order on the stock exchange. This is a result of the competition among the market participants, which has reduced the profit from trading. This is beneficial for the customers but affects the market participants' way of conduct their operation (Troedsson, 2016). The regulations also create a rigorous process to get the necessary permission to establish a business in the current market. When companies have received their permission many opportunities arise but the process to get it is a large hurdle for new establishments (Stenkrona, 2016).

The blockchain technology opens up a door as a possible way to completely disrupt the capital market, with the technology a lot of intermediaries can be cut out (Toll, 2016).

The blockchain technology might replace steps performed manually and many employees conducting the manually steps would not be needed anymore if this is implemented, it will mean significant savings for some and has the potential to affect a lot of people (Norlin, 2016). This might also change the role for a lot of market participants such as banks, clearinghouses and CSDs and not only the role demanding how they operate, it might interfere with their whole existence. The assets such as money and securities together with regulations will direct if this vision of a total disruption will be reality or not (Toll, 2016).

The main issue with the blockchain technology in the regulatory perspective is that no one really knows what the implementations of the technique will be. This complicates the regulatory process since regulations require an extensive knowledge (Norlin, 2016). This need for extensive knowledge might be regarded as a delay for the development of the blockchain technology since the market is ready but the regulators are not (Stenkrona, 2016). If structural changes or large changes of processes occur in the financial industry it might enforce analysis of how it affects current regulation to see if any changes or new rules is required. If the blockchain technology are implemented the existing regulations need to be analysed regarding possible effects. Depending of what information is stored on the blockchain and for what purpose it will be used; the technology will affect different regulations (Mild, 2016).

Another challenge with the blockchain technology is that someone probably needs to be held responsible if anything goes wrong (Tullilla, 2016). There will also be a need of KYC processes and identifications and someone needs to ensure that part (Toll, 2016). Identify the people involved in a trade and where the money originates from is necessary in order to comply with anti money laundering regulations. This information on the other hand counteracts for example the Bitcoin network where the foundation is anonymity for all users and no one knows where the money originates. This regulation limits the anonymous usage of crypto-currency (Stenkrona, 2016).

Another part of the blockchain technology contains smart contracts, which implies that a software engineer will write code, which might have a legal implication. If a lawyer writes something wrong in a legal document there is a predefined process but the corresponding process needs to be defined for a software engineer write something wrong in the code (Toll, 2016).

#### **6.2.4 Ethics**

One purpose of the capital market is to encourage people to stop put their money in mattresses and instead start investing money in alternatives like stocks, options, debts or other economize alternatives. In order to fulfil this purpose, customers must have trust in the financial system and companies within the capital market. If the system do not prove tidiness then it might get a bad reputation, involve large risks and insufficiency for the customers. This makes it more tempting to keep the money in the mattress than invest in the capital market. This is general for all phenomena like payments, consulting

services, finance through platforms and blockchain technology (Norlin, 2016). New technical innovations should not be released on the market without a proper assessment regarding the effects on consumer protection issues. It is important that the customers can feel a transparency in applied rules, conditions, and demands on organisation and also know what they pay for. At the same time new innovations need to be usage centred in order to reach approval from the customers (Norlin, 2016). Trust is an important parameter for any system, technical or not (Toll, 2016).

Centralised networks imply that one central authority has control and validate all transactions made. The centralised authority is well known and customers can chose whether they want to trust this centralised part or not (Toll, 2016). A centralised network also makes an easy identification for hackers or where information is stored and can be fetch. If a decentralised network is implemented there is no central point of information since many nodes monitors possessions and one node can easily be excluded from the network when an intrusion is discovered. If many nodes monitor possessions it is also harder to tamper with information (Strömberg, 2016). With the blockchain technology this central part might be removed and replaced with a decentralised network, the customers might need to trust a network to conduct their transactions without this central authority (Toll, 2016).

In general there can be some sceptic approach towards new and unproven technology, this sceptic approach might create a hurdle for blockchain technology (Mild, 2016). Customer needs can be expressed in many ways but this needs are often in focus when regarding motivation for change and development. Trust is a possible incitement for technical changes. One example is the digitalisation within the bank industry, this change has increase the need of keeping the trust from the customers even if many new vulnerabilities like passwords and digital identification methods as two examples have been introduced. This need of a secure environment even for digitalised products demands a development (Strömberg, 2016). It is important to handle sensitive materials carefully and when it comes to technical implementations there are policies, guidelines and processes; which are mandatory to conduct before implementation of new technology is made (Nyqvist, 2016).

New establishments on the capital market require that the new company build trust to establish customer and partner relations. This is not easy and there are many ways to gain trust. An unestablished company needs to work with the pieces it has; this can be for example to make sure that the board members contribute with a good reputation and experience. Another trust indicator is if a company within the finance sector has permission to conduct their business from the authorities of interest. No authority will give a business permission to establish its business on a market if they believe it will fail or that the business might create fatal consequences. Therefore, the regulator needs to understand all parts of a business before a permit is granted (Stenkrona, 2016).

### 6.2.5 Technical change

The current technical infrastructure is slow and very heavy to run. The IT infrastructure is in need for a change, both the software and the hardware. The amount of data increases and the large volumes put demands on create solutions to deal with these volumes it is important to keep up with transaction speed. The transaction speed is increasing and it is measured in fractions of a second, this also puts high demands on hardware as well as software (Nyqvist, 2016). Currently the banks need to clear payments with each other and the capital market has grown into involve a large number of currencies and assets, and an even larger number of involved countries since the origin. In trading there are a lot of different market participants involved and the number of transactions increase continuously, still there is some transactions who are not correct and the security needs to be adjusted to cover up the deliveries not settled. Within the capital market there are also different conditions applied for settlement days and currencies for different areas of the world. All those differences and conditions affect the post trade process and makes it hard to manage; this is one of the reasons why it is tempting to apply the blockchain technology into the post trade section of the capital market (Norlin, 2016).

Existing systems are not built to deal with the increased demands placed on them; this has contributed to many implementations of work around solutions in order to work through limitations (Norlin, 2016). On the other hand the current system works and they are not easy to remove both since the systems are operating and because all systems are currently connected with each other (Nyqvist, 2016). Before something already established is changed one needs to put a lot of effort into the changes. How the system works can make it complex and expensive to change the processes operating. The complexity and expenses tied to technical change are reasons, which might prevent a change of a larger magnitude (Mild, 2016). This complexity might be counteracting for the blockchain technology and it also expands the number of years it will take before an implementation of the blockchain technology is possible (Nyqvist, 2016).

One requirement to succeed with a brand new technology, which might enable a large shift in technology as the blockchain, is that the market participants need to create an ecosystem where the systems are aligned and where the environment embrace this new change (Strömberg, 2016). It is important to acknowledge that the blockchain technology will have to be aligned with existing systems, since all systems are not going to be changed at once. Also existing workflows are in need of attention when implementation the blockchain technology, since they might be affected and in need for update or change (Toll, 2016). New technology can be limited of existing technology since the old one needs consideration and creates a legacy (Nyqvist, 2016).

Technical change and the desire to change depend on the organisational culture and available assets (Nyqvist, 2016). The incitements for technical change differ depending on chosen perspective. One common business incitement is customer needs (Strömberg, 2016); the need changes over time and is expressed in different ways but it can be about

availability, trading behaviour, how customer communicates with both each other and with for example banks. Historically customers visited bank offices but nowadays the customers use mobile applications, this is the case for both business and private customers. This change in communication enforces a bank to meet the customer needs on the customer terms (Nygqvist, 2016). This has contributed to a trend of increasing mobile usage and a decreasing web application usage; this affects technical aspects and is a result from changed customer needs and behaviour (Strömberg, 2016).

The post trade section of the capital market is often mentioned, as a probable section the blockchain technology will affect. The post trade section of the capital market has not coped with the development like the trade section (Strömberg, 2016). The lack of development makes the post trade section a higher prioritizes than the trade section (Mild, 2016). The post trade section also involves time consuming and demanding work, which makes this section more beneficial to streamline (Norlin, 2016). If the post trade section becomes more streamlined the costs will be cut and this will save a large amount of money. Avanza estimates the cost of post trade up to 70 % and trade costs up to 30 % of one trade. The costs are this high because the post trade section is not efficient with those manually steps conducted and lack of digitalisation (Strömberg, 2016). The possible changes for the post trade section lies within workflows, processes and regulations (Tullilla, 2016). To align and make those three parts work together is a challenge in itself (Toll, 2016).

One part of the post trade section is the settlement time and this is a topic often brought up since the blockchain technology might enable a reduction of settlement time from 2 or 3 days as the current situation until instantaneous (Troedsson, 2016). The reason why a 2 days settlement cycle is standard are because of all the manually steps required to settle a trade and also because several transfers of money occurs (Mild, 2016). It is many businesses and industries behind those 2 days and they counteract the change into a reduction of the settlement time since their role will change together with this reduction (Tullilla, 2016). It is also important to remember that we have different time zones around the world and those are not changeable, the time zones makes it difficult to shorten the settlement time (Troedsson, 2016). It is possible to change the settlement time with the current technology instead of change into the blockchain technology but many market participants do not want to change the settlement time because of the money earned (Strömberg, 2016; Tullilla, 2016). A shorter settlement time requires that an investor cannot trade with papers or liquidity that the investor do not own in the moment of the trade. Every step in the trade requires being set before the trade is confirmed, this might be a risk but it also enforces order in the system. A shorter settlement time decrease the risk exposure (Troedsson, 2016). The customers are currently experience a trade as an immediately delivery but the trading companies have build it that way and takes the risk on themselves, if this risk take was not necessary things could be improved even for the customers (Strömberg, 2016). The most important thing is to follow international standards in order to keep a sound and attractive market to foreign traders (Troedsson, 2016).

The Nordic countries are very similar but there are differences between the countries. Norway and Iceland are not members of the EU, but of the EEA (European economic area), which makes them slightly different from Sweden, Denmark and Finland. The Danish market is more focused on the obligation market than the other countries. The Swedish market is instead more focused on stocks. Finland has a special regulation since a company have to be directly registered at Euroclear Finland, which makes the market slightly more regulated. Every country is slightly special but the cooperation between the countries is extensive. For example, the SSDA are co-operating with similar associations from the other Nordic countries. Members in the SSDA are not only national; they are Nordic, which makes cooperation natural (Troedsson, 2016).

Within the bank sector it will probably take 3-5 years before larger national or global implementations occur but during 2017-2018 smaller usage on smaller markets or segments will probably arise (Nyqvist, 2016). Even without an implementation of the blockchain technology it will bring out a lot of technical inspiration and this might solve current issues (Strömberg, 2016). The blockchain technology is a part from the technique, a catalyser for the whole industry. The blockchain innovation enforces all market participants to rethink how and why they conduct tasks and make the existing more efficient (Toll, 2016). The mental process is alone a progress for the industry, even if the technology itself does not succeed (Toll, 2016; Strömberg, 2016). The largest challenge might lie in shaping a standard and make all participants align to it (Gustafsson, 2016). This evolution might not look the same when implemented, as the current version in this start up phase but it is unstoppable (Strömberg, 2016).

## 7. Discussion

In this discussion section material from the literature study and the interviews are analysed. The discussion is divided with regards to the model of analysis presented in section 3.6.

### 7.1 The capital market

The original function of the capital market will probably not be affected by the blockchain technology within this decade. A change of the foundation will require time and a rebuild of the whole market; this is not a case currently discussed. Since many companies make their profit on the capital market they might create a hurdle to this kind of change. Instead of change in the foundation there are processes, workflows and job roles that seem to be affected of coming future implementations of the blockchain technology.

The blockchain technology has the potential to affect several areas but the capital market is a likely primary candidate. This is the case due to the need of developments in the capital market. The blockchain technology provides a level of security, which is an

important feature for the capital market. By develop the capital market it is possible to save a lot of money, it is also within the capital market that investments is possible to develop the blockchain technology. Within the capital market the post trade section seems to have a high prioritisation. This is a result from both the interviews and the literature study. It is a common opinion that the post trade section is in need of development and the blockchain technology is a suitable alternative to satisfy those needs. Within the post trade section there are numerous manually conducted steps, which is often highlighted as one reason why this specific section is in need for a change. The work processes seems to have remained the same for a long time. There are many tasks that could be digitalised and thereby more effective. Compared to the trade section of the capital market the post trade section has not been developed whereas the trade section has experienced extensive upgrades regarding effectiveness and streamline processes. The systems used are to be out-dated and they are made for requirements suited for an older environment than the current.

One issue that the blockchain technology might create a solution to is the need to shorten the settlement cycle. The technology is able to transfer both money and securities fast with no regards to borders. Time zones are highlighted as a potential hurdle for this implementation but it might not be significant enough. The companies that make their profit on a longer settlement cycle are larger hurdles for a shorter settlement cycle than the time zones. A shorten of settlement days reduces risk exposure for the trading companies and this makes a shortening tempting. But to shorten the number of settlement days the blockchain technology is not necessary, the databases currently used are capable to settle trades in a shorter time. The market participants need to align into a standard and the blockchain technology has highlighted wishes of a shorter settlement time standard. To make the market align might be an issue hard to solve.

The post trade section might be the most prioritised section to develop but it is important to remember that the blockchain technology will most likely affect several areas of the capital market and all parts of the market is of interest to change if it shows that this technique is beneficial. There are several arguments stating that even if the technique does not succeed it have started of a mental process, which is on its own a very important step for the whole industry. Several participants in the interview study states that it is the blockchain technology that is of interest for the future and not the crypto-currency Bitcoin.

## 7.2 Market participants

The blockchain technology enables co-operations between companies and competitors, as with the case of the DLG collaboration between banks. Those co-operations might be a way to establish a globalised solution for the blockchain technology. Co-operations are necessary since the blockchain technology requires a standard market participants can align to. The alignment is necessary if the technology should be able to flourish and

implemented. The blockchain technology might also decrease the need of intermediaries that conduct transfers between market participants or countries. This has an impact on the market participants currently making profit on being an intermediary. The blockchain technology challenges the intermediaries' existence and how they operate. It might be possible to replace market participants with the blockchain technology, but this would not be realised over one night. A replacement requires time and a lot of effort from those who want to replace a participant. But the potential replacement might contribute to another level of competition among the existing companies, since everyone wants to keep their operation.

Several market participants on the current capital market will likely be affected by the blockchain technology in some manner. Existing companies might be forced to change how they conduct their operation or their workflows. New business opportunities might arise together with new needs brought out by the blockchain technology. If the market changes it is important to keep a high level of trust from customers and clients. New establishments are forced to build up a level of trust and not interfere with trust from customers or clients. An interference with trust levels might affect the development of the blockchain technology if someone misuses it.

Currently there are a few minor initiatives launched based on the blockchain technology. The main question remaining is exactly what applications will be launched and what will the future launches provide. The general opinion is that the blockchain technology will continue to be used in minor launches during 2016-2018; larger initiatives will wait about 3-10 years. The developers of the technology require time to develop the technology and find solutions to potential issues or limits with the current version of the blockchain technology. The market and affected market participants also require time to prepare for a larger change and the effects the change might bring out. Before larger initiatives are launched regulations need to be reviewed. When specified applications are defined it is possible to more thoroughly review existing regulations, work processes and systems. Through this review it is possible to identify consequences that the technology might bring out.

The blockchain technology has the potential to affect several markets and not only the capital market. The blockchain technology is a technique for registration and as long as something needs to be registered it could be conducted through this new technique.

### 7.3 Regulations

The regulations are a highly central and important part, it is often brought up, as a crucial area for the capital market. Currently applied regulations will both be affected by the blockchain technology and affect the development of the technology. The regulators are currently focusing on understanding the technology and analysing how it might affect current regulations. It seems to be a strong wish to fit the technology in to existing regulations instead of creating any new material; this is partly a result from the extensive work put into regulations in the last couple of years. Regulations have to be

clarified in order for the blockchain technology to flourish and this is an issue that still needs a solution if the technology should be used. The regulators have to clarify what regulatory areas might be affected by the technology and how. This is necessary because no company would like to put a lot of effort into a technology that might be restricted by upcoming regulations. Regulations do not affect what specific technique a company uses but it has a significant effect on work processes and put demands on for example, surveillance and data protection. One issue with the blockchain technology that needs a solution before implementation is the lack of responsibility; the original Bitcoin network is completely free of hierarchy. An implementation on the current capital market requires someone to be responsible for the blockchain; this is necessary because the legal aspect requires someone to be able to hold responsible if anything goes wrong.

Smart contract is often highlighted as the most interesting innovation within the blockchain technology. The smart contracts will likely contribute to a digitalisation of the industry. This contribution probably makes the innovation even more interesting since it is a solution to a prioritised problem. However, there is an issue with smart contracts in the regulatory aspect. If the programmer writes something wrong in the code it needs to be determined who is responsible and how this will be handled legally. Currently lawyers making error in contracts are prosecuted and it is a determined process for this issue, a similar process needs to be established or at least the issue needs to be highlighted before a mistake is made.

With the blockchain technology several companies can share one single source of information. Synchronised data will save a lot of money but at the same time it might cost a lot to implement. When several companies share data it is important to remember the aspect of privacy protection if the shared information contains sensitive data. The sensitive data needs to be protected and not spread to someone unauthorised. Within the capital market there is a need to know the individuals involved in a transaction and this is ensured through the KYC process, if this kind of data is shared it is important to ensure that only the permitted ones who should have the access has it.

## 7.4 Ethical aspects

Change might lead to unintended consequences. A change might not bring out the expected and it could contribute to a rise of new issues. Currently the Swedish financing supervising authority put a lot of effort into analyse possible consequences to avoid unintended ones. This should be the case for all companies that might implement the blockchain technology. Since the technology is new and no larger implementations are currently launched, it could bring out consequences that are not predicted.

Changes need to be implemented without interfere with the trust connected to the system, if an unintended consequence arise this could interfere with trust levels. The trust is an important aspect for both new establishments on a market and current ones, people needs to be able to trust the technology and how it affects the work. Changes in

work processes might affect a lot of people and this kind of change is hard to implement, since there is an emergent risk in a lot of people lose their jobs. It is not unusual that people have a sceptic approach towards new technologies and this might be counteracting for the technology, especially if combined with people getting unemployed. It is important to remember this sceptic approach when implement a change of larger extend in an organisation.

To implement a change of this magnitude it is likely that a flexible approach is beneficial since it enables changes to be made and adjustments possible. The blockchain technology is new and a flexible approach might lead to the possibility to solve unintended consequences. When implementing a change it is also beneficial to bring ethical competence within the project in order to avoid an unintended result.

## 7.5 Technical effects

There are two possible alternatives of implement a blockchain network, a permissionless one and the permissioned one. The permissionless one is currently the most developed one, due to the interest in create open source code and contribute to the society. But the permissionless one requires a lot of energy only to run the validation consensus method and this is not applicable when high speed is required. The permissioned alternative is probably the most interesting one for the capital market since it opens up possibilities to establish collaborations between participants in the network and still ensure security. A permissioned network also reduces the need of heavy validation methods. The blockchain technology removes the need of a central validation method used in current centralised networks. In a permissioned network the participants need to agree on how the validation should be conducted. It seems to be multiple ways of solving this issue, which might bring out different solutions in different networks.

Many of the technical systems operating today is out-dated and created for an environment different from the current one. Possible impacts from the blockchain technology are changes in technical systems and work processes. The need for change has been present in several years but it seems to be the blockchain technology that has started the change process more seriously. Still it is important to remember that the blockchain technology will be used together with systems that operate with another technology as its foundation. Every system will not be changed into the blockchain technology at once and every future system will not be based on a blockchain technology. The collaboration between the blockchain technology and currently used systems is a challenge since there are a large number of systems with a lot of legacy that needs consideration.

One issue that still remains is that the blockchain technology requires time to mature; it is still new and only minor initiatives are launched. This highly affects the current state of the technology, it is still unclear how it will proceed and what it will bring out.

## 7.6 Additional reflection

This investigation has a geographic delimitation to the Nordic region. This is not significant because of the high level of impact from the EU, which Sweden, Denmark and Finland is members of. Even if Norway and Iceland is not members of the EU they are still affected through the EEA. It is likely a larger difference between the EU region and another part of the world for example, the US or the Middle East. The EU affects regulations and put demands on companies within the capital market and is a central part for the market.

## 7.7 Further research

This master thesis focuses on what the blockchain technology might bring out to the capital market, later in the future it would be interesting to further analyse how it actually affected the capital market. If the technology does not succeed, it might have brought anything else of interest into the market. This requires implemented solutions or an abandoned technique, which might take about 10 years before a review can be conducted.

This thesis only focus on the capital market, during both the literature and the interview study several actors have mentioned the blockchain technology as a potential technique to revolutionise many other areas. The only thing the blockchain technology requires is some kind of ownership and transfers, which can be related to areas like car registration, payments or real estate market. Those other areas are also interesting to analyse how they might be affected of a large technical change as the blockchain technology provides, it is possible that some areas have embedded constraints that makes an implementation of the blockchain technology unnecessary and this would also be an interesting result since today the approach is that every area is a possible implementation for the technology without any limitations.

As mentioned in 7.3 the delimitation to the Nordic region are not as applicable as expected instead the EU dominates the geographic region and this should make it interesting to further research potential differences between region outside the EU, for example to analyse the United States approach towards the technology compared to the Middle Eastern approach. Those regions are different in market practises and their capital markets are different as well.

## 8. Conclusions

This section aims to answer the two research questions defined in section 1.2.

- What are the possible future implementations for the blockchain technology within the Nordic capital market?

In the current capital market it is likely that the post trade part of the market will be prioritised for an implementation of the blockchain technology. This prioritisation is a result of the high security demands put on the post trade section that the blockchain technology can fulfil. The blockchain technology is able to update and develop the post trade section, which is in need for updates and modernisation. Currently only minor launches are made with the blockchain technology as its foundation, larger ones will probably take some time partly because regulations need to be clarified.

The blockchain technology consists of several new innovations and the smart contract one will probably affect the market a lot, because the many possible usage areas with the innovation. The smart contracts enable a possibility to remove a lot of manually conducted steps and a higher level of digitalisation. But regulatory aspects will have to be clarified in order to fully implement the smart contracts because it arises new potential risks if an error is made.

The blockchain technology is possible to implement either as a permissioned or a permissionless version. The permissioned alternative seems to be most relevant for the capital market due to integrity and security demands. Both alternatives might be used; which alternative depends on the application and its needs.

- What is the possible impact from a new technology like the blockchain technology?
  - What areas might be most affected?

The blockchain technology will affect several market participants on the capital market. If an implementation is made there are several technical processes and workflows that will be affected. But if the technology would not flourish, it has already affected many companies since it has created a wake up call for the capital market and its need for improvement and update. The blockchain technology might create new collaborations, competitors working together in order to creating an alignment necessary for the industry as one example.

The capital market contains uses several techniques that are out-dated or in need for updates. Within the market there are also a lot of manually work conducted. An implementation of the blockchain technology might replace the work of a lot of people and this might affect the technology. The technology might be antagonised if people will loose their jobs as a result. But the technology can contribute to a more efficient capital market with more modern technology. Every currently used system will not be changed at once; the blockchain technology needs to cooperate with the older system and this might be a challenge. When a large change is conducted unintended consequences might arise. It is important for every participant within a change to analyse possible consequences and prevent unintended ones. A flexible development and implementation process might help dealing with unintended consequences. The consequences might not be visible immediately; it might take awhile to identify all

effects. The consequences will have an impact on the outcome of the blockchain technology.

Regulations have a central function on the capital market since it affects how the market operates. The regulations might have to be updated or changed depending on the implementation of the blockchain technology. This is probably one of the areas that will be most affected and also affect the technology most. Regulations are able to both encourage and limit the usage of the blockchain technology.

## Bibliography

Aberer, K. (2011). *“Peer-to-Peer Data Management”* San Rafael: Morgan & Claypool Publishers. [Electronic resource].

Alvehus, J. (2013). *“Skriva uppsats med kvalitativ metod: en handbok”*. 1st. edn. Stockholm: Liber.

Andersson, L. (2010). *“Värdepapper: en genomgång av kapitalmarknaden och skattereglerna: [aktier, obligationer, optioner, fonder, konvertibler mm]”*. 8., [revised and updated] edn. Näsviken: Björn Lundén information.

Brinkmann, S. (2013). *“Understanding Qualitative Research: Qualitative Interviewing”*. USA: Oxford University Press.

Bryman, A. & Bell, E. (2013). *“Företagsekonomiska forskningsmetoder”*. 2., [revised] edn. Stockholm: Liber.

Buchmann, A., Karatsiolis, E. & Wiesmaier, A. (2013). *“Introduction to Public Key Infrastructures”* [Electronic resource]. Berlin: Springer.

Byström, H. (2014). *“Finance: markets, instruments & investments”*. 3., [revised and updated] edn. Lund: Studentlitteratur.

Carlsson, B. (1991). *“Kvalitativa forskningsmetoder för medicin och beteendevetenskap”*. 1st. edn. Solna: Almqvist & Wiksell.

Chan, D., Fontan, F., Rosati, S. & Russo, D. (2007) *“The securities custody industry”*. Retrieved 2016-05-19 from:  
<https://www.ecb.europa.eu/pub/pdf/scpops/ecbocp68.pdf?5ff757225862fdd1894d8dab08815b19>.

De George, R. (2006). *“Information technology, globalization and ethics”*. *Ethics and Information Technology*, vol. 8, no. 1, pp. 29-40.

- Delfs, H. & Knebl, H. (2007). *“Introduction to cryptography: principles and applications”*. 2nd edn. New York; Berlin: Springer.
- ESMA (2016). *“Who we are”*. Retrieved 2016-02-24 from: <https://www.esma.europa.eu/about-esma/who-we-are>.
- European union (2016). *“Regulations, Directives and other acts”*. Retrieved 2016-02-24 from: [http://europa.eu/eu-law/decision-making/legal-acts/index\\_en.htm](http://europa.eu/eu-law/decision-making/legal-acts/index_en.htm).
- Euroclear (2016). *“Our business”*. Retrieved 2016-02-24 from: <https://www.euroclear.com/en/about/Our-business.html>.
- Finansinspektionen (2016a). *“What we do”*. Retrieved 2016-02-08 from: <http://finansinspektionen.se/Folder-EN/Startpage/About-FI/What-we-do/>.
- Finansinspektionen (2016b). *“Börser och aktiehandel”*. Retrieved 2016-02-10 from: <http://www.fi.se/Folder-SE/Konsument/Fragor-och-svar/Spara/Borser-och-aktiehandel1/#N2>.
- Finansinspektionen (2016c). *“Värdepapper Esma”*. Retrieved 2016-02-24 from: <http://www.fi.se/Regler/Internationellt/EU-samordning/Vardepapper-Esma/>.
- Finansinspektionen (2016d). *“Lagar för värdepapper, börs och clearing samt kreditvärdering”*. Retrieved 2016-02-24 from: <http://www.fi.se/Regler/Lagar/Vardepapper-bors-och-clearing/>.
- Finanssivalvonta (2016) *“About us”*. Retrieved 2016-02-24 from: [http://www.finanssivalvonta.fi/en/About\\_us/Pages/Default.aspx](http://www.finanssivalvonta.fi/en/About_us/Pages/Default.aspx).
- Finanstilsynet (DK) (2016). *“Objectives and core areas”*. Retrieved 2016-03-07 from: <https://www.finanstilsynet.dk/en/Om-os/Objectives-and-core-areas.aspx>.
- Finanstilsynet (NO) (2016). *“About Finanstilsynet”*. Retrieved 2016-02-19 from: <http://www.finanstilsynet.no/en/Secondary-menu/About-Finanstilsynet/>.
- FME (2016). *“General information”*. Retrieved 2016-04-13 from: <http://en.fme.is/about-fme/general-information/>.
- Gonzalez, W.J. & SpringerLink (Online service) (2015). *“New Perspectives on Technology, Values, and Ethics: Theoretical and Practical”*, 1st edn., Springer International Publishing, Cham.
- Hansson, S. (2005). *“Aktier, optioner, obligationer: en introduction”*. 10. [revised.] edn. Lund: Studentlitteratur.
- Kavathatzopoulos, I. (2012). Chapter 26: “Assessing and Acquiring Ethical Leadership Competence” in Prastacos, G.P., Wang, F., Soderquist, K.E. & ebrary, I. *Leadership*

*through the Classics: learning management and leadership from ancient East and West philosophy*, 1. Aufl. edn, Springer, New York; Heidelberg. pp. 389-400.

Kelly, B. (2015). "The Bitcoin big bang: how alternative currencies are about to change the world". Hoboken, N.J.: John Wiley & Sons.

King, B. (2014), *Breaking banks: the innovators, rogues, and strategists rebooting banking*, 1st edn, Singapore: Wiley.

King, J. (1983). "Centralized versus decentralized computing: organizational considerations and management options", *ACM Computing Surveys (CSUR)*, Vol. 15, No. 4, pp. 319-349.

Mulligan P. & Gordon R. S. (2002). "The impact of information technology on customer and supplier relationships in the financial services". *International Journal of Service Industry Management*. Vol. 13, No 1, pp. 29-46.

Nasdaq CSD (2016) "General information". Retrieved 2016-04-13 from: <http://en.vbsi.is/AboutNasdaqCSD/Generalinformation/>.

Nasdaq OMX (2016). "Om oss". Retrieved 2016-02-24 from: <http://www.nasdaqomxnordic.com/omoss>.

Nationalencyklopedin (2016a). "Aktiefond". Retrieved 2016-02-10 from: <http://www.ne.se/uppslagsverk/encyklopedi/lång/aktiefond>.

Nationalencyklopedin (2016b). "Kapitalmarknad". Retrieved 2016-02-19 from: <http://www.ne.se/uppslagsverk/encyklopedi/lång/kapitalmarknad>.

Neelke, D., Spruit S., & Robaey, Z. (2016). "Editors' overview: Experiments, ethics, and new technologies". *Science and engineering ethics*. [Electronic resource].

Oslo Børs (2016) "About Oslo Børs". Retrieved 2016-02-24 from: [http://www.oslobors.no/ob\\_eng/Oslo-Boers/About-Oslo-Boers](http://www.oslobors.no/ob_eng/Oslo-Boers/About-Oslo-Boers).

Pacitti, E., Akbarinia, R. & El-Dick, M. (2012). "P2P Techniques for Decentralized Applications" [Electronic resource].

Pinna, A. & Ruttenberg W. (2016) "Distributed ledger technologies in securities post-trading". Retrieved 2016-05-02 from: <https://www.ecb.europa.eu/pub/pdf/scpops/ecbop172.en.pdf>.

Saint-Paul, G. (2008). "Innovation and inequality: how does technical progress affect workers?" Student edn., Oxford; Princeton: Princeton University Press.

Saunders, M., Lewis, P. & Thornhill, A. (2009). "Research methods for business students". 5. edn. Harlow: Financial Times Prentice Hall. [Electronic resource].

Segendorf, B. (2014). “*Vad är Bitcoin?*”. Retrieved 2016-02-01 from: [http://www.riksbank.se/Documents/Rapporter/POV/2014/2014\\_2/rap\\_pov\\_artikel\\_4\\_1400918\\_sve.pdf](http://www.riksbank.se/Documents/Rapporter/POV/2014/2014_2/rap_pov_artikel_4_1400918_sve.pdf).

Simmons, M. (2002). “*Securities Operations: A Guide to Trade and Position Management*”. Sussex: John Wiley & Sons.

SFS 1998:1479 “Lag (1998:1479) om värdepapperscentraler och finansiella instrument”.

SFS 2007:528 “Lag (2007:528) om värdepappersmarknaden”.

SFS 2010:1969 “Personuppgiftslag (1998:204)”.

SFS 2015:443 “Lag (2009:62) om åtgärder mot penningtvätt och finansiering av terrorism”.

Swan, M. (2015). “*Blockchain: blueprint for a new economy*”. 1st edn. Beijing: O'Reilly Media, Inc.

Swanson, T. (2015). “*Consensus-as-a-service: a brief report on the emergence of permissioned, distributed ledger systems*”. Retrieved 2016-02-04 from: <http://www.ofnumbers.com/wp-content/uploads/2015/04/Permissioned-distributed-ledgers.pdf>.

Trost, J. (2010). “*Kvalitativa intervjuer*”. 4th., [revised.] edn. Lund: Studentlitteratur.

UBS. (2016). “Extreme automation and connectivity: The global, regional, and investment implications of the Fourth Industrial Revolution - UBS White Paper for the World Economic Forum Annual Meeting 2016”. Retrieved 2016-02-01 from: [https://www.ubs.com/global/en/about\\_ubs/follow\\_ubs/highlights/davos-2016.html](https://www.ubs.com/global/en/about_ubs/follow_ubs/highlights/davos-2016.html).

Van de Velde, J., Scott, A., Sartorius, K., Dalton, I., Shepherd, B., Allchin, C., Dougherty, M., Ryan, P. & Rennick, E. (2016). “*Blockchain in Capital Markets, the prize and the journey*”. Retrived 2016-02-10 from: <https://www.euroclear.com/en/campaigns/blockchain-in-capital-markets.html>.

Verdipapirsentralen (2016) “*About VPS*”. Retrieved 2016-02-19 from: <http://www.vps.no/pub/about-us/organisation/about-vps/?lang=en>.

Vigna, P. & Casey, M. (2015). “The age of cryptocurrency : / how bitcoin and digital money are challenging the global economic order”. New York: St. Martin's Press.

VP Securities (2016). “*Profile*”. Retrieved 2016-03-07 from: <https://www.vp.dk/en/About-VP/Profile>.

## Interview bibliography

Gustafsson, K., Visigon Nordic, 2016-02-29. Stockholm, Personal interview.

Mild, M. Finansinspektionen, 2016-03-17. Uppsala, Telephone interview.

Norlin, R. Finansinspektionen, 2016-03-09. Uppsala, Telephone interview.

Nyqvist, A. SEB, 2016-04-20. Stockholm, Personal interview.

Stenkrona, A. Cryex, 2016-04-05. Stockholm, Personal interview.

Strömberg, P. Avanza, 2016-02-26. Stockholm, Personal interview.

Toll, J. Nasdaq, 2016-03-07. Stockholm, Personal interview.

Troedsson, V. Svenska Fondhandlare föreningen, 2016-02-23. Stockholm, Personal interview.

Tullilla Persson, L. Nasdaq, 2016-03-07. Stockholm, Personal interview.

# Appendix A

## Interview question areas

This is a collection of the interview questions. Note that all questions were not asked to every participant, this is a collection with all questions divided into the areas of focus. The objective with each area determining which questions should be asked, the objective is presented below for each section.

### Introduction and actor related information

Objective: To understand the companies impact on the capital market, what role they have and how they work. The objective is also to gather information about the participant and what the participants work responsibilities are.

- Can you describe the role of (company name) in the capital market today?
  - How does your company affect the capital market?
- Can you describe your role at (company name)?
- What trends do you identify on the capital market today?
- What are your thoughts on collaboration with other actors in order to introduce the blockchain technology?
- What are the differences between the Nordic countries in your opinion?
- How does the EU affect the capital market today?

### Technicalities

Objective: Gather information about how the blockchain technology affect the actor, what pros and cons the actor identifies with the technology, current level of experience.

- How does your company work with technical development?
- What are the features a system on the capital market needs to have?
- What are the main benefits with the blockchain technology?
- What are the main challenges with the blockchain technology?
- What would your company gain on introducing this technique?
- Have you consider potential usage areas?
- Do you believe in the technology?
- Are there any other reflections on the technology that you want to share?
- What effects do you think the blockchain technology might bring out?
- How long time do you think it will take before larger initiatives are launched?
- You're a part of the DLG collaboration; can you tell us more about that collaboration and what your purpose with it is?

### Related areas

Objective: How technical changes might affect the actor and the market in general, to what level the actor is willing to change, which areas the technology might affect most

like for example regulations. The objective is also to gain an understanding about how an actor can affect constraints put on technical change or development like for example customer behaviours and regulations.

- What drives technical change within the capital market?
- What limits technical change?
- Is the market in need for a change?
- Do you have any experiences of technical changes?
  - How fast was the process from idea into implementation?
- Is it likely that the market will accept a technical change?
- How does a financial supervising authority gain insight in technical developments?
- If the system were rebuilt, would it look the same?
  - Would all actors still exist?
- Today we have a centralised market, how might a more decentralised market affect?
- Why do we have a 2-day settlement time today?
  - Do we need it?
  - What would be the pros and cons with a reduced settlement time?
- Do you believe that your company can affect the regulations?
  - If yes, how do you affect regulators?
- What are the consequences with a lot of new regulation admittance?
- Are the regulations adjusting the technology or is it the reversed?
  - Is one part limit or promote the other?
  - What are the relation between technique and regulation?
- How do you as an unestablished actor work with gain trust among customers?
- How do you implement new technology?
- What demands are put on new technology at the capital market today?
- Do you believe that the market today is ready for the blockchain technology?
- The Bitcoin network is connected with a bad reputation; do you think it affects the technology acceptance?
- Banks (and the capital market) handles sensitive material, how do you deal with that when developing new technology?