

ME200X: Degree Project in Industrial Economics and Management

# The adoption of distributed ledger technology in trade and export finance operations of Swedish banks

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## Abstract

Centralized data storage and reconciliation by trusted intermediaries has historically put financial systems in the hands of a single central parties. The emergence of bitcoin and blockchain, combined with the 2008 financial crisis, has shifted the Swedish financial sector's traditional perspectives on democratization, centralization, transparency and automation. Trade and export finance is one of many sectors investigating how blockchain and distributed ledger technology can be used other than as a digital currency system. Swedish trade and export finance connects importers, exporters, banks, credit providers, customs, and transporters into a fragmented and complex process with many stakeholders. Sweden further has a history of quickly adopting technological innovations. Banks therefore face a dynamic environment and an inconsistent, manual operative process that removes profitability incentives in providing small enterprises with credit. The adoption of DLT could provide efficiency gains and cost savings in administration, communication, reconciliation and accounting.

In this thesis, the costs, benefits, and remaining barriers of implementing distributed ledger technology in Swedish trade finance are identified. Further, Swedish contextual factors' effect on the rate of adoption is addressed. The chosen methodology of deep interviews and thorough studying of literature provides an assessment of the potential transition dynamics, forming a foundation for future investment decisions. The conclusions drawn suggest that the main costs related to adoption lie in research and development and implementation. R&D costs for distributed ledgers in the Swedish financial sector during 2019 were approximated to USD 40 million. The main benefits of automation, efficiency and reduced level of complexity were concluded to likely outweigh the costs within approximately ten to twenty years. Experience will allow companies to optimize governance structures and consensus mechanisms, while learning to expose parts of networks into public space. The innovative, adaptive Swedish market environment presumably enables faster than average diffusion of innovation, while remaining barriers in cooperation, trust, interoperability and regulation may extend the adoption process.

Keywords: *Blockchain, DLT, distributed ledger, finance, technology, FinTech, bank, trade finance, export, cost reduction, efficiency, Sweden, innovation, diffusion*

## Sammanfattning

Centraliserad datalagring och avstämning genom centrala mellanhänder har historiskt sett lagt stort ansvar på enskilda centrala aktörer i att upprätthålla det finansiella systemet. Uppkomsten av bitcoin och blockchain, i kombination med finanskrisen 2008, har förändrat det traditionella synsättet på demokratisering, centralisering, transparens och automatisering i den finansiella sektorn i Sverige. Frånsett den digitala valutalösningen finns inom export och trade finance ett potentiellt användningsområde för blockchainteknologi. Den svenska trade finance-sektorn sammanbinder importörer, exportörer, banker, kreditgivare, tullar och transportörer till ett komplext och fragmenterat nätverk med många intressenter. Historiskt har man i Sverige snabbt anammat teknologiska innovationer. Svenska banker verkar därför i en dynamisk miljö där komplex, inkonsekvent processhantering raderar ut lönsamhetsincitament för kreditgivare till småföretag. Anammande av distribuerade liggare förväntas främst ge effektiviseringar och kostnadsbesparingar i administration, kommunikation, avstämning och redovisning.

I denna uppsats identifieras kostnader, nytta och kvarvarande hinder för implementering av en lösning baserad på distribuerade liggare i den svenska trade finance-sektorn. Vidare adresseras hur marknadsmässiga faktorer påverkar spridningen av teknologin i Sverige. I den valda metoden används djupintervjuer och en noggrann litteraturstudie för att bedöma dynamiken in en potentiell övergång, vilket bidrar med underlag för utvärdering vid framtida investeringsbeslut. Slutsatserna som dras är att de huvudsakliga kostnaderna för en övergång till system baserade på distribuerade liggare består av forskning- och utvecklingskostnader samt implementeringskostnader. FoU-kostnaderna för utveckling av distribuerade liggare i den finansiella sektorn i Sverige bedöms vara totalt cirka 40 miljoner USD under 2019. Den huvudsakliga nyttan i automatisering, effektivisering och förenkling kommer sannolikt att överstiga kostnaderna inom cirka tio till tjugو år. Erfarenhet möjliggör då för företag att optimera styrningsmodeller och konsensusmekanismer i nätverk, och delar av nätverk kan exponeras i det publika rummet. Den innovativa, anpassningsbara svenska marknaden gör att spridningen av distribuerade liggare i Sverige sannolikt sker snabbare än genomsnittligt, medan barriärer som samarbete, tillit, driftskompatibilitet och reglering gör att anammandet i stort kan ta längre tid.

Nyckelord: *Blockchain, DLT, distribuerade liggare, finans, teknologi, FinTech, bank, trade finance, export, kostnadsbesparing, effektivisering, Sverige, innovation, spridning*

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# Chapter 1

## Introduction

*In this chapter, the thesis subject is presented. Initially, the background is introduced and a problematization is provided. The chapter proceeds to specify the purpose of the study, the research questions and how the authors intend to contribute to the academic field of study. The limitations and delimitations are established, and the remainder of the investigation is outlined.*

### 1.1 Background

In 2008, Satoshi Nakamoto announced the premier release of Bitcoin, a decentralized electronic cash system based on a peer-to-peer network (Nakamoto, 2008). The Bitcoin technology allows for transfers from one party to another without the need for a known, trusted intermediary. This is done by verification and addition of new transactions to so-called blocks. These batches of transactions are followingly chained together in a blockchain, wherein the transaction history is stored. Blockchain is a type of distributed ledger of which each network node keeps an individual copy. (Yli-Huumo et al., 2016) The blockchain network used in the case of Bitcoin is public and thereby free for anyone to join. Each new addition to the ledger must be validated by the network peers prior to being added, in a process of agreement named consensus. (Nakamoto, 2008) Upon agreeing on the validity of a transaction, the network peers subsequently update their individual copy of the distributed ledger (Yli-Huumo et al., 2016). The blockchain possesses several differentiating properties, such as robustness and immutability. It receives these properties by its construction and the use of cryptographic procedures to encrypt the blocks. (Collomb & Sok, 2016)

The trade and export finance sector is one of many in which actors have recently started exploring the potential applications of blockchain and distributed ledger technology (hereinafter referred to as DLT) in general, to leverage the technology in aspects other than as a digital currency system (Wang, 2018). The technology has proven to be particularly useful in transaction services due to some of its unique properties, such as immutability and the ability to embed trust in the network. Some commonly perceived advantages of the technology are the cost savings and efficiency improvements it could bring. (McLean & Deane-Johns, 2016) The financial sector has historically relied on centralized data storage and trusted intermediary agents. An issue with a centralized solution as such is that the entire system depends on the central party, with every transaction having to go through them. (Nakamoto, 2008) The properties of DLT lead researchers to believe that the technology could simplify traditional structures and their ambient requirements on administration, reconciliation and accounting through disintermediation and automation (Natarajan et al., 2017).

Today's method of processing trade and export finance transactions has remained relatively un-

changed for many years (Barclays, 2016). The trade finance ecosystem consists of importers, exporters, banks, credit providers, customs, transporters, and more, depending on the nature of a certain transaction. The systems can handle a fair amount of data at a moderate rate, are secure and are trusted by network participants.(Dab et al., 2016) In the wake of Bitcoin, several consortiums of institutions have gathered to explore the potential of DLT and to develop new solutions in umbrella projects, such as WeTrade, R3 Corda and IBM Hyperledger.

## 1.2 Problematization

The financial crisis in 2008 largely prompted the recent democratization, decentralization, transparency and automation development seen in the Swedish financial sector. Furthermore, revolutionizing infrastructures (for example BankID) have been established since the turn of the millennium, enabling accelerated digitization and innovation in Sweden over the past decade. The country also has a history of quickly adopting innovations in technology. (Teigeland et al., 2018) Swedish banks therefore face a dynamic, highly competitive and swiftly developing environment.

Trade and export finance processing involves a wide range of intermediaries between the importer and the exporter. For banks specifically, many steps require manual input such as scanning and gathering of relevant documents.(Dab et al., 2016) The documents must be read and the bank clients' plausibility for the demanded credit must be assessed. Furthermore, the client must ensure that an authorized representative signs the documents, and the bank must verify that the transaction adheres with current sanction lists and Know-Your-Customer (KYC) requirements. Regulatory and legal conditions also affect the approval process. (Sinclair, 2017) The documents are still conventionally sent to the bank via email or postal services and may not all be sent concurrently. In its current shape, processing is therefore rather fragmented and complex (Dab et al., 2016).

The complex, fragmented nature of trade and export finance operations causes several issues. For example, the regulatory complexity and high fixed cost of performing a transaction removes incentives for banks to provide small and medium sized enterprises with credit. A transaction must be large enough to be profitable for the bank. A survey in 2017 by the Asian Development Bank concluded the unmet demand was approximately USD 1.5 trillion, causing large funding deficiencies in the market. (Wang, 2018) Additionally, today's process increases operational risk due to inconsistency and errors occurring due to manual handling (Guo & Liang, 2016). At a glance, DLT could contribute to solving these problems, mainly through automation.

By the above, the Swedish trade and export finance sector provides for an interesting investigation. It is relatively well-established what DLT can and cannot do. But are banks' businesses ready for the consequences of a more widespread implementation of DLT and, perhaps more importantly, are banks required to invest in DLT to stay competitive? In this thesis the aim is to identify the costs, benefits, and remaining barriers of implementation for DLT, and to discuss how Swedish contextual factors may affect the rate at which the technology is adopted.

## 1.3 Purpose

The purpose of this study is to assess the rate of adoption of a potential transition to DLT-based systems in trade and export finance in Sweden. The swift, recent emergence of bitcoin and its underlying technology has contributed to the rapidly changing financial environment faced by banks. Banks likely face pivotal investment decisions in the near future, whereby it is of significant importance to evaluate the rate at which diffusion of DLT will occur and how an investment may benefit the company over time.

## 1.4 Research questions

Research question:

- What factors affect the rate of adoption for distributed ledger technology in Swedish trade and export finance?

Sub-research questions:

- What are the costs and benefits related to an adoption of DLT?
- What are the contextual factors that affect the rate of adoption of DLT in Swedish trade and export finance specifically?
- What are the major remaining barriers of adoption?

## 1.5 Expected contribution

This investigation will provide banks with information to support future investment decisions based on a range of perspectives and market consensus, whilst raising thoughts on how their future business model may be affected by their choice of path. Analyzing costs, benefits, challenges, and contextual factors whilst subsequently discussing how they may interact and occur over time will provide the appropriate understanding. The expectation is to provide a groundwork for discussion on how the business model of a bank may need to evolve in the long-term, as competitors could employ more cost efficient, reliable and easy-to-use solutions. Further, the investigation could contribute to FinTech companies' development by giving insight to market demands and the dynamics of a potential transition. Thirdly, the investigation could contribute to the Swedish government and the country's export industry through raising knowledge of factors that impede international trade, and how they could be addressed.

As will be further discussed in the literature review, a multitude of research articles from the past three to four years cover the disruptive potential of DLT. Others specifically investigate the potential of DLT within banking, whilst some research articles cover the advantages and disadvantages of DLT in trade finance operations. Some of these also highlight the challenges that exist with implementation of DLT in this part of banks' operations. Thus the field of research is well-established, yet does not cover implementation of DLT in Swedish banks specifically. Sweden stands out from many other developed countries as it has a highly developed and rigid technological infrastructure, which enables for early adoption and policies that generate an innovative climate (Teigeland et al., 2018). Addressing this and considering the business climate in Sweden today further adds to the originality of this thesis.

## 1.6 Limitation

The suggested method revolves mainly around gathering data in the form of deep interviews. It is important to seek a variety of interviewees to gain understanding of the different views on the phenomenon being investigated. One limitation of this study is that it is not possible to identify all different perspectives of the trade finance sector using the chosen method. Due to the natural subjectivity of qualitative interviews, the findings of our study may give a deep understanding of a certain company's situation (N.K. Saunders et al., 2009). Such results may prove to have a low level of generalizability, and could be incorrect to apply in all situations.

## 1.7 Delimitation

In this paper, applications of distributed ledger technology in the Swedish trade finance sector will be analyzed from the perspective of Swedish banks. The perspective of the end customer of the banks (e.g. importer or exporter) will not be considered in this thesis. There are many other sectors in which distributed ledger technology may prove to be useful, and other sections of banks where the technology may see implementation. Some applications of distributed ledger technology adjacent to trade finance that will not be considered in this thesis are post-trade settlements, capital markets, and insurance.

In ledger technology (such as blockchain) it is important to distinguish public ledgers from private ledgers. Bitcoin, for example, is based on a public permissionless ledger. In such a ledger the information is typically accessible to everyone whereas in a private ledger the ability to access the information is limited (Jayachandran, 2017). In a consortium ledger, a network of peers can combine the two types of ledgers. While transparency and easy access to information is important for a potential adoption of DLT in trade finance, it could be even more important to maintain a high level of security and integrity when dealing with sensitive information. Hence, this paper will focus mainly on private ledgers and consortium ledgers, leaving public ledgers a point of discussion and a future technique to thoroughly investigate.

## 1.8 Outline

The chapters of this thesis are dispositioned as follows:

1. **Introduction;** In this chapter the investigation is presented. The background and problematization are presented prior to the purpose and research question of the thesis. Subsequently, the expected contribution, limitations, and delimitations are presented in this chapter.
2. **Research method;** In this chapter of the thesis, the research method is presented. More specifically the chosen research design and method along with the process of the research. The reliability and validity of the thesis are presented in this chapter as well.
3. **Theoretical background;** The chapter *theoretical background* presents the theory necessary to understand in order to fully grasp the analysis and discussions made in this thesis.
4. **Literature review;** In chapter four a brief summary of the most relevant sources are presented.
5. **Results;** In this chapter, the empirical results from the conducted interviews are presented.
6. **Analysis and discussion;** This chapter contains an analysis and discussion of the results.
7. **Conclusions, implications and future research;** The last chapter presents the conclusions made in this thesis, its implications and the future research with regards to the chosen field of research.

# Chapter 2

## Research method

*In this chapter, the approach used to research the specified problem and the motivation as to why that approach was used is presented. First, the the methodological approach is introduced. Then, the research process is presented as a three stage process. To conclude the chapter, data collection methods are evaluated in terms of reliability, validity and generalizability.*

### 2.1 Methodological approach

An exploratory study will be conducted to investigate the chosen topic. There are three main ways to perform such an investigation (N.K. Saunders et al., 2009). First, existing literature can be studied. Second, interviews with leading researchers, managers and other professionals deeply involved in the field of research can be conducted. Lastly, focus group interviews can be used (N.K. Saunders et al., 2009). A combination of the first and second method will be employed in this thesis.

Moreover, the design of the research presented in this thesis will follow an inductive method of reasoning as opposed to a deductive one (N.K. Saunders et al., 2009). Thus, the research will move from specific to general by using current literature and interviews to draw broader conclusions regarding the implementation of the new technology. Interviews will be conducted to complement a literature review. This will allow an approach to the research question that adds value to the existing research.

### 2.2 Research process

The research process will be executed in three stages. First, a study of literature will be conducted. Second, a variety of interviews in financial institutions will be administrated. Lastly a summary, analysis and discussion of interviews will conclude the process.

#### 2.2.1 Stage one: Study of literature

Stage one will consist of a study of literature on related topics. Literature will be collected and evaluated critically by primarily considering articles from acclaimed journals. The literature review serves as a foundation for the research that will be conducted (N.K. Saunders et al., 2009). Conducting a literature review includes searching the existing literature in a critical manner. This implies that the authors must be skeptical towards what is being read and constantly question

what is concluded by a source. This process will generate a summary of the most relevant research for the thesis (N.K. Saunders et al., 2009).

The subjects to be investigated in the current literature are primarily those directly relatable to the research questions. This implies research in the DLT field, and in trade and export finance operations. Further, reports on the future of trade finance and the diffusion of technological innovations in the banking sector are relevant. In order to understand what value a DLT-based system can add to the trade and export finance system, the reasons behind the success and failure of the current solutions are relevant to investigate.

When searching for literature in academic search engines such as Google Scholar, DiVA portal (an archive for student theses and other publications) and Google Books the following key words have been used separately and in combinations:

- "blockchain"
- "DLT"
- "distributed ledger"
- "finance"
- "technology"
- "FinTech"
- "regulations"
- "trade finance"
- "cost reduction"
- "usability"
- "benefits"
- "challenges"
- "barriers"
- "adoption"
- "Sweden"
- "innovation"
- "diffusion"

## 2.2.2 Stage two: Interviews

### Initial interviews

The initial three interviews will be conducted in order to gain wider understanding of the studied phenomenon. An employee at the Swedish central bank will be interviewed, as well as the Nasdaq product manager for blockchain and the Head of DLT/Blockchain at Nordea. These interviews will be carried out with a direct focus on blockchain and distributed ledger technology. The interviews will be semi-structured, with seven predetermined questions. Open-ended interview questions will allow for interviewees' individual reflections on the chosen topic (N.K. Saunders et al., 2009). Additional follow-up questions will be asked for clarification and to allow for further development of opinions and thoughts. The competencies and experience of the interviewees in this stage allows for collection of credible and relevant answers. The following questions will be asked in this stage:

1. How is distributed ledger technology (e.g. blockchain, Ripple) used in the financial sector today?
2. What are the greatest challenges in the financial sector today, in your opinion?
3. What incentives are there for actors in the financial sector to use distributed ledger technology and underlying techniques?
4. In what segments of the financial sector do you consider the need/benefit of the technology to be the greatest?
5. What is missing today in order for distributed ledger technology to become more commonly used in the Swedish financial sector? What are the main issues with the available solutions?

6. According to a recent article, a large proportion of Bitcoin transactions may be illegal. What is your view on the need for future regulation of the market for digital currencies and underlying techniques?
7. Where do you think the market for distributed ledger technology is in five to ten years? What trends do you think we will see?

### Later interviews

Later in the study, qualitative interviews in the applicable subdivision in Swedish banks will be conducted. By interviewing a wide range of individuals within the sector, the aim is to acquire an holistic view of trade finance operations and the adoption of DLT. Hence, the interviewees will be chosen such that the group of individuals is small, but demographically diverse. Central bank research and technological expertise from earlier interviews will thus be complemented with competencies of individuals with distinct managerial responsibilities. Positions will range from head of trade finance in Sweden specifically, to head of transaction services, within which trade finance typically is a subdivision. The following questions will be asked in this stage:

1. Which are the greatest challenges with the current procedures? What needs to be altered in order for the current procedures to become more efficient?
2. Which are the latest trends within trade finance?
3. Have your bank implemented DLT? Which incentives do you see for a financial institution such as the one you work at and more specifically the division you work at, to implement DLT?
4. What are the key factors to consider in order to achieve a widespread adoption of DLT in trade finance? Which are the main issues with the existing DLT-solution?
5. Where do you think the market for distributed ledger technology is in five to ten years? What trends do you think we will see?

### 2.2.3 Stage three: Review and analysis of empirical material

In order to answer the research question, each sub-research question will be addressed separately. Each part of the analysis will subsequently build knowledge of the chosen topic such that in the end, the main research question has been wholly covered. The results will initially be analyzed using a cost-benefit analysis. This will provide the answer to the first sub-research question. A PESTLE analysis of Swedish contextual factors will provide a framework for answering the second sub-research question. This type of analysis divides contextual factors into six categories: political, economical, sociocultural, technological, legal and environmental factors. An analysis of the remaining challenges and barriers of a DLT adoption will follow as the answer to the third sub-research question.

## 2.3 Reliability

The accuracy and replicability reflect the reliability of a study (Collis & Hussey, 2014). Further, (Blomkvist & Hallin, 2015) argues that reliability implies studying the phenomenon *in the correct way*. The qualitative nature of the report, with semi-structured interviews as the primary source, is appropriate as the report will seek to explore a phenomenon. This is typically a situation when qualitative interviews are suitable (Blomkvist & Hallin, 2015). However, there are drawbacks with qualitative interviews. The interviewees may be biased towards the corporation they represent and

may not give full disclosure of their business, which slightly lowers the reliability of this thesis. The interviewees were offered to be anonymous to alleviate this potential issue.

The reliability is further strengthened by the conscious choice of sources. Primarily articles from acclaimed journals will be used. Moreover, all information gathered from external sources will be referenced in the bibliography. One risk to consider is that another researcher may draw contrasting conclusions from reading the literature. This could slightly reduce the reliability. It is therefore important to have a critical mindset when gathering information and reading the literature, for the study to provide a high level of reliability. In-depth knowledge will help fully understand the field of research and the reviewed journals such that its main message and fundamental flaws can be pin-pointed (Blomkvist & Hallin, 2015).

Further, the researchers will ensure that interviewees answered at least the mandatory questions that are decided on prior to the interviews to improve the reliability and replicability of the study. Also, one must assure that the interviewee understands the questions correctly. This will be done by making sure the language is clear and concise, but also by iterating the formulation of the question so that it is formulated as concisely as possible. All interview questions can be found in the appendix.

## 2.4 Validity

Validity is the degree to which the chosen methodology measures what the researcher wants to measure (Collis & Hussey, 2014). Blomkvist & Hallin (2015) defines the validity as studying *the right thing*. As for this report, the validity can be considered high as the literature review and the interviews covers the same field of research as the research question defines, which Blomkvist & Hallin (2015) deems necessary for achieving validity. In combination with the reliability of the study, this will generate relevant findings for the thesis. Further, the analysis section will verify the validity of the study by using cross referencing between interview answers and conclusions drawn from literature. For this to be possible, the method and interview design must be aligned with the research question.

## Chapter 3

# Theoretical background

*The theoretical background briefly explains the functions of a bank and specifies how the currently employed trade finance system works. Focus lies mainly on the applicable parts of the process that were determined to affect banks, since that is highly relevant for this study. Further, the chapter presents how DLT-networks function and how they differ from traditional solutions, and concludes with an explanation of the differences between public, private, permissioned and permissionless DLT solutions.*

### 3.1 Banks

Banks are financial institutions that provide loans and offer safekeeping of assets. They further manage different types of risks and make sure that transactions can be done with high efficiency and security (Sveriges Riksbank, 2016). There are several different type of banks. The most common types of banks are commercial banks, retail banks, central banks and investment banks (Pritchard, 2017).

- Commercial banks target different sized businesses to which they provide loans, financial products and deposits.
- Retail banks targets individuals or smaller businesses as main customers. These banks are providing a wide variety of services and products to these customers, such as savings, mortgages, loans, debit and credit cards.
- Investment banks provide services towards businesses regarding different financial decisions such as mergers and acquisitions or new rights issuing.
- Central banks are institutions responsible for monetary policies in a certain country or state(s). Its task is mainly to control the country's financial stability and reserves. A central bank works with a multitude of tools to perform its duties, one of which is the regulation of reference interest rates and, thereby, the rate of inflation. Further, central banks can implement monetary policies and manage the country's foreign exchange and gold reserves (Sveriges Riksbank, 2016).

In Sweden, the four largest banks, SEB, Handelsbanken, Nordea and Swedbank, are examples of banks that offer all of the services mentioned above (Sveriges Riksbank, 2016). Their legal structures are conventional as limited liability companies. Other types of banks in Sweden are savings and cooperation banks which represent only a minority (SBA, 2018). These two types of banks are essentially variations of retail banks. Some of the most prominent functions provided by a bank are capital funding, risk mitigation and trust (Bankföreningen, 2017).

### 3.1.1 Capital funding through deposits and lending

One of the most important functions of a bank is to provide its clients with the possibility to deposit money (Bankföreningen, 2017). The bank can then transfer resources to individuals or businesses that require financial support to realize investments. Banks collect deposits from both households and companies. In December 2016, 43 percent of the bank deposits in Sweden came from Swedish households, 23 percent from Swedish companies and 23 percent from foreign investors (Bankföreningen, 2017). In Sweden, lending to households and companies can also be provided by mortgage institutions such as SBAB.

By acting as an intermediary that channels acquired deposits to sources of capital demand, banks increase the efficiency in the capital markets considerably. For example, a lender needs only to trust the bank and its ability to perform its task rather than be concerned about the credit rating of the borrower (Sveriges Riksbank, 2016). Apart from lending capital, financing can also be accessed by issuing bonds and similar financial instruments. In that case, the company acquiring capital does not need to involve an intermediary such as a bank. However, a bank can still increase efficiency in such cases by supporting a standardized and regulated market (Sveriges Riksbank, 2016). Providing attractive interest rates for deposits and loans is crucial in order for a bank to stay competitive and avoid declining deposit levels. The rates depend on for example the credit rating of the involved parties, current key rate and the additional calculated risk for the bank (Bankföreningen, 2017).

### 3.1.2 Risk mitigation and trust

Another function of a bank is to manage risk. The bank's own risk is affected by the fact that it traditionally has relatively low levels of equity financing compared to the other sources of funding. This is a great risk not only for the bank itself but also for the society as a whole. Thus, there is a capital requirement level that each bank has to maintain. This total capital requirement is based on different pillars according to Finansinspektionen, the Swedish authority responsible for supervising the financial markets in Sweden. The pillars are the basic capital requirement and the risk assessment and supervision. In addition, there is the combined buffer requirements. The first pillar is based on the different types of risk that a bank typically is exposed to, operational risk, credit risk and market risk. (Finansinspektionen, 2017)

Not only does a bank manage its own risk; it also provides instruments and services that can help their clients mitigate their own risk (Bankföreningen, 2017). Depending on the nature of its business, there are different risks that a company can be exposed to. Examples are fluctuations in exchange rate or in price levels of various commodities (Barned, 2012). In order to mitigate these types of risks, the bank can provide different types of financial instruments (Bankföreningen, 2017). In the upcoming section, the description of trade finance operations includes an explanation of the commonly used risk mitigation instruments in trade finance specifically.

## 3.2 Trade and export finance operations

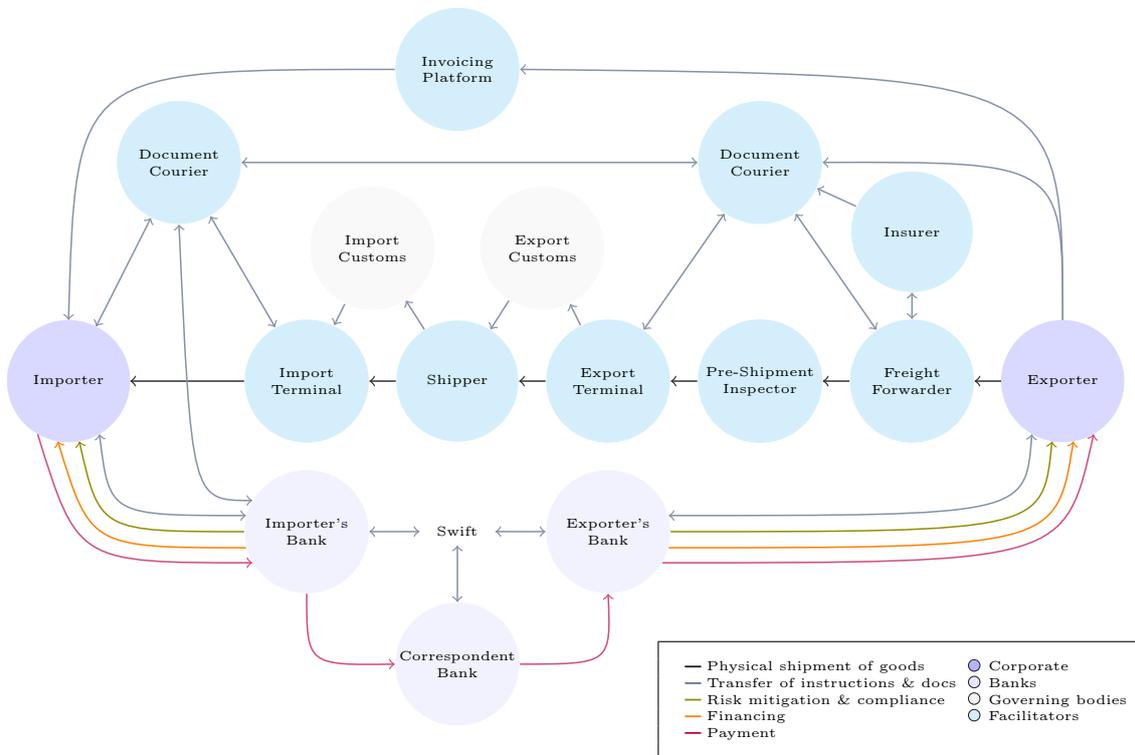
The service provided by banks generally referred to as trade and export finance exists to serve clients who do not fully trust their counterparties in trade agreements and hence seek to mitigate counterparty risk (McWaters, 2016). Mainly through two different products that banks offer: bank guarantees and letters of credit (Deloitte, 2018). A bank guarantee is a guarantee issued by the bank on request of a client of the bank (sometimes referred to as the principal) in favour of the party who will receive the guarantee (beneficiary). By such a guarantee a bank provides a beneficiary with security independent of the principal in questions of urgency or capability to fulfill its part of a contract. (SEB, 2006)

Common types of guarantees are advance payment guarantees and performance guarantees. An advance payment guarantee implies that the bank ensures the buyer/importer that the amount paid in advance of delivery of the underlying service or product will be returned, would the terms of the agreed contract not be fulfilled (for example unsuccessful delivery). A performance guarantee ensures that the counterparty fulfills other obligations stated in the contract. For example, the seller/exporter could commit to delivering goods that hold a certain level of quality. The bank’s commitment in such a guarantee is purely financial (in form of a payment obligation). (SEB, 2006)

Letters of credit are products which similarly reallocate risk between the parties of a trade and their respective banks. In general, this is accomplished by a written contract issued by a bank on behalf of one party, stating that payment will be made should terms and conditions of the contract be met. Consequently, the bank can overtake the buyer’s credit risk. The conditions are generally agreed upon in the initial purchase contract, and commonly include requirements on providing paper documentation for a multitude of proceedings. The letter of credit is a useful product if a corporation conducts trade with counterparties in relatively unstable regions of the world. (SEB, 2014)

The infrastructure and processes necessary to issue a trade finance product can be referred to as a trade finance platform or network (used synonymously throughout this thesis), visualized in figure 3.1. In this network, the importer and exporter’s respective banks, as well as customs, insurers, transporters and document couriers are all involved. Together, they manage shipment, financing, payments and risk mitigation between the end parties as per figure 3.1 below.

Figure 3.1: Traditional Trade Finance processing



Source: The Boston Consulting Group, Digital Innovation in Trade Finance (2017)

Banks' involvement in the trade finance platform is largely reliant on communication via the interbank messaging system SWIFT. In Swedish trade and export finance operations, relatively nascent online systems have gained traction. The new systems allow banks' clients to apply for a trade finance product online. (Dab et al., 2016)

Today's traditional process of issuing trade and export finance products requires manual labour and physical handling of paper in several of the necessary steps (Dab et al., 2016). The application for a guarantee is commonly sent to banks via email or by traditional postal service. The application is reviewed by an employee at the trade finance department manually (McWaters, 2016). If the application is correctly signed and the necessary documents are attached, such as a copy of the purchase agreement, the process of issuing the product can start (SEB, 2014).

An up-to-date sanctions lists and anti money laundering (AML) registries must then be inspected. If there are no matches in these lists and the know your customer (KYC) documentation is correctly filed, the issuing can proceed. (Dab et al., 2016) Commonly, the majority of processing of sanctions, AML and KYC is manual (McWaters, 2016). Further, the bank must ensure that the client wishing to issue the trade finance product has enough credit. Then, the terms of the contract regarding the product are agreed upon and the actual contract for the product can be written. This is also commonly done manually, and the document may need to be inspected by several colleagues depending on the routines of the bank.

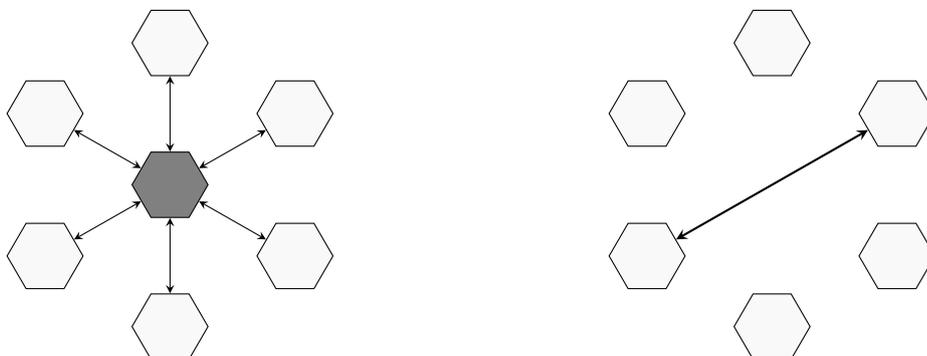
### 3.3 Types of networks

There exists several types of networks in and between banks and stakeholders involved in a trade finance transaction. Networks are necessary to enable for transactions to happen, by simplifying the process of ownership change of payment and goods and allowing for other communication. The following section summarizes the common types of networks and describes their functionality and properties.

#### 3.3.1 Traditional networking

In a traditional centralized network, a trusted third party acts as an intermediary between the network members. The third party is responsible for reconciliation, accounting and safekeeping. (Mills et al., 2016) A bilateral transaction can surpass the central counterparty. It is instead reconciled solely by the involved parties. (Steigerwald, 2013)

Figure 3.2: A centralized network (left) and a bilateral transaction between two parties (right).



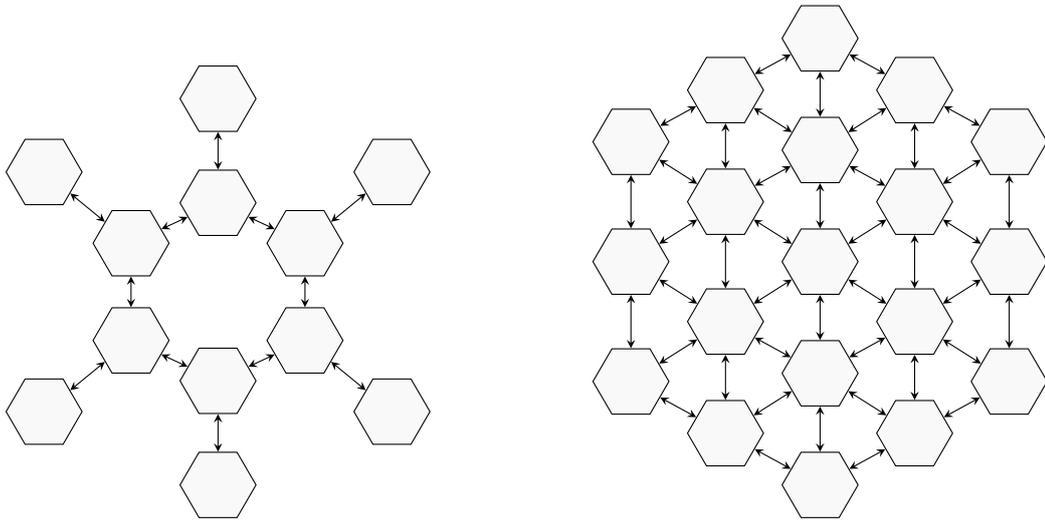
Source: Federal Reserve Bank of Chicago

### 3.3.2 DLT networks

In its most basic form, a distributed ledger is a shared database that can be updated independently by every member of a network. By distributed ledger technology (DLT), the authors refer to combinations of peer-to-peer networking, cryptography, and these distributed data records. Distributed ledger technology enables recording, sharing and synchronizing of data across a distributed network. As a result of this, every member of the network (also known as nodes) has a record of all transactions. (Mills et al., 2016) The blockchain technology on which Bitcoin is based is an example of a distributed ledger technology (Benos et al., 2017).

In a distributed ledger technology network, the nodes are connected such that information is not only collectively maintained and shared but also necessarily validated by all connected nodes in the network. Traditional databases are generally different to distributed ledgers since they are most commonly centralized around a single hub that controls and validates transactions. (Mills et al., 2016) Disintermediation of the central party is referred to as decentralization. Allowing multiple nodes a copy of the ledger is referred to as distribution. An illustration of a simple decentralized network and a distributed network can be found in the below figure.

Figure 3.3: A decentralized network (left) and a decentralized, distributed network (right).



Source: Federal Reserve Bank of Chicago

#### Differentiating properties

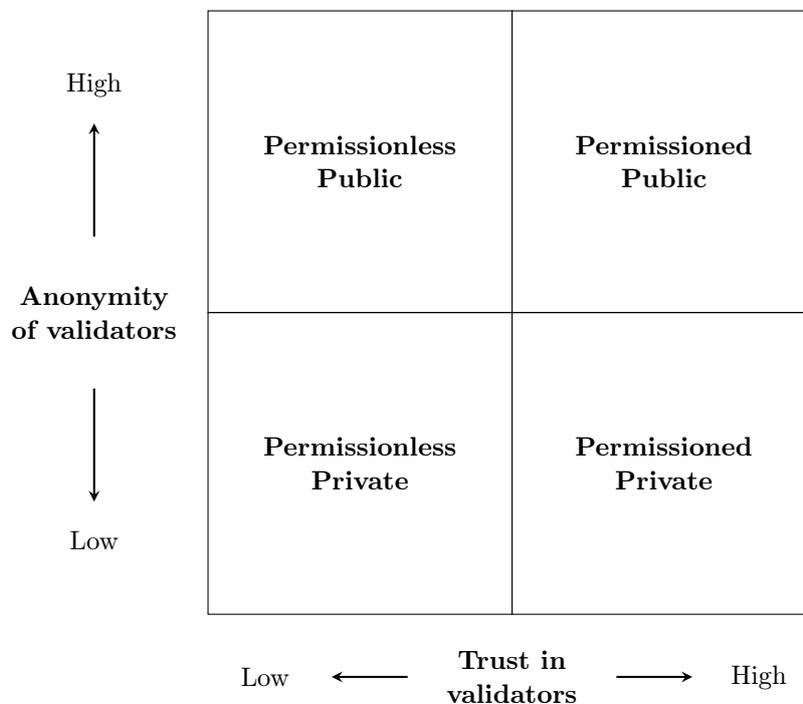
Distributed ledgers have multiple use cases. First, they enable a single agent to efficiently keep information stored across multiple locations in order to, for instance, reduce operational risk. Second, DLT may be used in a network including several nodes belonging to actors for different companies to allow for seamless peer-to-peer communication within the network. (Mills et al., 2016) Cryptography is used in order to ensure authenticity of transactions in a DLT network. A node owns a private key by which it can sign outgoing transactions. The remaining nodes validate that node's outgoing transactions using their public key. The encryption is commonly done using a so-called trapdoor function (or a similar alternative). (Piccolo, 2017) The value of this function is easy to compute in one direction, however is almost impossible to invert. This provides the desired functionality.

Due to its peer-to-peer properties, distributed ledger technology places computational requirements on all participating entities' nodes. If one node provides less computational power than the others,

the performance of the network is affected. The owners of a network may therefore decide for access to be restricted or closed for entrants, in contrast to for example the Bitcoin network that is open for anyone to join. (Mills et al., 2016)

Furthermore the network can decide on permissions for individual nodes in order to restrict their ability to perform certain actions. For example, a peer-to-peer network of banks would likely require such restrictions to inhibit a node from viewing internal transactions in another bank. One of the current challenges in designing such networks is thus privacy for its members. While blockchain and cryptocurrency arrangements are commonly permissionless and open, the financial sector generally anticipates for prospective applications of the technology to be both (at least partially) permissioned and closed. (Mills et al., 2016) Distributed ledger networks are commonly categorized as either public or private. Also, networks can be either permissioned or permissionless. (Hancock & Vaizey, 2016) The choice of network type for a given scenario depends on the intended function of the network. Further, the level of trust and anonymity of validators in a DLT network is also important to consider. The below figure describes the key differences between the different types of DLT networks.

Figure 3.4: Permissioned vs public, permissioned vs permissionless networks



Source: Blockchainhub

# Chapter 4

## Literature review

*This chapter specifies the conclusions drawn in earlier research on the chosen topic. Initially, the most relevant academic research is summarized. Subsequently, the most relevant commercial research is recapitulated.*

### 4.1 Academic research

For clarification purposes in the results and analysis sections, the journals covered in this section and the following, *Commercial research*, were coded with letters a through v.

#### 4.1.1 General use cases, advantages, disadvantages, challenges

An overview of the general use cases, the main advantages and challenges related to DLT, focused on but not limited to the banking sector, are presented by the research articles below.

##### **Guo & Liang (2016) (a)**

In their journal *Blockchain applications and outlook in the banking industry*, Guo & Liang (2016) argues that the blockchain technology has promising application possibilities in the banking sector and that it could be a suitable technology to utilize in order to transform the mentioned sector. By reviewing the technology the authors present what they believe to be some of the best use cases as well advantages and challenges with the technology. Lastly Guo & Liang (2016) presents a recommendation which is to establish regulations and industry standards necessary to implement DLT across the sector.

Guo & Liang (2016) are optimistic when describing the blockchain technology as might having the potential to fundamentally transform current operations in financial institutions. Further, the authors see the following areas as the most important use cases:

- payment clearing and settlement
- point-to-point payments
- supply chain finance
- credit information handling thanks to more efficient data usage

Continuing on, Guo & Liang (2016) sees several advantages with blockchain technology when adopting it to the mentioned use cases. They compare a potentially blockchain based banking

operations with present operations that are, to a large extent digitally influenced, and what they call traditional banking operations. According to the authors, the main advantages are:

- Enhanced customer experience
- Increased efficiency
- Decreased costs partly due to increased automation
- Increased safety partly due to distributed data storage
- Reduced manual operations risk in trade finance due to automation

As an example of these advantages, Guo & Liang (2016) states that the cost for cross border payments to and from the US could decrease by 42%, from USD 26 to USD 15.

The authors point to some of the challenges that needs to be dealt with before adopting blockchain in the mentioned use cases. These are:

- Cooperation between stakeholders
- Possibility to achieve disintermediation. The authors argue that some level of centralized will be necessary in the financial sector in a foreseeable future due to for example regulations
- Speed of transactions in blockchain needs to increase
- Need for regulations of blockchain and DLT based operations and industry standards

#### **McLean & Deane-Johns (2016) (b)**

Similar to what Guo & Liang (2016) did in their journal, McLean & Deane-Johns (2016) presents their view on the best use cases for DLT, its main advantages and challenges in *Blockchain's potential of transforming business and its legal and regulatory implications*. The authors conclude that the main use cases are financial services, within for example settlement, but also asset registers, by introducing a ledger which can record, track and validate assets. When focusing on the applicability of the technology within the financial services, McLean & Deane-Johns (2016) mentions the following parameters as the main advantages.

- Cost savings
- Efficiency enhancements
- Increased transparency
- Reduce fraud
- Assist with compliance
- Reduced settlement times for transactions

When presenting the main challenges, the authors present similar aspects such as Guo & Liang (2016) with the addition of some aspects.

- Need for updated regulatory framework
- Limitation in scalability
- Lack of mainstream understanding for the technology itself and the technical skills to identify use-cases better
- Readiness, in the sense that all data that would need to be digital isn't
- The need for increased collaboration
- Standardization

- Interoperability between ledgers to increase usability of the technology
- Reputational damage of DLT based applications which doesn't work successfully

Further, McLean & Deane-Johns (2016) discusses relevant regulatory challenges such as determining who regulates an operation that is decentralized and to a larger extent than today cross-boarder influenced.

McLean & Deane-Johns (2016) conclude that DLT has great transformatory potential for several business sectors, but take a more critical view on the technology than many others. Their conclusions suggest that while decentralization may be beneficial in some scenarios, it is probable that a variety of centralized intermediary functions cannot simply be replaced by the technique. In the end, a rigorous analysis of the risks, cost and benefits involved with the implementation is concluded to be necessary such that the results do not underwhelm.

### Tapscott & Tapscott (2016) (c)

In *Blockchain Revolution - How the technology behind Bitcoin is changing money, business, and the world* (Tapscott & Tapscott, 2016) presents a comprehensive review on the usability of blockchain technology. In the first chapters of this book, the authors present and describe the technology itself. Then, the best usability of the technology today is considered, and the advantages and disadvantages of the DLT in general terms are identified. The challenges remaining are stated, followed by a prediction of the future for blockchain and DLT.

Tapscott & Tapscott (2016) emphasize the importance that blockchain technology can have as a means to ensure trust in transactions and in recorded information unconditional on other stakeholders. Unlike, for example, today's trade finance operations, which is to a large degree based upon a low or non-existent level of trust between seller and buyer. Continuing, the authors present what they believe to be the main benefits of implementing blockchain technology, which are:

- Increased speed in transactions due to the potential of pier-to-pier automation
- Reduced costs partly due to eliminating redundant intermediaries
- Increased efficiency
- Reduced risk due to minimized number of human errors
- Increased security as trust is ensured by the technology
- Reduces energy consumption
- Increased privacy protection

Tapscott & Tapscott (2016) does also emphasize that there exists challenges aswell. First of all and similar to what McLean & Deane-Johns (2016) mentioned is understanding. More specifically, the lack of understanding or even awareness of blockchain technology, let alone DLT. This is a major hindrance for further development of blockchain and DLT according to the authors. Moreover, the authors point at challenges with implementing the technology such as the following:

- The technology is not ready for wide spread usage as for example transactional capacity is currently lacking, legal structure is lacking and a behavioral change is needed
- The energy consumed by running a blockchain based system today (Bitcoin) is at an unsustainably high level
- The usage of blockchain based operations has to regulated and legislated in a way that uncertainty is omitted but at the same time doesn't suppress the purpose of the innovation.
- Few powerful corporations could try to become dominant and capture the value of the technology and hence limiting the benefits of the technology to society.

- The incentives for a distributed mass collaboration are currently insufficient.

As a last note in this book, Tapscott & Tapscott (2016) presents the different types of blockchain based networks.

#### Natarajan et al. (2017) (d)

In their article *Distributed Ledger Technology (DLT) and Blockchain* Natarajan et al. (2017) has a similar structure as Tapscott & Tapscott (2016). The authors present the key features of DLT, key advantages with the technology, challenges and risks related to it and lastly applications of DLT and how the technology can be leveraged by the World Bank and the financial sector as a whole.

When presenting the key advantages, DLT is compared to centralized and in other ways shared ledgers. The authors note that generalization is difficult due to the variety of the formation and usage of blockchains and DLT but still concludes what the key advantages of DLT are. Namely,

- greater transparency and easier auditability
- automation and programmability
- immutability and verification
- gains in speed and efficiency
- cost reductions
- enhanced cybersecurity resilience

When addressing the challenges and risks with this new technology, Natarajan et al. (2017) emphasize that it is still unclear whether DLT application will generate advantages over current procedures and if yes, in which parts of the banking sector. Further, the authors conclude that the gains are likely to be incremental rather than instant. The authors have compiled what they claim to be the most commonly cited challenges regarding DLT and they are the following:

- Lack of maturity of the technology as it is still in a development stage which implies questions regarding the robustness of the technology for transactions of large volumes.
- Scalability and transaction speed
- Interoperability and integration between different DLT systems
- Cybersecurity will always be an issue for software
- A governance structure regarding DLT has to be formed
- Forming industry standards, increase legal clarity and comply abide current requirements such as KYC (Know-Your-Customer) and AML (Anti-Money Laundering).

Lastly, Natarajan et al. (2017) concludes that there are multiple potential application of DLT in the financial sector. Such as, payment authorization, clearing & settlement, foreign exchange and micropayments but also as a means to replacing internal ledgers recording information across different departments and subsidiaries, otherwise maintained by external corporations.

#### 4.1.2 Frameworks for adoption

In order to analyze the rate of adoption of DLT, one could use existing frameworks. For example one that compares the adoption of DLT to the development of currently wide spread technologies.

**Iansiti & Lakhani (2017) (e)**

This is something that Iansiti & Lakhani (2017) has done in their article *The Truth About Blockchain* as they compare the development of DLT with the development of the internet using a framework presented in the article. The framework entails four different phases that a technology can be determined to relate to. The phases are labelled the following by the authors:

- single use, which has a low degree of complexity and novelty
- localized use, which has a low degree of complexity but high degree of novelty
- substitution, which has a high degree of complexity but low degree of novelty
- transformation, which has a high degree of complexity and novelty

In the case of the internet it took 30 years to go through all four these phases, from single use in the U.S Department of Defense to providing the opportunity for transformative innovations such as Google or Ebay to succeed. In the case of first application of Blockchain, Bitcoin, the authors claims that it can be identified as having a single use purpose. Iansiti & Lakhani (2017) stresses that by using the framework to identify which phase a certain blockchain innovation relates best to, the challenges that exists in terms of adoption of the innovation will become apparent, the level of collaboration necessary and type of legislation needed.

Conclusively, Iansiti & Lakhani (2017) argues that the technology holds significant potential but a wide spread application is relatively far away as it what the authors refer to as a "foundational technology" and not a disruptive technology. The authors points out that some of our main barriers of entry in the financial sector, such as technological, governance, organizational and societal, will have to be overcome in order for this technology to be widely used. Thus, it is wise to be realistic and reflective about blockchain by showing careful consideration to the apparent risks and engage in the technology in a small scale initially.

**Lai & Lee Kuo Chuen (2018) (f)**

In their book *Handbook of Blockchain, Digital Finance, and Inclusion* (Lai & Lee Kuo Chuen, 2018) aim to provide guidance when deciding to implement blockchain to a given business situation or operation. In the first part of the relevant section of the book, the authors present the technology itself and the different types of blockchain that exists. By compiling the characteristics, advantages and challenges with DLT, the authors present a framework, useful to analyze the potential of blockchain technology in given situations. Similar to the framework presented by Iansiti & Lakhani (2017), this one consists of different steps that act as a checklist to evaluate the situation. These steps are:

- Decide if Blockchain is the Right Solution for the Problem. Blockchain is not a solution for a large amount of issues. However, where it has potential to be effective, Lai & Lee Kuo Chuen (2018) argues that it will be much more efficient than existing solutions.
- Assess the benefits and admonitions. If one has concluded that blockchain is plausible as a solution to one's issue, one must decide if the advantages outweigh the disadvantages.
- Assess the technical design considerations after one has established that implementing blockchain technology is a suitable and beneficial
- Consider how the functional design should look like in this stage
- Before one implements the technology, Lai & Lee Kuo Chuen (2018) stresses that one should take into consideration the challenges that comes with implementation. Most of these are non-technical, such as regulatory, corporate policies and privacy issues. These should be dealt with prior to implementation

Much like Iansiti & Lakhani (2017), the authors stresses the importance of having an as objective view as possible of the potential of blockchain. Further, Lai & Lee Kuo Chuen (2018) emphasize that when evaluating blockchain one must not focus on what issues that blockchain can solve but rather focus on the present issues and then potentially apply blockchain if suitable.

### 4.1.3 Diffusion of innovation

Rogers developed theories regarding how and why innovations spread, and modelled the rate of technological development in his famous work "Diffusion of Innovations". Since DLT is seen as a potentially disrupting technology (Davidson et al., 2016), DLT makes for an interesting innovation to study in terms of Rogers' models.

#### Woodside et al. (2017) (g)

Woodside et al. (2017) has conducted such a study focusing on blockchain and bitcoin, using a so-called PEST analysis (political, economic, social, technological factors) and summarized the results in terms of drivers and drawbacks. The conclusions drawn suggest that the main political driver is the transparency that DLT can provide, while the political drawback is the regulatory status. Further, the economic factors suggested are cost benefits and volatility issues. The social factors are concluded to be primarily the drawbacks in privacy and security, while the technical drivers identified are reliability, durability, protection against fraudulent transactions and drawbacks such as processing time issues, and integration issues.

The author further uses text analytics to analyze the diffusion of innovation for blockchain. This was done by evaluating the occurrence of keywords in annual reports of large-sized U.S. companies. Last, financial analysis of the blockchain growth was used to triangulate and draw conclusions regarding the current position of the diffusion of innovation. The summary places blockchain in the innovators category in three of three cases. The financial analysis suggests that blockchain may be on the verge of moving to a classification of "early adopters".

#### Collomb & Sok (2016) (h)

Collomb & Sok (2016) presents the key differences to today's financial markets and potential DLT-based markets in terms of paradigm, architecture, database, security and price/cost. The article also provides an overview of blockchain technology in terms of its multi-faceted potential and use cases in a financial setting. The conclusions drawn in the article are:

- Given the fact that a multitude of initiatives are being heavily invested into (e.g. in payments and international transfers), DLT is likely to prosper and have significant impact on both e-commerce (in the upcoming decade) and the economy as a whole.
- The application of DLT must be analyzed based on how the technology is used. We must analyze what is specific for DLT - not just for IT improvements. An example described by the author is as follows: while DLT can be used as a database for storage of data, that is a completely different scenario than using it in a blockchain-enabled application.
- One must not forget that important mechanisms of public distributed ledgers are lost in a private setting.
- The technological debate distributed ledgers initiated by the introduction of blockchain forces organizations to reflect on how it may affect their future just like the internet did in the late 1990's.
- It is too early to draw conclusions on interoperability and scalability. Private blockchains still require more research on how to design appropriate consensus mechanisms.

- Key issues for efficient large-scale networks today are governance, standards and interoperability. Also, systems must allow for adaptations due to potential new or modified regulatory adjustments.
- In places where DLT may see future implementation, for example in post-trade settings, the infrastructure in place is complex and reliant on legacy systems. The conclusion drawn is that DLT integration is relatively easy in niche settings such as low-frequency trading on a private market, but that it is much harder to implement in post-trade. Further, there is no margin for error in the majority of financial systems (Collomb & Sok, 2016), which also raises issues for new technology implementation.

#### Davidson et al. (2016) (i)

In *Economics of blockchain*, Davidson et al. (2016) focus on how historical economic research relates to distributed ledgers, and how economics can impact the diffusion of the technology. One way to look at the economics of DLT is concluded to be that it is an innovation in the process of adoption and diffusion through the economy, as defined in Schumpeter's theories. While DLT in some ways emphasizes disruptiveness in markets and industries, the authors dissent that it simultaneously competes with firms, markets and economies in coordinating the actions of groups of people. As a closing example of such a situation, the authors refer to a case study of the Ethereum-enabled platform Backfeed that is completed in the article. Backfeed is concluded to be a case of how blockchains can establish their own, new types of economies.

#### Ito et al. (2017) (j)

Ito et al. (2017) discusses the potential disruption of blockchain and the similarities with the development of internet technology. Ito et al. (2017) emphasizes how important the early stage of the development of the internet was, when its robustness and effectiveness could be improved without any commercial ambitions. Blockchain on the other hand has emerged with Bitcoin, a commercial use, whereby the authors stress the need for research and experimentation of the technology among companies in order to embrace the blockchain technology in the best way possible.

### 4.1.4 Business models

Several researchers (Maull et al., 2017; Zamani et al., 2018) investigate how blockchain and DLT could evolve into a disruptive technology in terms of companies' future business models.

#### Maull et al. (2017) (k)

The disruptive potential of blockchain and DLT is considered by Maull et al. (2017), who contribute to this debate in *Distributed ledger technology: Applications and implications*; an investigation based on qualitative interview data and a workshop with industry members. The interviewees were members of the core developer teams of Bitcoin and Ethereum. An extensive overview of the features of DLT lays the groundwork for the authors' model of its disruptiveness. The paper further describes the future problems that need to be resolved for DLT to become more widely applicable, establishing that an important part of future research lies in the investigating synergy between the evolution of new technology and the companies' business models.

A lot of questions remain unanswered, the authors conclude. The authors' main concerns are fundamentals such as how to resolve permission issues and network governance, and other issues such as the number of DLTs and how each one will interoperate and affect existing economic structures. Lastly, an important question is said to be what the early indicators are of the technology's

disruptiveness, and when a potential "tipping point" is reached. It is asserted that the questions raised are key to both the technological development of DLT and to the future structure of the economic system.

#### **Zamani et al. (2018) (1)**

Further, Zamani et al. (2018) add to the debate on disruptiveness of DLT. *Distributed Ledger Technology and Market Disintermediation* is a conceptual, argumentative paper drawing on commerce research, and theories in economics and disruptive innovation. It analyzes previous studies of synergy between cryptocurrencies, machine-to-machine (M2M) commerce and the Internet of Things (IoT). The areas examined are analyzed cross-sectionally such that conclusions can be drawn on the effect of putting trust in a decentralized network. The claim is that such an investigation is important in a time where many regulatory issues prevail, while the technology is likely to impact companies' future business models. The authors identify three areas where it is considered probable that DLT will be used in the future:

- As standalone applications
- As autonomous economic agents
- In leading the evolution of decentralized autonomous corporations

In terms of market disintermediation, the authors consider the most likely outcome to be that new kinds of intermediarization will develop in establishing and performing blockchain-based economic transactions. The authors further claim that complete disintermediation is much less likely. The hindering factors are considered to be mainly the following:

- Inherent technological risk
- Infrastructure requirements
- Reluctance of early decision makers
- Lack of skills and competencies.

## **4.2 Commercial research**

Many commercial actors could be significantly affected by the availability of DLT solutions in the future. Both the companies' own businesses and their clients' businesses could see major changes. (Zamani et al., 2018) Therefore, some actors have executed studies on the topics of blockchain, DLT and surrounding topics relevant to this paper (Dab et al., 2016; Chandrashekar et al., 2016; Deloitte, 2017). The commercial research is presented in the below section.

### **4.2.1 Consultant firms' research**

Many firms have issued their analysis on DLT and its impact on banks and trade finance. The following section summarizes some additional consultant firms' key figures and conclusions on the topic.

#### **Chandrashekar et al. (2016) (m)**

Chandrashekar et al. (2016) conclude (on behalf of the consultant firm Capgemini) that the banking industry is currently faced with a situation where their customers, both individuals and companies, are more connected and exposed to digitization than ever before. The banking industry lags many

other industries in this aspect, hence the rapid expansion of Fintech companies. Thus the authors conclude that, in the near future, adopting new technology such as DLT, Robotic Automation and Biometric Authentication but also engaging in new collaborations with for example FinTech companies are some of the trends that will be most important in the banking sector. Chandrashekar et al. (2016) further discusses that these engagements will have consequences for banks' operations which entails other necessary priorities such as investing in more sophisticated cyber security systems.

#### **Piscini et al. (2017a); Deloitte (2017) (n)**

Deloitte (2017) discusses the outlook of the banking sector in their annual report Banking Industry Outlook, compiled by the Deloitte Center for Financial Services. They concluded that there are a number of vital areas which needs attention in order to achieve results in the long run. One of the most vital long term priorities for banks, according to Deloitte (2017), are to shift focus from products and services to the customers and thereby generate a long-term growth that is sustainable. Other means of creating sustainable long-term growth in banking is to capitalize on the new technologies emerging and thus increasing agility. Closely related to this, the authors mention that a regulatory recalibration will be needed to focus on as well as an increased protection against cyber risk. The workforce will also become an important priority for banks as adopting new technologies will likely result in increased automation of operations.

Even though Blockchain technology is becoming more and more popular, Piscini et al. (2017a) points out that the main criticism of the technology today is regarding security, scalability and sustainability. Piscini et al. (2017a) discusses the second concern, security of the Blockchain. They conclude that, as for the adoption of any new technology, implementing a rigorous security system is of importance when looking at implementing Blockchain technology. However, the authors also emphasizes that one must not focus solely on cyber security in these situation. Other key aspects to consider mentioned by the authors are regulations, technology architecture, operations.

#### **EY (2017) (o)**

EY (2017) has conducted a survey where they asked senior executives in 221 banks in 29 different markets about their view on the strategic priorities and financial performance over the coming 1,5 years. The authors conclude that although costs are generally expected to rise within the mentioned time period, the revenue are expected to rise as well. The authors further conclude that this is where many of the leading banks globally will have their focus the coming years, improving results by optimizing operations, which is aligned with what above mentioned articles state. The authors also claims that another challenge that banks will have to face during the coming years is the changed customer behavior and hence entrance of new competitors such as FinTech and e-commerce firms. The banks will have to adopt new technologies and become more innovative in order to meet these new behaviors. According to the authors, customers want simpler, more personalized and transparent solutions. Increasing digital maturity levels is a priority that banks will generally be looking at in order to meet these new customer behaviors. For example investing in cloud technology, mobile technology and increased data analytics. Another aspect the authors emphasizes in regards to the aim to increase digital maturity is the need of a so called banking ecosystem, collaborating and with peers and partners better in order to develop new solutions that will lead to more efficient operations.

#### **Accenture (p)**

Accenture has issued two reports where the focus is on DLT in investment banks and capital markets. Some conclusions, however, are interesting to note.

Treat et al. (2015) presents an adoption timeline for DLT:

- 2015 - Exploration and investment
- 2016-2017 - Early adoption
- 2018-2024 - Growth
- 2025 - Maturity

The report Treat & Brodersen (2017) released in 2017 suggests that actors in the capital markets could see a 30% (or more) operational cost saving with implementation of blockchain technology. The report lists the benefits and challenges similar to reports from other consultant reports.

Four important regulatory questions are also raised:

- How will standards be created, and by whom? As the technology matures over time, how will new standards be changed and adopted to keep pace with the technology?
- How will governance models be structured? How will expectations around these functions shift in an environment where group consensus is key to success?
- What regulations will apply to assets that are transacted both on and off chain? Will regulators accept a bifurcated market?
- Will rules need to be amended or created to balance privacy and transparency in a way that is acceptable to regulators?

## BCG (q)

BCG has issued a report on digital innovation within the trade finance industry. In this report, Dab et al. (2016) map what trends that currently exists within digitization of trade finance operations, what implications these innovations could have and what it takes to make trade finance operations overcome current operational shortcomings such as inefficiencies. Naturally, Dab et al. (2016) covers more than just DLT in this report but still concludes that DLT could live up to the hype that is has been apparent for some time.

What follows are some conclusions, estimations and statements found in the report.

- Dab et al. (2016) approximates that the total revenues for banks alone within trade finance are currently \$36 billion. Further, they predict the revenues will grow faster than trade flows, at 4.7% annually. To realize this the stakeholders have to become more digitized.
- As previously concluded, trade finance operations are very labor and paper intensive. According to this report, approximately 4 billion papers are printed annually in the industry.
- A process of ordering and generating a product within trade finance, point-to-point process, can be segmented into several interactions, from creating value adding data to simply signing off information. Dab et al. (2016) estimates that in one point-to-point process, 5000 interactions are made but only 1% of these create value adding data.
- Stakeholders in trade finance are corporations, banks, governing bodies, facilitators and disruptors (such as FinTech or AI-tech companies).
- As the disruptors becoming a threat to various stakeholders within the trade finance operations, the ones previously not interested in adopting modern technology is starting to reconsider these standpoints.
- Dab et al. (2016) states that previous attempt to digitize operations have not been successful partly due to large initial investments. So large that costs have had to be reduced by 20% in order to break even according to a bank.

- Regulatory compliance in trade finance means, at least for banks, for new technologies to comply with Know-Your-Customer (KYC), Anti-Money-Laundering (AML) and current sanctions.

Dab et al. (2016) concludes in this report that the trade finance industry could see significant cost and time savings related to an implementation of a DLT platform. Such as:

- According to Dab et al. (2016), adopting a DLT platform such that all stakeholders can transfer title, shipping and documents through a secure network which is distributed could imply reducing processing times from seven to ten days to four hours.
- Disruptors are interested in all aspects of the trade finance operations, trying to generate earnings by introducing new and efficient alternative solutions. For example a DLT based register of all containers globally, to minimize transport of empty containers, which are estimated to be 35% and 45%.

Further, BCG concludes that an introduction of for example a DLT platform in trade finance could generate a greater demand for these products as small and medium sized enterprises (SMEs) will be able to afford these products. Moreover, BCG states that a challenge for banks is the wide spread lack of interest in digitization from their large clients. Lastly, BCG estimates that a digitized trade finance could generate cost reductions of about 35% over a 3 to 5 year period driven by the digital innovations mentioned. Apart from these cost reductions, BCG approximates that revenues could increase by 10% as well.

### **Infosys (r)**

The information technology specialist firm Infosys' report lists the key attributes of blockchain and lists its uses and benefits in trade finance:

Uses in trade finance:

- Real-time multiparty tracking and management of letters of credit, bank payment obligations, open account instruments
- Debt servicing, insurance, factoring
- Receivables financing
- Commodities trade finance
- Decentralized contracts execution
- Document preparation services (trusted private e-doc exchange, real-time review, approval of documents)
- Interaction between import and export banks (eliminate correspondent banks)

Benefits in trade finance:

- Real-time review of approval of financial documents and reduced shipment initiation time.
- Reduced counterparty risk. Bills of tracked by DLT and elimination of double spending.
- Transparent factoring, invoices on DLT give transparent and real-time view of short term financing.
- Disintermediation by removal of correspondent bank
- Transparency and proof of ownership and location of goods
- Decentralized contract execution by smart contracts with status updates in real-time. Reduced time and effort required to monitor goods delivery.

- Regulatory transparency of essential documents benefits AML and enforcement.

## 4.2.2 Banks and FinTech developers' research

### ADB (s)

The Asian Development Bank (ADB) has also issued a report on trade finance. More specifically on how a specific trade finance program can be used to lift the obstructions to trade that exists. Further, ADB present its view on the importance of digitization of trade finance operations but also the challenges that comes with such a renewal of existing operations. What follows are some of the assumptions and conclusions that ADB has specifically about DLT in trade finance.

- ADB approximates that the global trade finance industry is worth USD 10 trillion annually.
- ADB argues that there exists a positive correlation between increased trade finance products used in a company and the increased number of job opportunities.
- The main obstructions to having more efficient trade finance operations in general is regulations and risk according to ADB.
- An advantage of DLT in trade finance not commonly discussed is what ADB mentions about documents. Namely disputes over documents that occasionally occur will vanish.
- The fact that a new DLT platform will include stakeholders in different countries with different levels of development poses an issue as less developed countries are generally still very dependent on paper-based business operations, ADB concludes.
- Smaller banks should see FinTech companies as potential partners in order to be able to keep up with the larger banks that lead the digital transformation in trade finance.

### IBM (t)

IBM have issued several reports on the applicability, challenges and opportunities for distributed ledgers. The point of focus for the reports is friction. Banks experience friction in manual processes and in the complex requirements on management and tracking of transactions. One example is stated to be letters of credit, that include multiple parts and are generally paper-based. Small enterprises that do not have credit sources may be particularly affected by this type of friction. The company concludes that with the removal of manual input, actors in the market can streamline their processes and leverage the technology to increase margins. Additionally, distributed ledger technology can help actors offer new products and services in less time, reach out to new client segments and avoid increasing risk while doing so.

Blockchain systems would likely aid in automated back-up of important information such as contract details. Further, trade logistics would be easier to coordinate as information is available through the integrated real time network. IBM is developing solutions such that ledger transactions connect small enterprises through a trusted bank. The company estimates that 50% of small and medium enterprises (SME's) miss the financing they need. This creates a credit gap of approximately USD 2 trillion. Larger enterprises can use the company's technology in transaction tracking.

IBM reports include information on what parts of the economy are considered the most likely to be disrupted by DLT. Additionally, the company discusses the properties it considers that a DLT solution needs to have. The most important barriers are presented, and the company draws similar conclusions to others on these topics. Conclusively, it is said that DLT will likely create new business models and force changes to existing ones.

### World economic forum (u)

The World Economic Forum (WEF) issued a report on the future of the financial infrastructure. It is one in a series of reports on disruptive innovations in the financial services. More specifically, with this report WEF aims to investigate what potential distributed ledger technology has in terms of transforming the financial services industry and thus complement existing research on how financial services can be redefined. The report covers several use cases of DLT in financial services and how to overcome the most imminent obstacles regarding implementation.

Some of the key findings that WEF found was that:

- DLT itself will not solve all the issues and malfunctions of current trade finance operations but rather as part of a future solution and next generation trade finance platform. Along with biometrics, cloud computing, cognitive computing (AI), machine learning, quantum computing and robotics.
- A more highly developed digital identity and/or other digital innovations such as digital fiat currencies will increase the usability and benefits of the DLT platform even further.
- A new DLT platform will most likely question assumptions and standard procedures acting as a foundation for the current business operations of trade finance. Such as the low level of or non existing degree of transparency increases regulations on financial institutions. The transparency of a DLT platform could increase cooperation between regulators and the financial institutions.

Further, WEF concludes that important characteristics of high-potential use cases are areas where there are shared repository, multiple writers, minimal trust, multiple intermediaries and transaction dependencies. Amongst several use cases, WEF mentions that DLT in trade finance could imply managing letters of credit (L/C) via smart contracts which would automate and simplify the process. Further, a DLT platform could alter or even eradicate the role of correspondent banks as financial institutions could communicate with each other directly. However, WEF points at challenges with implementing a DLT based trade finance platform such as the uncoordinated regulatory climate and claims that an unanswered question is the pricing levels. WEF wonder what the impact on the financing fees will be as corresponding banks will become less significant to the trade finance operations.

### European Banking Association (v)

The European Banking Association (EBA) deduce that cryptotechnologies (blockchain, DLT) has a transformatory potential in trade finance. It states that since open account trading has grown significantly, banks and corporates demand solutions that remove today's troublesome processes. Adoption of the technology will likely happen gradually and in niche cases to begin with. The two most likely use cases are seen as the exchange of trade data and financing.

Cryptotechnologies can aid in the approval and matching of documents, execution of payments, and facilitate transparency and data access in the value chain, the EBA says. It can thereby enable equal terms for all actors in the market and increase speed, efficiency and security between all parties: buyers, sellers and their respective banks. Improved methods of assigning credit ratings and risk is concluded to possibly result in more advantageous financing agreements for both buyers and sellers. The conclusions drawn by EBA on the remaining challenges are legal/regulatory issues, confidentiality issues and stability. Meanwhile, the benefits of cryptotechnologies are considered substantial should the issues be overcome.

# Chapter 5

## Results

*This chapter presents and summarizes the empirical results of the conducted investigation. The chapter commences with a recapitulation of the interviewees. Then, the interview results are presented in the form a table of quotes in different themes.*

### 5.1 Interview assessment

For clarification purposes in the results and analysis sections, the interviews were coded with numbers one through six as per the below table.

Table 5.1: Interviewees and their positions

Name	Institution	Position
1. Björn Segendorf	Riksbanken	Researcher, Department of Financial Stability
2. Johan Toll	Nasdaq	Associate Vice President Product Manager Post Trade
3. Ville Sointu	Nordea	Head of DLT & Blockchain
4. Paula da Silva	SEB	Head of Transaction Services
5. Bernhard Szablowski	Swedbank	Head of Global Transaction Services
6. Stefan Carleke	Handelsbanken	Head of Trade Finance Sweden

The interviews were transcribed and quotes on similar themes were grouped and summarized into the below table. The initial focus was on identifying key incentives and issues regarding DLT adoption in banks in general and trade finance specifically. This information was then used in the cost-benefit analysis. Then, focus shifted to the fundamental trends and factors identified as common among the interviews and long-term consequences of the development of distributed ledgers. These trends, factors and consequences will be used as a basis for a PESTLE analysis of the Swedish financial infrastructure, the barriers of adoption and discussion topics. The interview transcripts can be found in the appendix.

Table 5.2: Interview results

Theme	In. Quote
Incentives	– <i>Backup</i>
	1 "DLT provides an automatic way of backing up information."
	– <i>Simplification</i>
	5 "Internally, some intricate processes could benefit from use of distributed ledgers."
	6 "Customers are satisfied with current procedures but I believe that companies frequently utilizing trade finance products will gradually realize the efficiency enhancement possible in the current, relatively outdated, process."
	"Handelsbanken see great potential in blockchain technology [...] especially as a means to make the trade finance operations simpler and less paper intensive."
	– <i>Automation</i>
	1 "Smart contracts and increased automation could provide important benefits, and in turn reduce transaction costs in back office services, information sharing and financial transaction."
	3 "The main force that drives our research into DLT is one that creates better, cheaper and/or faster services. Distributed ledgers primarily provide these qualities because of automation."
	"Cost savings for a financial network probably lie mainly in the automation that comes with a more democratic and decentralized governance model."
	"The advantage of DLT is all about networking; it mainly enables removal of the notion of intermediaries to shift communication to a peer-to-peer level"
	4 "Since reconciliation is to a large extent manually processed as mentioned, there is a risk of a payment isn't successfully completed or sent to the wrong account. These types of errors will be omitted [by using DLT]."
	6 "Handelsbanken sees great potential in blockchain technology [...] especially as a means to make the trade finance operations simpler and less paper intensive."
– <i>Privacy</i>	
3 "Today, a third party does reconciliation and processing between the two parties. The third party must be trusted by all parties to take good care of data and must display transparency of its intentions, which almost never happens. This creates a honeypot of data. There will almost always exist someone looking to take advantage of such data, which is a weakness of the model."	
– <i>Efficiency</i>	
2 "Continuously developing the [DLT] technology is important but it is even more important to focus on finding inefficiencies in the current operations and other incentives to adopt new technology such as increased end-customer value."	
"Potential areas where DLT could be profitably applied are where the market is fragmented (many intermediaries involved), the operations is currently plagued with inefficiencies and are relatively lightly regulated."	

"These characteristics are found in trade finance, cross-border transactions and the operations behind the trade of mutual funds, collaterals and bilateral contracts at banks."

- 4 "Trade finance operations will definitely adopt DLT since there is so much money in circulation in these operations."

"If utilized correctly, DLT could help us lower costs and become better at utilizing data of the customers."

"There is great potential for DLT [in trade finance] as these operations are based on a complex network of stakeholders which essentially can be translated into a trust issue between the exporter and the importer. This in turn generates heavy workloads for all parties involved and thus big expenses."

- 5 "The main incentives for implementation of a distributed ledger would be efficiency, cost reductions and risk mitigation"

"It is mainly for the smaller products where the surrounding processes require more manual input. There are large potential profitability increases in these processes"

## Issues

### – General

- 2 "I am concerned about the legal and regulatory aspects. Other concerns are information security and business relations."

- 3 "Some of the greatest challenges lie in replicating and providing functions of the current system."

- 5 "The inconveniences they [DLT] bring show up when you start digging a bit."

"There exists a demand for a third party that guarantees money actually exists, which is partly why it is so troublesome when banks encounter problems."

"In Sweden, the deposit guarantee (insättningsgaranti) as well as other societal mechanisms are in place to handle such situations. There are no similar functions in place in case of a scenario where a blockchain fails. Prior to a more widespread implementation of distributed ledger technology in the bank, there is a need for these functions to be acknowledged."

- 6 "At the moment, we are seeing setbacks to the global free trade and as a consequence I believe that this will impede the development of DLT based trade finance solutions."

### – Security

- 1 "We need to study how decentralization will require cyber security to evolve."

- 2 "If blockchain is used to transfer information between members of a network, all data would be shared freely with all members. How can a member of this proposed network be certain that the other members handle the shared data the same way that itself does?"

"If a [bitcoin] transaction is not correctly executed or someone steals your Bitcoins there is no juridical system to utilize in order to correct the mistakes or improper actions made. Such a scenario implies too great of a risk for financial institutions."

- 5 "Must assure that the ledger is near impossible to infringe upon for unauthorized parties."

"We must be able to mitigate certain situations. What if wallet is lost? In real life, we have security solutions in place for a lot of these situations."

"We cannot simply walk into a bank and steal other people's money. We need systems in place such that digital identities and assets cannot be stolen."

– *Performance*

- 1 "Scalability and transaction speed are issues with decentralized solutions; an exponential increase in the amount of information handled with each additional node puts requirements on efficient consensus algorithms."

"Blockchain can handle approximately 300 000 transactions per day (24 hours), [...] whereas there are approximately ten million credit and debit card transactions per day in Sweden."

- 2 "At the moment it is more time consuming to execute a transaction in a centralized network compared to a decentralized network. The key for success in this aspect is being able to handle more transactions in a decentralized network."

- 4 "Today a bank has one to two days to acquire enough credit for a given situation. Reducing this time (to instant) given the requirement to provide available credit for all parties constantly will put immense pressure on the bank."

"DLT in its current form is not ideal for SEB in general due to the speed and capacity limitations. It is better suited for businesses with fewer but more complex transactions rather than many but less complex." (KG)

– *Regulations*

- 1 "Regulations will be an important factor in how blockchain develops in the financial sector. The past has shown that we cannot simply treat blockchain differently in a regulatory sense. Regulations of the system need to be technique-neutral and should fall in place naturally when there is a need for it."

- 2 "DLT in the current operations at banks will likely imply new means of interactions with stakeholders. Hence, existing regulations will have to be altered in order for them to stay up to date."

- 3 "DLT requires the participants to sign a rulebook for the network - a kind of constitution. Thereby, everyone knows what happens in different scenarios in the network. The rulebook needs to be integrated with local law which creates a complex situation."

"The contract law where the system is deployed, as well as mapping the regulatory environment onto the network creates for most of the heavy lifting."

- 4 "As we know, one cannot delete information stored in a distributed ledger. This stands in contradiction to the new regulatory framework, GDPR which says that we have to delete the stored personal information after usage." (KG)

- 5 "This far, the problems lie in the regulations and complex, demanding structures that exist in a bank today."

"Any bank-related event must be documented, and any part of the business that occurs outside the bank must be reported. The authority is generally skeptical towards outsourcing and strict routines for information security are employed such that information cannot leave the European Union."

"Will the regulatory authorities allow us to appoint the responsibilities to a distributed ledger network consensus without a central counterparty?"

"Swedish banks have very specific requirements on them applied by authorities regarding for example knowing their customer (KYC). The blockchain applied by Bitcoin allows for anonymous transactions and is therefore not applicable in a majority of cases."

- 6 "Current regulations have to be updated in order for blockchain-based trade finance solutions to be viable and avoid a situation such as the one seen with Bitcoin, where a significant part of the transactions are illegal."

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**Comparison versus other solutions**

- 1 "In order for a blockchain system to replace a centralized system, it needs to provide some sort of incentives and comparative advantages."

"Permissioned decentralized systems with governance function pretty similarly to current systems."

"Necessity is the mother of invention - there must be incentives along the chain of users to implement the technology."

- 2 "[The major banks in Sweden] have come far in terms of understanding of blockchain and DLT but are still looking for the most profitable applications."

- 3 "The distributed ledger technology itself is not a reason to do anything."

"You still have to do all the work you did before."

"There is a need for integration to law as well as for intermediaries to take certain part of the risk in transactions. In fact, there are not many intermediaries that can be simply removed from the current system."

"The replacing of Bankgirot in Sweden by blockchain or DLT would only be possible if someone administrates the new system. DLT removes the physical database, but still requires for someone to manage the network: an entity who creates the rules, the governance model and does so in a transparent manner."

- 5 "While applications of distributed ledgers in trade and export finance are fantastic, vanilla digitization could be just as good. The trade finance process is very paper-based, and it is a secondary question as to whether blockchain or other digitization is the correct way to evolve it."

"Many, if not all processes in a bank have emerged from a paper-based society. Automation and digitization of these mechanisms is an ongoing procedure that does not have a stable end state."

"It is easy to become fascinated by the technology. We must be aware of the potential issues that may evolve with its implementation."

- 6 "Focusing on implementing blockchain technology in trade finance is to focus on the future development too much and not on increasing customer value and efficiency today."

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**Cost, risk for early adopters**

- 1 "The risks have not been adequately examined yet, which is important to investigate prior to moving valuable assets and information onto a blockchain."

"By letting others explore and encounter the teething troubles, a bank could avoid part of the large fixed cost involved with installing a new IT-system. The IT system of a bank is often complex and large in scale, which makes it hard to handle and replace. This is true for most financial infrastructures, such as those of the Swedish central securities depository from the mid 1980's."

- 4 "There is a relatively high costs of implementing the [DLT] technology today, as its still not in a mature state. This is something SEB has experienced with Ripple, as SEB has not cut costs at all using this new technology."
- 5 "An investment can be costly and incur high fixed costs, but may be worthwhile if it can benefit customer relations and/or a client demands that specific product or service to stay with us."
- 6 "We do not aspire to be the leader of innovation, we see advantages of being second or third when it comes to implementing new technology. This strategy is good as one avoids spending resources on products and technology not requested by the customers."

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**Trust**

- 3 "WeTrade primarily addresses the issue of trust between two companies without a previous relation."
 

"The consortium (R3) draws the conclusion that trust issues are a major hindrance to trade."

"Thus, the aim of WeTrade is to provide a trust network. It does so by sharing KYC for companies on both sides of a trade and bridging the trust in an automated network across multiple jurisdictions."
- 4 "Trust is a cornerstone for the services SEB provides and a reason to why SEB invest in the DLT initiative R3. On that note, SEB could invest in an internal, private, blockchain and it could serve a purpose but as there are no trust issues internally the benefit would be marginal." (KG)
- 5 "Banks sell capital funding and trust. Banks are just an intermediary that is trusted by its clients; the capital that the bank holds is there because people trust the bank to keep track of their money."
 

"[...] catastrophic effects of losing clients' trust for the bank and for the financial system as a whole; trust is *that* thing we own and must keep."

"The current question that the bank asks itself is where to put trust, and how to balance that trust versus risk."

"All regulatory frameworks, everything surrounding the bank is about trust."

"DLT is available to the bank. It is relatively easy to implement. But once trust is lost, it is very hard to regain. Therefore, the biggest challenge lies in balancing fast, active technological transformation with a working business model, while not compromising the clients' trust."

"Putting some branch of the business in a distributed ledger would mean a large alteration of the process in a short amount of time."

"To receive the full value of distributed ledger technology, this must be made possible and we must be able to entrust the network with our own information."

"Who is responsible if my money or assets disappear? Essentially, historical proof of existence and stability provide for example currency trading with trust and stability. A degree of trust must exist similarly for blockchain."

"For example in a diamond exchange, there exists an underlying asset, and the blockchain supplies the network with a way of tracking the ownership via a ledger. It is important to remember that this representation of the physical reality addresses other questions than for example Bitcoin, where there are no tangible assets involved in the currency itself."

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"Given the lack of tangibility in digital assets, trust is such a vital aspect."

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- Cooperation** 2 "Cooperation is the key to successfully apply blockchain technology"
- 4 "The R3 initiative is a way to quickly utilize the best parts of the DLT technology, the network effect, as the more stakeholders that agrees on one standard the better." (KG)
- "One of the main questions regarding DLT is how to effectively implement the technology externally, with other banks, clients and regulators instead of internally within the bank." (KG)
- 5 "In a perspective of five to ten years ahead, I am hesitant as to how widespread the use of distributed ledgers in the bank sector will be. The market will need to agree on how to proceed."
- 
- Sweden and its financial sector** 1 "Banks already provide services that simplify most tasks for their customers."
- "In a payment system like Swish for example, users create a transaction in seconds and sign it with their digital signature in Bank-ID. Any technology that aspires to outcompete the existing technology must provide similar real-time service and consistency, whilst having a leading edge elsewhere."
- 4 "The swedish clearinghouse for mass payment, Bankgirot and similar units in the other Nordic countries are working on a cross-border collaboration that could be based on blockchain technology. That is not yet decided but it could imply a much more efficient and rigid infrastructure for payments in the region."
- 5 "In general, the infrastructures in place for Swedish retail payments are already very digitized. Therefore, there are not enormous efficiency gains on the customer side associated with a potential transition to DLT-based solutions."
- "In its core business where volumes are large, we are already quite efficient."
- "FinTech companies in some ways have an advantage over banks when it comes to development of DLT, [...] a different regulatory structure, and the companies do not commonly take the real risk. They are usually just front-end aggregators or distributors. It does not matter too much if things go wrong."
- "The Swedish system is unique. We have an advanced infrastructure with UC, Bankgirot, Swish, Bank-ID, and handling of individuals' credit risk. Credit losses in Sweden are very costly for the individual [...]. The system functions very well, is very stable, and creates a high payments morality. The infrastructure is easily reusable and we must not underrate what we have built."
- "Sweden's financial supervisory authority (Finansinspektionen, FI) demand extensive reporting from banks such that the authority gains insight on how the bank monitors the assets and liabilities of its clients."
- 
- Rate of adoption** 1 "The technology is not mature enough for implementation in most cases. The reason could be that we are yet unable to fully leverage the potential of the technology, like we are able to with the systems in place."
- "In a perspective of five to ten years, we will see a limited growth of blockchain solutions in the financial sector. My hypothesis is that potential implementation will happen gradually and take longer than expected, mainly because of the large costs involved and the satisfactory functionality of current systems."

"In a time roughly twenty years away, when the market is more open, there will be fewer legacy dependencies and more degrees of freedom to the new technology with more research, increased awareness and knowledge."

"Look at how long it took to develop the Basel Standards"

- 2 "Gradually, more companies will see uses for DLT as development continues."

"In somewhere between ten to twenty years we will see a more widespread application of the DLT technology within the financial sector in Sweden."

- 3 "The implementation process to probably not be as fast as you would hope."

- 5 "FX and share transactions carry extremely low variable costs today."

"There are a lot of questions that are yet to be addressed. Small steps will be taken at a time, and adaptations will be needed after each step."

"Isolated parts of banks' businesses will see use cases for distributed ledgers."

- 6 "Rather than seeing widespread application of blockchain in trade finance this or the next year, a time horizon of around 5 years is more probable. The main reason is that the companies and bank divisions that are experts on blockchain technology do not fully understand the complexity of trade finance operations."

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**Long-term effects**

- 2 "DLT could completely change the business relations and communications of today by directly connecting stakeholders and hence completely change their [Nasdaq's] role as a intermediary."

- 3 "DLT has redefined the work environment and opened up peoples mind into a different way of thinking. Employees are allowed to think differently; there must not always be a processor in the middle."

"A good analogy is bank technology versus the introduction of and transitioning to the internet. I see similar development for blockchain and DLT, but connection points to the outside will still require specific permissions. There will always be private and public elements to networks of financial institutions, as there should be. In the upcoming years the elements will just harmonize in terms of technology and interoperability."

- 4 "Our earnings today will not disappear because of changes in the service portfolio but merely shift. Services we don't charge for today could be services they do charge for tomorrow. As an example, a service such as BankID (an electronic ID service) is something SEB don't charge for today but generates great value to clients."

- 5 "Microeconomic theory suggests that should the marginal cost decrease, people are willing to pay less for a product or service in a competitive market. Thereby, there is a risk of the bank eroding its own business by implementing DLT."

"Take for example a situation where a ledger is placed outside the bank with a number of nodes. What is the role of the bank in such a network? What value does the bank add? Can the client simply just log in themselves without the involvement of the bank? In a transition to blockchain based systems, would a bank perhaps hold some key to the network? In that case, is that really what the bank does best? Are there other actors, with other competencies, that would do that job better than a bank? The conclusion drawn is that at this point it is clear that the business model is not mature for such a transition."

"The issue is not that the technology is not mature enough. It is moreover the business model that is not mature enough for a transition. We need to trust the technology and feel safe using it."

"People will probably need loans to finance their lives. There will be a need to evaluate people's creditworthiness, and for safekeeping, track-records and handling of people's money, depending on how we see money in the future."

"Banks also have the advantage of being able to handle risk by aggregating small risks like an insurance company."

"If everyone in the entire world knows exactly who everyone is, and we can faultlessly identify who stands behind a digital identity, there really is not much left for a bank to do."

- 
- Public, permissionless networks**
- 3 "Permissionless DLT networks are hard to implement from a regulatory standpoint, but it is likely that regulators, banks and the participating entities will find ways to create equal playing rules for people who want to use DLT in public space. There is a likely convergence in approximately ten years, where participants can expose certain parts of networks into a permissionless space."
- "DLT is just another enabler for networking."
- 5 "To reach the full potential and maximize the value of distributed ledger technology he says that one must dare to place the ledger outside the bank."
- "In a theoretical scenario where a global bank controls a global distributed ledger network, everyone could use the same currency abroad and there would be a lot of advantages. However, individual countries lose the ability to control their economics through for instance fiscal and monetary policies. A proposal as such raises a lot of complex thoughts regarding the structure of the network"
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## Chapter 6

# Analysis and discussion

*In the following chapter, the results of conducted interviews and the study of literature are examined and analyzed. The analysis is comprised of a cost and benefit analysis, a PESTLE analysis of the contextual factors and an analysis of the barriers of adoption. Then, a discussion on the key elements is held.*

### 6.1 Costs and benefits analysis

One of the main themes common among all interviews and sources used in this report is that distributed ledger technology can bring cost savings. McLean & Deane-Johns (2016) identifies a cost-benefit analysis (CBA) as necessary in order to understand what DLT offers, such that expectations on returns to a proposed investment are met. Initially, the below cost-benefit analysis will thus focus on costs incurred with the adoption of DLT for trade finance operations in Swedish banks, while subsequently identifying the benefits that come with the implementation.

#### 6.1.1 Costs

The main two cost items relatable to DLT adoption identified in the research process were development costs and implementation costs.

##### Development costs

Adopting new technology can be costly as the development costs are often high. According to the report *Digital Innovation in Trade Finance* (Dab et al., 2016), this is likely true for the adoption of blockchain technology as well. Dab et al. (2016) conclude that the high development costs can result in only large-size banks being able to afford the research and development necessary to keep up with rate of adoption of DLT. As a consequence, smaller institutions could lag the larger ones in DLT adoption. However, letting others explore and develop new technology need not be a disadvantage (Segendorf, 2018; Carleke, 2018). It could contrarily be advantageous to the lesser resourced institution to let others explore and encounter teething troubles, as it could save them parts of the otherwise large fixed costs that comes with installing a new DLT platform (Segendorf, 2018).

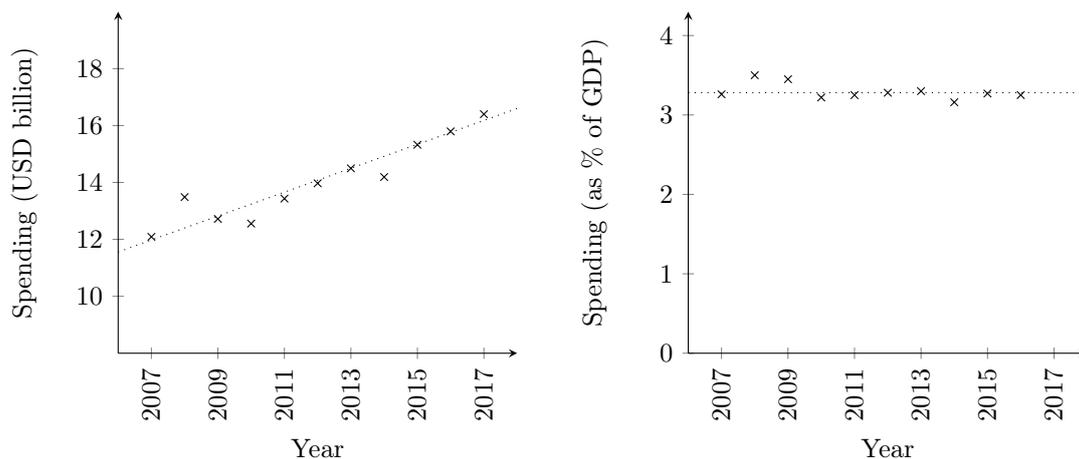
It is difficult to estimate how large the development costs of DLT are for Swedish banks. The costs are not openly communicated, and it is likely difficult even for the bank itself to judge the total cost at an early stage of the adoption process. The global market intelligence firm International

Data Corporation (IDC) estimates in their semiannual report *Worldwide semiannual blockchain spending guide* that the global research and development (R&D) spending on DLT during 2018 will be \$2.1B in total. In the financial sector, the R&D spending will amount to \$754M in 2018, out of which \$199M (or 26.4% by dividing \$199M with \$754M) will be spent on developing distributed ledger technology for trade and export finance operations and post-trade settlements (Ahuja et al., 2018).

Furthermore, Ahuja et al. (2018) argues that these DLT investments will exponentially increase until 2021. To put the DLT spendings estimated by Ahuja et al. (2018) in context, one can compare them to the total R&D spendings conducted by all companies, institutes, universities, etc in all OECD (Organization for Economic Co-operation and Development) countries. This figure was \$1149B in 2017 (OECD, 2018). Hence, a rather small part of what is invested in research and development are focused on DLT and blockchain applicability (0.18%). But out of the capital that is invested in the research of DLT in the financial sector, a considerable amount can be considered spent on DLT in trade finance (26.4%).

Total gross domestic spending on R&D in Sweden shows a recent increasing trend as per the below figure. Expressed as a percentage of GDP over the past six years, spending has been relatively stable at approximately 3% to 3.5%, with an average spending equal to 3.26% of GDP over the past six years.

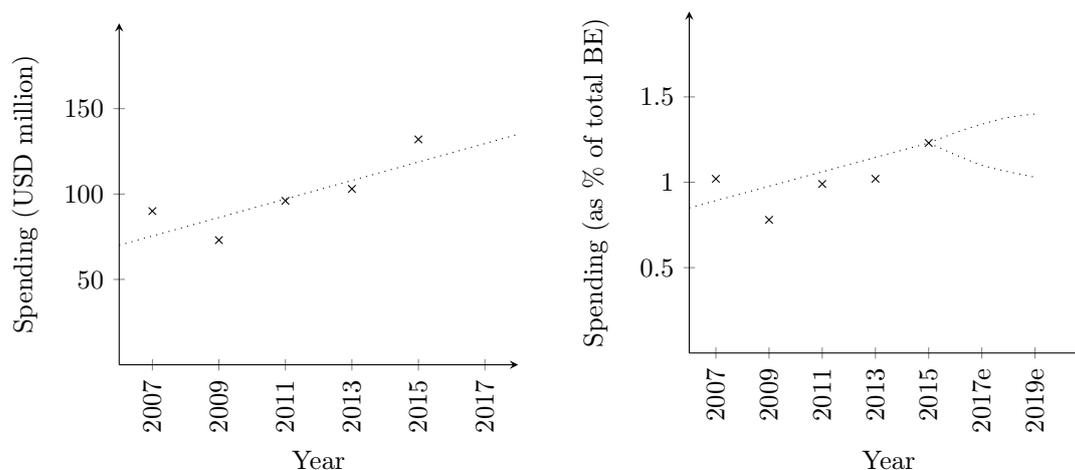
Figure 6.1: R&D spending, Sweden



Source: OECD

Examining business enterprises (BE) in Sweden specifically shows a similar trend. On average, 71% of investments in R&D in Sweden are done by businesses. The remaining 29% of investments are attributable to for example university, state agency and private non-profit sector research. The below figures display business R&D expenses for financial and insurance (F&I) companies, two sectors that are commonly grouped in data (NACE 64-66). The left figure shows the absolute amount invested in finance and insurance. The right figure shows R&D in finance and insurance as a percentage of the total investments by Swedish business enterprises in R&D.

Figure 6.2: R&amp;D spending, Sweden: Business enterprises in financial and insurance activities only



Source: OECD, SCB. SEK/USD conversion rate 8.50

On average, the above data suggests that approximately 1% of R&D spending in Swedish business enterprises occurs in financial and insurance activities. The percentage shows a relatively stable, slightly growing trend in later years. The OECD estimates Sweden's real GDP growth to 2.81% in 2018 and to 2.34% in 2019. The average business enterprise spending on R&D was 71% between 2007 and 2015. Further, 1% of business enterprise spending was attributable to financial and insurance activities. Future investments in R&D by financial and insurance (F&I) enterprises can now be forecasted using these averages and projected GDP growth rates. Further, Ahuja et al. (2018) conclude that approximately 26.4% of R&D investments in the financial sector will be spent on DLT in trade finance (TF) and post-trade settlements (PTS) in 2018. Assuming this percentage is relatively stable, the above information can be combined to yield estimates for DLT investments in trade finance and post-trade settlements for the upcoming years in Sweden. This is exemplified in table 6.1 below.

Table 6.1: Research and development in Sweden (simple calculation of potential scenario)

(USD million)	2007	2009	2011	2013	2015	2017
GDP	371,163	368,646	413,451	438,480	469,296	504,589
R&D Spendings	12,089	12,718	13,433	14,496	15,322	16,376 <sup>e</sup>
R&D as % of GDP	3.26	3.45	3.25	3.31	3.27	3.26 <sup>e</sup>
BE spendings on R&D	8,834	9,032	9,261	9,997	10,794	11,757 <sup>e</sup>
BE % of total spendings on R&D	73	71	69	69	70	72 <sup>e</sup>
% of BE R&D in F&I	1.02	0.78	0.99	1.02	1.23	1.20 <sup>e</sup>
R&D in F&I	90	70	92	102	132	141 <sup>e</sup>
Spendings on DLT, TF and PTS	24	19	24	27	35	37 <sup>e</sup>

<sup>e</sup> = own estimate

Source: OECD, SCB, own research

In a low investment scenario, the percent of all business R&D spent in finance and insurance could slightly decrease, nearing the eight-year average of 1%. In a high investment scenario, the corresponding percentage could instead increase (which is visualized in the right graph in figure 6.2). Similarly, it is hard to determine whether the finance and insurance DLT investments will match the 26.4% estimated by Ahuja et al. (2018). To express how the investment may vary for the chosen estimation method, both percentages were analyzed in a multivariate data table, yielding the following result.

Table 6.2: Sensitivity analysis for DLT investments in TF&PTS in 2019 (for above scenario)

		% of R&D investments in F&I spent on DLT in TF&PTS					
(USD million)		10%	15%	20%	25%	30%	35%
% of BE R&D in F&I	1.0%	12	18	25	31	37	43
	1.1%	14	20	27	34	41	47
	1.2%	15	22	30	37	44	52
	1.3%	16	24	32	40	48	56
	1.4%	17	26	34	43	52	60
	1.5%	18	28	37	46	55	65

Conclusively, the chosen method estimates investments in research and development of DLT by banks in Swedish trade finance to lie within USD 12 to 65 million. The interval can be considered large. The upcoming years will likely determine whether DLT gains traction or not, which could pivot investments in either direction. If banks invest only 10% (instead of 26.4% as estimated by Ahuja et al. (2018)) of their R&D into the investigated sector and instead choose to invest in for example artificial intelligence, that decision will evidently have a large effect on the estimate of total investment. This explains the wide interval.

The expected value of investments for 2019 using the chosen method is USD 40 million (for 1.23% and 26.4% values of the table variables). The percentage of businesses' R&D investments in finance and insurance was 1.23% in 2015, when the latest data was issued. It is reasonable to assume for the percentage to be held constant in a base scenario. It should further be noted that the estimate includes the insurance sector and investments in post-trade settlements, which means the actual number for trade finance in banks may be slightly lower.

### Implementation costs

Interview answers and conducted research indicate that implementation of a DLT-based trade finance platform could be intricate. This is true for most financial infrastructures as they are often both complex and large in scale (Segendorf, 2018). Further, as current operations have been relatively unchanged for a long time and a lot of stakeholders are involved, the lock-in effect of such a platform can be considered significant. These factors combined indicate that implementation costs of a DLT platform in trade finance will be high, concluded by Korpela et al. (2017). In this report, the implementation cost will not be estimated since it is considered to vary greatly depending on the properties of the party implementing the technology.

In the report *Digital Innovation in Trade Finance*, Dab et al. (2016) indicates that implementation costs today are so high that costs would have to decrease by 20% in order for such an investment

to reach break-even. This claim is further strengthened as da Silva (2018) also states that implementation costs of DLT are high today, due to the still non-mature state of the technology. As the technology matures, more and more companies will see potential in DLT (Toll, 2018). Subsequently, implementation costs will likely decrease. However, an investment that incurs high fixed costs can still be worthwhile if the new platform can benefit the customer relations and/or satisfy a specific customer demand, as Szablowski (2018) describes it. This relates to what many sources (Guo & Liang, 2016; Tapscott & Tapscott, 2016; da Silva, 2018; Toll, 2018; Szablowski, 2018; Carleke, 2018) mention as vital for long term prosperity from a corporate perspective, namely increased customer value.

### 6.1.2 Benefits

In the table below the benefits for the institution adopting a DLT based trade finance platform has been presented. If an interviewee or research article has mentioned a particular benefit, its identifying number or letter has been presented under the source column in the table below.

Table 6.3: Benefits analysis

Benefit	Source	Description
<b>Automation</b>	1,3,4,6, a,c,d,r,n	DLT will result in an increase of the currently low level of automation in trade finance. For example, smart contracts will enable the bank to digitally verify that a payment is executed and then automatically trigger one or more events (Barclays, 2016), which leads to several secondary benefits.
<b>Backup</b>	1	DLT will provide means of automated backup of information.
<b>Compliance</b>	b,h,p	Compliance will be simplified due to automation and regulatory authorities having access to the DLT platform. Treat et al. (2017) estimates <b>30-50%</b> cost savings on compliance for banks.
<b>Cost savings</b>	All	All sources used have indicated that an adoption of a DLT platform in trade finance will in some way result in long-term cost savings.
<b>Customer value</b>	2,4,5,6, a,c	The customer value is enhanced as the speed of transactions is increased, error level decreased and level of complexity is decreased. Digitization of the application process for trade finance products would facilitate the process for the customer and could give banks an advantage over competitors.
<b>Efficiency</b>	2,4,5,a,b,c, d,f,r,q,v	There will be efficiency gains from automating the trade finance operations, reducing the complexity and increasing transparency and trust. Approximately <b>50%</b> cost savings on business operations will be possible to achieve, (Treat et al., 2017).
<b>Fraud prevention</b>	3,b	Decreased risk of fraud as trust and transparency are inherent in the (so far) immutable DLT platform (Barclays, 2016).

<b>Human error</b>	4,c	As a DLT platform in trade finance would decrease the manual labor intensity, the human errors could decrease. The manual labor intensity could decrease for example due the omittance of manual reviewing and sign-offs of contracts in a DLT platform (Dab et al., 2016).
<b>Paper intensity</b>	4,6,5, h,q	An adoption of DLT would automate the process of issuing trade finance products. In combination with increased level of simplicity, the paper intensive trade finance operations would decrease its usage of paper and become more digitized.
<b>Privacy</b>	3,c	A DLT platform would imply the omittance of a centralized database (so called honeypot of data) and hence increases the privacy and security of sensitive corporate information.
<b>Regulatory advantages</b>	3,b,r	The process of regulation will be improved as DLT could imply regulatory authorities having direct access to the trade finance network. They could have a node in a DLT based trade finance network along with the importer, exporter and their respective banks. There could be as large as a <b>70%</b> cost reduction on the financial reporting (Treat et al., 2017).
<b>Risk mitigation</b>	5,4, a,c,r,v	The level of risk would minimize as the human error would decrease and cybersecurity resilience increases.
<b>Security</b>	1,2,5, c,d,v	Cybersecurity resilience will be increased by using a DLT platform. Should attackers gain access to the network or the distributed ledger, it does not automatically imply the attacker can actually read the information due to data encryption (Piscini et al., 2017b).
<b>Simplification</b>	3,5,6, d	The high level of complexity in trade finance operations, partly due to the large amount of intermediaries, will decrease using DLT. As an example, DLT will enable direct contact between the banks of the importer and exporter, omitting the role of the corresponding bank (Vysya & Kumar, 2017).
<b>Speed</b>	3, b,d,r,q,v	DLT will benefit the speed of transactions (Natarajan et al., 2017). Increased automation, less complexity and reduction of manual labor in the trade finance operations will increase the speed of transactions and end-to-end service time. Specifically, there will be fewer intermediaries and non value-adding activities with a DLT platform.
<b>Transparency</b>	3,b,d, r,v,g,h	Transparency is a key benefit of DLT, as members of a DLT based trade finance platform would have access to distributed information.
<b>Trust</b>	4,c,h	The trade finance operations exists due to a trust issue between exporter and importer as da Silva (2018) describes it. As transparency and immutability is inherent in DLT, the level of trust towards the counterpart will be enhanced.

Many factors affect the cost structure of trade finance operations. It is therefore difficult to approximate what the potential cost savings will amount to. In their report *Digital Innovation in Trade Finance*, Dab et al. (2016) approximates that the potential cost savings over a three to five year period is will be as much as 35%. In addition to this, they also predict that revenue streams

will increase by as much as 10% by an increased demand for the services. Moreover, in a similar report but focused on investment banks, Treat et al. (2017) approximates the average overall cost savings implied by adopting DLT in investment banks operations to as much as 30%, similar to the conclusions drawn by Dab et al. (2016). These estimates could serve as an indication for a future best case scenario. However, articles such as Bloomberg (2018) describe how cautiousness is key, and state it is important not take these estimates for the definite truth. More specifically, Bloomberg (2018) describes how the cost structures in banking operations are generally more complex than described by Treat et al. (2017). Factors such as increased energy consumption (at least initially) and cost of storage (as blockchain technology uses up storage) are omitted when estimating cost savings according to Bloomberg (2018). Hence, the total estimated cost savings could be significantly lower than what Treat et al. (2017) and Dab et al. (2016) estimates according to Bloomberg (2018).

Cross-border transaction fees also affect costs within trade finance operations. Between European countries, the transaction fees are small or non-existent but transactions to and from the US are costly (da Silva, 2018). Guo & Liang (2016) state that cross-border transactions to and from the US could be reduced by as much as 42.3% (a decrease from \$26 to \$15) by implementing a DLT solution for transactions. This will affect the cost structure of Swedish trade finance operations as the US is a frequent trade partner for Sweden, amounting for 6.7% of the country's exports and 2.5% of its imports (SCB, 2018).

The benefits presented in this analysis will likely emerge within a time horizon of twenty years as per interview consensus. The implementation of a DLT-based trade finance platform will presumably result in sequential effects with varying size. *Automation* and *Simplification* can be considered factors that are noticed immediately after implementation, that could bring considerable benefits to the bank. As a result of automation and simplification, the *paper intensity* and level of *human error* likely drops. Implementation is considered to also increase *Security* and *Privacy* at an early stage based on the interviews conducted, given that the platform is properly tested before its implementation. The new system may need initial adaptations and updates before privacy and security benefits are prominent. *Trust* in the new system is built up and brought at a relatively early stage. The trust brings *customer value* by enabling trade and generating network effects. Consequently, the *efficiency* in the DLT platform will increase. The implementing institution will subsequently see *cost savings*.

### 6.1.3 Weighing costs versus benefits

The implementation and development costs are the main cost drivers of DLT implementation in trade finance. The implementation costs of a DLT platform are considered high, as the technology is not mature (da Silva, 2018) and the lock-in effect of the current system is high (Korpela et al., 2017). As the technology matures, the required further investment in research and development will decrease, while the implementation costs can be considered constant over time. There is likely no significant added cost of replacing existent technology at a later point. As more solutions are developed, market competition and increased supply likely pushes prices down such that implementation for a third party user could, if anything, become slightly cheaper.

The benefit analysis indicates that for example *automation*, *efficiency* and *reduced level of complexity* are prominent benefits of DLT implementation in trade finance. The benefits of utilizing a DLT based trade and export finance platform further increase with the number of platform users by the network effect (Dab et al., 2016). The interviews and literature suggest that the costs currently outweigh the benefits, and that the adopters of DLT at present-day likely consider their commitment a long-term investment. As more research and development is conducted, the level of benefit will increase and likely outweigh the costs at some point in the future. The point at which this happens will be discussed in section 6.4.

## 6.2 Analysis of Swedish contextual factors

The below table summarizes the contextual factors that were concluded to significantly affect the rate of adoption for distributed ledger technology in Sweden according to the literature reviewed and interviewees, structured as a PESTLE-analysis (Political, Economical, Socioeconomical, Technological, Legal and Environmental-analysis).

Table 6.4: Swedish contextual factors analysis

Factor type	Hinders for adoption	Accelerators for adoption
<b>Political</b>	<p>Uncertain political situation and unpredictability in parliament's future direction (Lindvall et al., 2017) causes ambiguity and hesitancy</p> <p>Political differences between Sweden and its trading partners may cause issues (Carleke, 2018) and conflicts of interest in how platform is developed</p>	<p>Government and regulatory authorities gain ease of access to real-time tracking and reporting for improved transparency (Vysya &amp; Kumar, 2017)</p> <p>Real-time, automated digital solution improves efficiency of process (Vysya &amp; Kumar, 2017) (trade sanctions for certain counterparties may vary on a daily basis)</p>
<b>Economical</b>	<p>Low comparable government subsidies and tax incentives (to OECD countries) for private R&amp;D (OECD, 2017) leaves less room for businesses investments in research and development</p> <p>Low interest rates and potential recession approaching may negatively affect willingness to invest in necessary research and development (Brockhoff &amp; Pearson, 1998)</p> <p>High economic complexity (rank 6 of 89) (OEC, 2018); trade in complex products could complicate processing</p>	<p>Among lowest statutory tax rates on business income in OECD (OECD, 2017) enables investments in R&amp;D</p> <p>Economic growth potential incentivizes governmental support</p> <p>Trade currently hindered could take place (Sointu, 2018), boost growth:</p> <ol style="list-style-type: none"> <li>(1) SME's gain access to credit</li> <li>(2) New platforms bridge trust between SME's</li> <li>(3) Real-time access to cost breakdown simplifies investment decisions</li> </ol>
<b>Sociocultural</b>	<p>Population has high requirements and expectations on security, personal integrity and trustworthiness, whereby systems are expected to provide constant uptime and must be tamper-proof from outside intrusion</p> <p>Currently available, well-developed functions are expected to be preserved, need to be replicated for the new system to become accepted (Szablowski, 2018)</p>	<p>High average level of education stimulates development and innovativeness</p> <p>Trust and creditworthiness are central and highly valued in society (Szablowski, 2018)</p> <p>Current information asymmetries (Wang, 2018) create uncertainty for SME's; clear contract conditions create less ambiguity</p> <p>Rising crime rates in fraud and identity theft (BRÅ, 2016) could benefit from additional security provided</p>

<b>Technological</b>	<p>The already highly digitized Swedish society may result in low marginal increase in performance per invested unit and therefore provides less incentives to invest in development and implementation of new, improved technology</p> <p>Vanilla technological solutions and improvements could provide similar properties at a cheaper cost (Szablowski, 2018) if they are further invested into</p>	<p>Booming FinTech industry (Teigeland et al., 2018) forces investments into technological improvements</p> <p>Decreasing margins (Guo &amp; Liang, 2016) forces banks to investigate possible efficiency improvements in outdated procedures</p> <p>Firms must stay competitive in the rapidly developing environment</p> <p>Well-functioning current infrastructure (Szablowski, 2018) simplifies interoperability and development</p>
<b>Legal</b>	<p>Advanced regulatory structure complicates the development of technology and efficient consensus algorithms</p> <p>Local differences in legal environment between Sweden and its import/export partners make development of consolidated system intricate</p>	<p>Majority (~85%) of trade occurs within the European Union (OEC, 2018); easier to map the regulatory environment</p> <p>Automation benefits companies in advanced regulatory structure with extensive reporting requirements (McLean &amp; Deane-Johns, 2016)</p>
<b>Environmental</b>	<p>Today's consensus algorithms are inefficient and power consuming (Trepte et al., 2017)</p> <p>Technology needs to mature in terms of environmental impact prior to more widespread use</p>	<p>Population is increasingly aware of environment issues and climate change (Wodmar, 2007)</p> <p>Generally positive attitude towards participating in the transition to a more sustainable way of living (Wodmar, 2007)</p>

## 6.3 Barriers

### 6.3.1 Cooperation and trust

One of the most central aspects in a potential transition to distributed ledger-based platform in trade and export finance is trust. First, setting up a distributed ledger network requires there to be some level of trust between its participants. The technology and the governance model of the network can place restrictions on how certain members can act, yet there must still exist a level of trust between the founding members of the network. The trust network is subsequently used to bridge the connection between importers and exporters. Ultimately, the implementation of such a system leads to risk being moved from importers and exporters to the administrators of the permissioned network. The reallocation of risk is similarly the main function of trade finance operations. An apparent possible use case for DLT is thus that it could provide a way of digitizing and automatizing the trade finance operations in Sweden. Further investigating the trade finance process shows that its current fragmented state could see many other improvements with DLT implementation, as stated in the cost-benefits analysis section. However, there still exist major challenges in terms of cooperation and trust.

Trust in DLT is affected by many factors, one of which is the lack of historical proof of existence and stability in blockchain. The existence of this stability is apparent in for example currency trading where exchange rates have been relatively stable for a long period of time. It is also important to

remember that DLT in representations of the physical reality (for example ledgers used to track ownership of physical items) addresses other questions than for example bitcoin, where there are no tangible assets involved in the currency itself. Given the lack of tangibility in digital assets, trust is such a vital aspect. (Szablowski, 2018) Trust issues in DLT should therefore be carefully evaluated as to what contexts they appear in. They could be subject to firms not being able to entrust the network of peers with the information in a ledger, or occur because the ledger could be tampered with such that assets are moved from one node to another in a fraudulent manner. In this text, focus lies on registries rather than digital assets, since trade and export finance challenges lie mainly how information in registries is stored and communicated in the DLT network.

By the definition of DLT, implementation of the technology cannot be a single organization's decision. Choosing to operate on a blockchain infrastructure demands firms to manage themselves in a network (Zamani et al., 2018) where cooperation is essential in successfully applying the technology (Toll, 2018). The potential uses require cooperation across all interested parties, be it stakeholders, regulators, or customs. But traditionally, firms are more acclimatized to competition than they are to cooperation (McLean & Deane-Johns, 2016). One of the main challenges for DLT is therefore how to effectively implement the technology externally with other banks, clients and regulators instead of just internally within the bank. Trust is a cornerstone for the services provided by banks and a big reason to why they invest in it. One could invest in an internal, private, blockchain and it could serve a purpose, but as there are no trust issues internally the benefit would be marginal. (Gärder, 2018)

The managerial challenges in adoption of DLT were captured comprehensively by Szablowski (2018). Receiving the full value of distributed ledger technology requires the ability to entrust the network with private information. But as banks sell capital funding and trust and are just an intermediary that is trusted by its clients, there are catastrophic effects of losing clients' trust for the bank and for the financial system as a whole. The current question that the bank continuously asks itself is thus where to put trust, and how to balance trust versus risk. While DLT is available to the bank and is relatively easy to implement, it is very hard to regain trust once it is lost. Therefore, one of the biggest challenges lies in balancing fast, active technological transformation with a working business model, while not compromising clients' trust. (Szablowski, 2018)

### 6.3.2 Standardization and interoperability

Industry standards for a DLT platform in trade and export finance is an important factor for DLT adoption. The more stakeholders that acknowledge an industry standard the better (Gärder, 2018). Non-standardized information and procedures would create inefficiencies for the institutions using the DLT platform and the regulatory authorities monitoring these institutions. The inefficiencies would primarily exist because the interoperability between distributed ledgers would not be as widespread as otherwise, and standards encourage interoperability. (Maull et al., 2017) Consequently, implementers could miss out on cost savings. For the regulatory authorities, a standardized DLT platform used by several institutions would be beneficial as control and flexibility in regulations would be enhanced. Interoperability could help authorities in employing trade restrictions and confirming qualified auditors (Maull et al., 2017). Hence, it can be concluded that there is a need for industry standards to be developed, as also stressed by Zamani et al. (2018).

Presumably, standardization can enable for interoperability between different DLT networks. Networks exist internally and externally, and there is a need for DLT networks to communicate with other critical information systems. Regardless of how interoperability is interpreted, be it internally, externally or across different systems, it will likely be a necessity in order to leverage the power of DLT (McLean & Deane-Johns, 2016). It is important to note that there will always be private and public elements to financial networks, which could complicate the communication between them. In the upcoming years, Sointu (2018) states that private and public elements to networks will harmonize in terms of interoperability.

The compatibility of a DLT network with internal IT-systems will affect the early adopters, inhibiting them and their potential success if not possible (Zamani et al., 2018). Therefore, by creating an infrastructure that supports interoperability, with the purpose of supporting an efficient adoption of DLT across the entire organization, will significantly reduce a barrier of entry and increase the rate of adoption of the technology (Zamani et al., 2018). For trade finance, this implies ensuring that a DLT-based trade and export finance platform is interoperable with conventional payment and financial services infrastructure (Natarajan et al., 2017). By doing so, the potential of the DLT will be magnified Natarajan et al. (2017); McLean & Deane-Johns (2016).

### 6.3.3 Governance in complex regulatory environment

Fully leveraging distributed ledger technology in trade and export finance implies adopting a viable governance structure and adapting necessary regulatory processes (Collomb & Sok, 2016). A governance structure is important in any type of business climate as a means to provide assurance to stakeholders by controlling and auditing corporations and their management (Provan & Kenis, 2008). For example, a third party that can guarantee that one's capital exists and provide other societal mechanisms (Sointu, 2018). There exists a demand for similar services for DLT networks (Szablowski, 2018; Toll, 2018). Hence, a great challenge lies in replicating the current governance system for trade finance operations (Sointu, 2018) and developing a clear governance structure for DLT-based solutions. Then, a widespread implementation of DLT can be realized (Iansiti & Lakhani, 2017). The development of such a governance model is intricate because a DLT-based trade finance platform could be used by participants from different legal jurisdictions (Sointu, 2018). The DLT platform further requires someone to control the network even though the database and its information is decentralised (Sointu, 2018; Provan & Kenis, 2008). One therefore still has to find some entity governing the network in a transparent manner.

For a platform to provide trust to all stakeholders, it must also be regulated appropriately. Current regulations will therefore need to be updated to support the potential transition to DLT networking (Toll, 2018). In addition, the regulatory framework requires continuous alteration for reasons such as trade restrictions. Such regulatory alterations are something that a DLT platform must adhere to (Collomb & Sok, 2016). The regulatory environment poses a complex challenge because:

- En entrant to a DLT network must sign a rulebook which acts much like a constitution. In order for the new technology to adhere to laws and regulations, the network constitution needs to be integrated to the local law. (Sointu, 2018) Meanwhile, it can be considered of great importance that the regulatory framework for trade and export finance is technique-neutral and fills a clear purpose (Segendorf, 2018).
- A potentially greater regulatory challenge in regards to the transition to a DLT-based system is the fact that internationally agreed regulatory principles may prove to be necessary, due to the cross-border nature of trade and export finance. (McLean & Deane-Johns, 2016) This is difficult and time consuming to achieve due to varying regulatory environments seen across different countries (Guo & Liang, 2016).

Another regulatory concern in regards to the transition to DLT is the decentralization itself. Questions to be answered in this regard are for example:

- Will the regulatory authorities approve an implementation of a distributed ledger based trade finance platform without a centralized counterpart (Szablowski, 2018)?
- Who will be have responsibility for the DLT network, and what is to be regulated (McLean & Deane-Johns, 2016)?

### 6.3.4 Technical challenges

Banks in Sweden, who are likely candidates for administration of a DLT system, face complex regulatory standards and needs for interoperable system integration per the previous section. Further, they are under pressure to deliver high returns for their stakeholders in a highly competitive, heavily digitized environment. This places high requirements on the distributed ledger network, its security, the network democracy (governance model) as well as its efficiency and performance. The new network must provide comparable advantages to today's solutions to be worthwhile to develop and implement (Segendorf, 2018). In that sense, some momentous challenges remain for most use cases of DLT in the financial sector altogether. But how do these challenges apply to trade and export finance in Sweden specifically?

It is mostly the technical issues in governance model design and cyber security that are identified as potential problems in trade and export finance. Cyber security will always be an issue for software (Natarajan et al., 2017; Woodside et al., 2017). In this case, the issue is two-sided. First, the information in a distributed ledger must be accessible to some parties, whilst being restricted to others and protected from unauthorized access. Second, the network in its entirety must not be manipulable such that parties can modify the information and send false signals. One example could be that an exporter falsely signals that it has dispatched goods, leaving the network administrator accountable for a loss of goods that were not sent. As learned in our investigation, there is a need to study how decentralization requires cyber security to evolve (Segendorf, 2018) and banks will require infrangible ledgers (Szablowski, 2018).

Guo & Liang (2016) and Segendorf (2018) state that for the financial sector in general, the speed of transactions in blockchain based networks is currently not fast enough to satisfy the sector's needs. This applies especially to capital markets and post-trade settlement (Guo & Liang, 2016). There is further a limitation to scalability and some applications of DLT suffer from extreme transaction processing delays or latency (McLean & Deane-Johns, 2016). While trade and export finance would likely see an increase in the number transactions with a potential trust bridge for SME's (Sointu, 2018), the number and nature of transactions does not compare to for example credit card payments. Trade finance transactions are fewer and more complex. Therefore, the current technical limitations on scalability and speed that exist in DLT are less relevant for trade finance.

## 6.4 Discussion

### 6.4.1 Is DLT the right way to proceed?

Investigating distributed ledger technology makes it apparent at an early stage that while the technology may significantly change a variety of inefficient processes, it is no solution on its own. You still have to do all the work that you did before. (Sointu, 2018) Meanwhile, as stated by Szablowski (2018), many if not all processes in a bank have emerged from a paper-based society. Automization and digitalization of these mechanisms is an ongoing procedure that does not have a stable end state. While distributed ledgers could prove to be useful in trade and export finance, vanilla digitization could be just as good. The trade finance process is very paper-based, and it is a secondary question as to whether blockchain or other digitization is the correct way to evolve it. (Szablowski, 2018) Necessity is the mother of invention; there must be incentives along the chain of users to implement the technology (Segendorf, 2018). Lai & Lee Kuo Chuen (2018) and Carleke (2018) also emphasize the importance of proceeding from the issue or customer value rather than from a proposed solution.

In order for a blockchain system to replace a centralized system, it needs to provide some sort of incentives and comparative advantages (Segendorf, 2018). Permissioned decentralized systems with

governance function pretty similarly to current systems (Segendorf, 2018), and while decentralization may be beneficial in some scenarios, some centralized intermediary functions cannot simply be replaced or removed Guo & Liang (2016); Sointu (2018); McLean & Deane-Johns (2016). It is unlikely anyone will be disintermediated entirely, but the respective participants' roles may change in a DLT environment. (McLean & Deane-Johns, 2016) Intermediaries would still be needed in for example taking certain part of the risk in transactions (Sointu, 2018). A more practical example discussed by Sointu (2018) is the potential replacing of Bankgirot in Sweden by blockchain or DLT. This would only be possible if someone administrates the new system. DLT removes the central database, but still requires for someone to manage the network; an entity that creates the rules, the governance model and does so in a transparent manner. (Sointu, 2018)

It is easy to become fascinated by the technology. We must be aware of the potential issues that may evolve with its implementation. (Szablowski, 2018) Important functions of public distributed ledgers are lost in a private setting, which is one reason to be cautious and to thoroughly evaluate the implications of DLT implementation. Natarajan et al. (2017) also emphasize caution as a necessity as the advantages over current procedures are relatively uninvestigated. Hence, it will be important to carefully evaluate early adopters' progress to track the potential disruptiveness of the technology (Maull et al., 2017).

#### 6.4.2 How will DLT affect banks' future business models?

What banks sell is capital funding and trust (Szablowski, 2018). A bank is an intermediary trusted by its clients; the capital that it holds is there because people trust the bank to keep track of their money. Losing clients' trust is catastrophic for the bank and for the financial system as a whole. A question that the bank continuously asks itself is where to put trust, and how to balance that trust versus risk. Banks' business models build on bridging trust and allowing for capital reallocation between parties that in most cases do not know each other. But in a scenario where everyone in the entire world knows exactly who everyone else is, and we can faultlessly identify who stands behind a digital identity, there really is not much left for a bank to do. (Szablowski, 2018)

Distributed ledger technology is therefore a potential threat to some of banks' current profitable activities. DLT may especially diminish profitability in business cases where banks have previously acted as a central coordinator (Collomb & Sok, 2016). It could entirely redefine the business relations and communications of today by directly connecting stakeholders, hence completely changing the role of an intermediary (Toll, 2018). da Silva (2018) states that earnings today will not simply disappear because of changes in the service portfolio, but merely shift. Services that the bank does not charge for today could be services they charge for tomorrow. Some services (such as for example BankID) are offered for free, but still generate great value to clients. We may therefore see a shift in banks' profitability opportunities with the introduction of DLT.

Szablowski (2018) discusses an example where a ledger is placed outside the bank with a number of nodes. What is the role of the bank in such a network? What value does the bank add? Can the client simply just log in themselves without the involvement of the bank? In a transition to blockchain based systems, would a bank perhaps hold some key to the network? In that case, is that really what the bank does best? Are there other actors, with other competencies, that would do that job better than a bank? The conclusion drawn by Szablowski (2018) is that it is clear that the company's business model is not mature for such a transition. The bank must trust the technology and feel safe using it. DLT is available to the bank and is relatively easy to implement, but putting some branch of the business in a distributed ledger would mean a large alteration of processing in a short amount of time. Once trust is lost, it is very hard to regain. Therefore, one of the biggest challenges lies in balancing fast, active technological transformation with a working business model, while not compromising the clients' trust. (Szablowski, 2018)

Microeconomic theory suggests that should the marginal cost decrease, people are willing to pay less for a product or service in a competitive market. Thereby, there is a risk of the bank erod-

ing its own business by implementing DLT. (Szablowski, 2018) So why are some Swedish banks investing heavily in DLT? Over the past two years, a multitude of collaborative efforts between financial institutions and DLT startups have affected traditional banking. (Collomb & Sok, 2016) As discussed in the analysis section, Sweden has historically been a country where technological innovations have been adopted quickly, and the Swedish FinTech sector is growing in a rapid manner (Teigeland et al., 2018). FinTech companies in some ways have an advantage over banks when it comes to development of DLT. They face a different regulatory structure, and the companies do not commonly take the real risk, as they are usually just front-end aggregators or distributors. It does not matter too much if things go wrong. (Szablowski, 2018) The tough competition faced by banks in the Swedish market may therefore force them to invest in DLT despite the fact that it could erode their business cases in the long-term.

In the majority of cases, it makes no financial sense for medium and small organizations to invest in developing a private or hybrid blockchain of their own (Zamani et al., 2018). However, this barrier may be overcome through third parties, whereby an intermediary can surface as blockchain provider for many smaller organizations (Zamani et al., 2018). This could be something that a bank provides. Szablowski (2018) suggests people will probably need loans to finance their lives, that there will be a need to evaluate people's creditworthiness, and for safekeeping, track-records and handling of people's money, depending on how we see money in the future. Banks also have the advantage of being able to handle risk by aggregating small risks like an insurance company. (Szablowski, 2018) These functions exist today, but the way in which they are profitable for the bank (and to what extent) may shift in the future.

### 6.4.3 What is the rate of adoption?

The costs, benefits, market-specific factors and challenges all affect the rate at which DLT could be adopted in trade and export finance. The majority of sources used in this thesis suggest that potential implementation will take longer than expected for trade finance in general. Many barriers have to be overcome before successful implementation of DLT, forcing cautiousness (Iansiti & Lakhani, 2017). Segendorf (2018) states that the rate at which implementation of DLT occurs will likely be slower than expected. The rate will for example be affected by large inaugural costs involved and by the satisfactory performance of the current system. As an example, Segendorf (2018) discusses how long it took for the Basel standards to be developed. Sointu (2018) also considers the implementation process to not be as fast as one could hope, while Carleke (2018) accentuates that DLT experts may not fully understand the complexity of trade finance operations.

At this point, there is a relatively high cost of developing the appropriate technology as it is still not in a mature state. da Silva (2018) states that SEB's implementation of Ripple technology focused on creating customer value rather than cutting costs. While Ripple serves a different purpose than a DLT platform for trade finance, the transition from old to new technology can be considered similar. Natarajan et al. (2017) states the gains of implementation will be incremental and not instant, while Toll (2018) says that as more corporations see the uses and benefits of DLT, it will gradually become more commonly applied. In a perspective of five to ten years, Szablowski (2018) is hesitant as to how widespread the use of distributed ledgers in the bank sector will be; there is a need for the market to agree on how to proceed. In that time span, blockchain technology will at least likely force a firm's managers to reassess their various administrative and management processes (Collomb & Sok, 2016). DLT has already redefined the work environment and opened up peoples mind into a different way of thinking. It has allowed employees to think differently; there must not always be a processor in the middle. (Sointu, 2018)

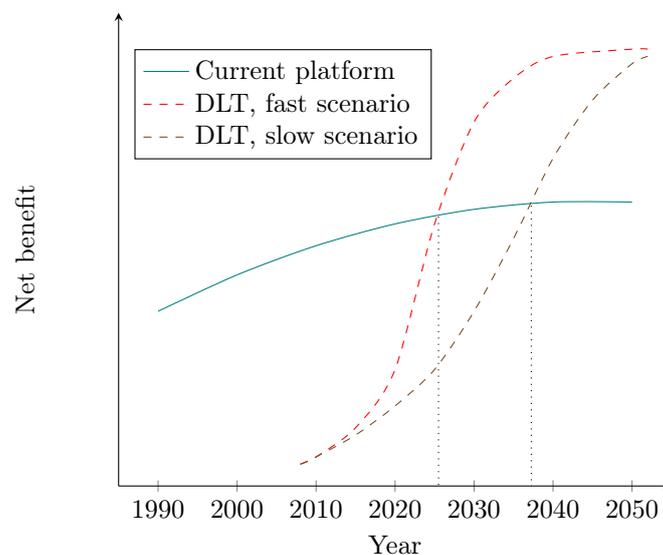
To reach the full potential and maximize the value of distributed ledger technology, one must dare to place the ledger outside the bank, and entrust the network with the bank's own information (Szablowski, 2018). Meanwhile, the needs of reality will likely require more centralized consortium and private blockchains to be derived from completely decentralized public blockchains (Guo &

Liang, 2016), and DLT integration seems relatively easy to do for peripheral or niche activities (Collomb & Sok, 2016). Therefore, consortium blockchains and private blockchains will likely be employed in niche parts of banks within five years, while it will take longer until parts of networks are exposed into a permissionless space. Permissionless DLT networks are harder to implement from a regulatory standpoint, but could further improve the ability to leverage the full potential of DLT. It is likely that regulators, banks and the participating entities will find ways to create equal playing rules for people who want to use DLT in public space within approximately ten years (Sointu, 2018).

Historically, researchers have modelled technological advances using a wide spectrum of methods and philosophies. Thomas Kuhn claimed that progress in a specific science field is made through intermittent so-called paradigm shifts, as opposed to progression in a steady, linear fashion (Kuhn, 1970). Giovanni Dosi expanded on Kuhn's theories and studied technological paradigm shifts specifically. His conclusions drawn were that technology is a problem-solving activity for the issues (or anomalies) experienced by firms. Dosi identified that a technological paradigm steers the direction of technological change such that technical improvements gradually converge towards distinct solutions along certain technological trajectories. (Dosi, 1982) Competing technologies have also been studied by Brian Arthur, who for example studied technology in terms of lock-in effects by historical events (Arthur, 1989). Everett Rogers popularized the S-curve to describe the rate at which an innovation spreads (Rogers, 1971).

Many properties and common themes encountered in the construction of this thesis are relatable to Arthur (1989); Kuhn (1970); Dosi (1982). The current paradigm in this case could be considered the traditional trade finance process, whereas DLT could be part of a paradigm shift to some further digitalized platform. The distributed ledger technology competes with other technological trajectories, such as machine learning or artificial intelligence paths (Carleke, 2018; Dab et al., 2016). Examples of anomalies in that sense could be the fact that small to medium sized enterprises are left unserved in the market, and that the current process is time consuming. By the study of literature and analysis sections, the rate of adoption for DLT in Sweden is determined to rely on a multitude of factors. In cases where public ledgers can be applied, the power of the technology can be leveraged in an optimal way. Judging from interviewee consensus, it seems that this could be a key factor in DLT becoming more efficient than what is currently available to firms. By the above reasoning and the conducted research, the below graph provides a visualization example of how the diffusion of innovation for distributed ledger technology could occur in Sweden based on the sources used.

Figure 6.3: Example of net benefit of respective platform over time



As stated, the ability to cooperate and design interoperable systems are also key factors in the rate of adoption for DLT. In a theoretical scenario where a global bank controls a global distributed ledger network, everyone could use the same currency abroad and there would be a lot of advantages. However, individual countries lose the ability to control their economics through for instance fiscal and monetary policies. A proposal as such raises a lot of complex thoughts regarding the structure of the network. (Szablowski, 2018) An analogy discussed by Sointu (2018) is bank technology versus the introduction of and transitioning to the internet. Connection points to the outside of a bank will still require specific permissions and there will always be private and public elements to networks of financial institutions. In the upcoming years, the elements will just harmonize in terms of technology and interoperability. (Sointu, 2018) Sweden has further seen recent success stories of for example Klarna, and many other companies, whose business models have revolved around taking over risk. Therefore, by the analysis and discussion, it is concluded that while there exist barriers for adoption of DLT in Swedish banks and their trade finance operations, the Swedish market likely enables for adoption of DLT at a fast pace.

## Chapter 7

# Conclusions, implications and future research

*In this chapter, the conclusions made in this thesis are presented along with implications and proposed future research that has been identified. The conclusions provide the answer to the research question proposed initially in this thesis by sequentially stating the conclusions of each respective sub-research question.*

## 7.1 Conclusions

### 7.1.1 Answering the research questions

The purpose of this thesis was to assess the dynamics of a potential transition to a DLT-based system in trade and export finance in Sweden. In order to answer the research question in a systematic and organized way, three sub-research questions were formed. The questions and answers are presented below.

#### **The first Sub-RQ: What are the costs and benefits related to an adoption of DLT?**

**The costs** of adopting distributed ledger technology for banks in Swedish trade and export finance were determined to consist of development costs and implementation costs. The research and development (R&D) costs for DLT in trade finance operations and post trade settlement were estimated to USD 40 million for 2019 (section 6.1.1 presents these calculations in detail). The conducted research also suggests that the implementation cost of DLT in trade finance in Sweden today is high but likely to decrease.

**The benefits** of adopting distributed ledger technology for banks in trade and export finance in Sweden were determined to be many by the conducted research. Some of the most prominent benefits identified were for example *automation*, *efficiency* and *reduced level of complexity*. Further, these benefits can result in sequential effects with varying size for the bank. For example, *automation* can be likely be noticed immediately after implementation, consequently resulting in other benefits for the bank, such as less *paper intensity* and reduced *human error*.

As the the technology matures, the implementation cost will likely decrease from the current high levels. Further, the magnitude of benefits increases with the number of network users. The adoption of DLT in trade and export finance in the technology's current state is therefore likely seen as a long-term investment by implementers. Moreover, research suggests that the future cost

reduction compared to currently employed solutions could be as much as thirty percent. It will be key to explore how parts of processing can be exposed into public space to leverage the full potential benefit of the technology.

**The second sub-RQ: What are the contextual factors that affect the rate of adoption of DLT in Swedish trade and export finance specifically?**

The following table presents the main contextual factors. The full version can be found in section 6.2.

Table 7.1: Condensed Swedish contextual analysis

Factor type	Hinders for adoption	Accelerators for adoption
<b>Political</b>	Parliamentary uncertainty Political differences between countries	Real-time tracking Transparency
<b>Economical</b>	Low comparable government subsidies and tax incentives Low interest rates and potential recession approaching High economic complexity	Among lowest statutory tax rates on business income in OECD Economic growth potential incentivizes governmental support SME's gain access to credit
<b>Sociocultural</b>	High required security, personal integrity and trustworthiness Need to preserve current functions expected by the population	Innovativeness of population Trust and creditworthiness valued Information asymmetries exist Crime rates in fraud and identity theft
<b>Technological</b>	Low marginal performance increase per invested unit Vanilla technological solutions could provide similar properties, cheaper	Booming FinTech industry Decreasing margins force improvement Firms must stay competitive Functioning existent infrastructure
<b>Legal</b>	Advanced regulatory structure Consolidated system becomes intricate	EU trade eases mapping Automation of reporting
<b>Environmental</b>	Consensus algorithms inefficient and power consuming, technology must mature for less environmental impact	Increasing awareness of environment issues and positivity towards sustainability among population

**The third sub-RQ: What are the major remaining barriers of adoption?**

The conducted research suggests that there exists a number of barriers, mainly:

**Cooperation and trust;** since banks are used to competing rather than cooperating, and have business models dependent on clients' trust.

**Standardization and interoperability;** because start-ups, initiatives and firms' IT-systems develop differently and may need to be integrated to work with a DLT solution. Standardization is needed in order to ensure seamless procedures and efficiency.

**Governance in complex regulatory environment;** since integration to law of a DLT system is complicated by the fact that different laws and regulations apply in different geographical areas. The system must operate over multiple regions by the nature of export trade occurring across borders. Moreover, someone must control and be responsible for the DLT network even though

decentralization of information and responsibility is the definition of a DLT network.

**Technical challenges**, such as speed and scalability, are less prominent in trade and export finance specifically. Trade and export finance transactions are generally large and less frequent than in for example equity capital markets. The main technical issue for DLT adoption in trade finance in Sweden is forming a governance model according to the above mentioned, whilst maintaining a high level of security.

**The research question: What factors affect the rate of adoption for distributed ledger technology in Swedish trade and export finance?**

The rate of adoption for DLT in trade and export finance in Sweden depends on a variety of factors. In this thesis, the factors affecting the rate of adoption for DLT in Swedish trade and export finance were considered to appertain to three different categories.

- Costs and benefits of development and implementation for the bank, and thereby what value a transition would add to the bank.
- Swedish contextual factors, per the table in section 6.2
- Barriers of adoption such as cooperation, trust, standardization, interoperability, governance and technical issues.

## 7.2 Implications and future predictions

The conducted research suggests that while DLT will not solve the trade finance sector's current issues and inefficiencies by itself, it likely plays a role in the future, more digitized version of trade finance operations along with other technologies such as artificial intelligence and machine learning. A technological transformation seems inevitable per the conducted research. It is therefore key for today's dominant trade finance actors to stay alerted of how the landscape evolves. Banks in Sweden may even be forced into investments and new business cases due to pressure from FinTech companies. The rate of adoption for DLT in general is likely slower than most people expect, but Sweden provides for a market environment that enables for adoption at a fast pace.

The leading banks within DLT development for trade finance have made large investments in DLT for trade finance through collaborations such as R3. The sheer amount invested likely increases the pressure on regulatory authorities to consider DLT a possible future path. The current regulatory framework may need to be altered to cover new occurrences, while remaining technique neutral. Further, more research and development will allow for efficiency improvements of today's DLT solutions through more democratic, adept network governance models.

A scenario in which the trade finance market considers a DLT platform for cost savings is likely. As the efficiency of a DLT platform will increase with more network members, the transition hinges on the ability to cooperate and to gather participants into a network as large as possible. Further efficiency gains can presumably be achieved through mechanisms that expose part of the trade finance process into public space. Within a time horizon of approximately ten to twenty years, the study suggests that benefits of DLT likely grow larger than the benefits of the current processing, incentivizing use of the technology for a wider user-base looking for profitability and efficiency gains.

## **7.3 Future research**

The adoption of DLT in trade finance operations is a major trend among recent research articles. The field of research for this thesis is contemporary and frequently covered in both academic and commercial research. Current research mainly covers how DLT would impact trade finance operations and why the technology is suitable. However, some topics that are relatively unexplored yet to be considered important for the future of DLT in trade and export finance are:

- The future business model of banks. What is a bank in the future? Where does its profitability lie?
- Public, permissionless networks. How will we be able to leverage them?
- The benefit for other parties. How do banks' customers, regulators and customs benefit from the technology?

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# Appendix A

## Interviews

### A.1 Björn Segendorf, Swedish central bank

Björn Segendorf works at the Swedish central bank since 2001, where he has had a multitude of roles. He has recently focused on monitoring of financial infrastructure at the department for financial stability. Moreover his work has also involved transaction security such that international standards are met, transitioning into FinTech (financial technology), innovation, the cashless society, clearing, settlement and payments. His role includes participating in international workgroups who analyze, investigate and develop blockchain and artificial intelligence technology.

#### Use cases and incentives

In today's world there is a lot of optimism about blockchain, Björn says. Not only in FinTech; regulatory technology (RegTech) developers as well as insurance companies see multiple potential applications of blockchain or DLT. One example discussed during the interview was the collaboration between the french central bank (Banque de France) and direct debit service providers in France, where a common registry is held. Björn says that application of blockchain technology was a good choice in this case, since the implementation could be motivated by the fact that blockchain fulfilled a lot of the sought-after criteria for solving the "problem". In general, he sees more applications, such as in automation of cross-border payments, smart contracts, back office services or trade finance, but at this time, the technology is not mature enough for implementation in most cases. The reason could be that we are yet unable to fully leverage the potential of the technology, like we are able to with the systems in place.

In order for a blockchain system to replace a currently used centralized system, it needs to provide some sort of incentives and comparative advantages. The old systems have been in place for many decades, while decentralized systems have only recently entered the market. Björn advocates that permissioned decentralized systems with governance function pretty similarly to current systems. The advantages of employing blockchain could for example be that the decentralization provides an automatic way of backing up information. Further, smart contracts and increased automation could provide important benefits, and in turn reduce transaction costs in back office services, information sharing and financial transactions.

#### Problems and challenges

Björn asserts that a blockchain system could certainly work in many cases, but that there are many unanswered questions and unsolved issues yet. First, the risks involved have not been

adequately examined yet, which is an important topic to investigate prior to moving valuable assets and information onto a blockchain. Second, Björn discusses how expensive it could be to take a leading position in such investigations. By letting others explore and encounter the teething troubles, a bank could avoid part of the large fixed cost involved with installing a new IT-system. The IT system of a bank is also often complex and large in scale, which makes it hard to handle and replace. This is true for most financial infrastructures, such as for example those of the Swedish central securities depository from the mid 1980's, Björn says. Furthermore, he sees scalability and transaction speed as other issues with decentralized solutions; an exponential increase in the amount of information handled with each additional node puts requirements on efficient consensus algorithms. Björn discusses Bitcoin as an example. The underlying blockchain can handle approximately 300 000 transactions per day (24 hours), increased slightly by some tweaks made to the technology, whereas there are approximately ten million credit and debit card transactions per day in Sweden. This gives a perspective on the scale of the problem in for instance a global payment system.

Regulations will be an important factor in how blockchain develops in the financial sector says Björn. However, the past has shown that we cannot simply treat blockchain differently in a regulatory sense. Regulations of the system need to be technique-neutral and should fall in place naturally when there is a need for it. Björn mentions how long it took to develop the Basel Standards to exemplify how long it may take for an international standard to be set up. Finally, he discusses how we additionally need to study how decentralization will require cyber security to evolve.

### Future predictions

In a perspective of five to ten years, Björn sees a limited growth of blockchain solutions in the financial sector. His hypothesis is that potential implementation will happen gradually and take longer than expected, mainly because of the large costs involved and the satisfactory functionality of current systems. Banks already provide services that simplify most tasks for their customers. The wide majority of banks will therefore prefer to buy a working system in the future rather than leading the experimentation. Björn however sees a time in roughly twenty years when the market is more open, primarily because there will be fewer legacy dependencies and more degrees of freedom to the new technology with more research, increased awareness and knowledge.

Conclusively, Björn is positive towards blockchain and DLT. His general take on blockchain in finance is that "necessity is the mother of invention" - there must be incentives along the chain of users to implement the technology. But what functionality of blockchain adds value? In a payment system like Swish for example, users create a transaction in seconds and sign it with their digital signature in Bank-ID. Any technology that aspires to outcompete the existing technology must provide similar real-time service and consistency, whilst have a leading edge elsewhere.

## A.2 Johan Toll, Nasdaq

Johan Toll is product manager for blockchain at Nasdaq, with extensive knowledge in blockchain technology. His previous involvements at Nasdaq has varied among different areas, such as data and machine intelligence but currently he focuses solely on blockchain. More specifically potential applications of the technology within the financial sector.

Even though the blockchain and DLT technology is relatively new and many of Nasdaq's customers still has low awareness when it comes to blockchain and DLT, Johan believes that the major banks in Sweden are ready to adopt blockchain and DLT technology gradually. They have come far in terms of understanding of blockchain and DLT but is still looking for the most profitable application. Further, Johan emphasises that the implementation of new technology takes long

time. All major Swedish banks are committed to the blockchain consortium R3 which, according to Johan, could be a means of finding these profitable applications. Especially since cooperation is the key to successfully apply blockchain technology as he describes it.

### **Incentives**

Continuously developing the technology is important but it is even more important to focus on finding inefficiencies in the current operations and other incentives to adopt new technology such as increased end-customer value according to Johan. In essence, primarily focus on the problems and inefficiencies of today rather than on a solution to a non identified problem. That is a key when Johan and his team are looking for potential applications of DLT technology. More specifically, Johan mentions that the characteristics of a business where he believes new technology such as DLT could be profitably applied are where the market is fragmented (many intermediaries involved), the operations is currently plagued with inefficiencies and are relatively lightly regulated. Examples of areas within the banking sector which Johan believes have these characteristics are trade finance, cross boarder transactions and the operations behind the trade of mutual funds, collaterals and bilateral contracts.

### **Potential**

Johan currently see two potential areas of application of blockchain and DLT from Nasdaqs point of view as a market place, disruptive and efficiency enhancement. Disruptive in the sense that, with DLT, completely change the business relations and communications of today by directly connecting stakeholders and hence completely change their role as a intermediary. When Johan discusses disruption, he also mentions the possibility to disrupt one of their current procedures with new technology. In that case, he believes the settlement procedures have potential of becoming more efficient with blockchain. Transferring ownership from seller to buyer could be traced easier through using blockchain. Efficiency enhancement is, as mentioned, also a great incentive for applying new technology. This is very important for Nasdaq in their role as a market place and intermediary. As an example, Johan mentions that clearing services could benefit from blockchain by making the synchronizing process between stakeholders and the clearing house more efficient or even redundant.

### **Challenges**

There is great potential in the blockchain and DLT but Johan mentions several challenges with the technology and its application that needs to be considered before it can be applied in the banking sector on a large scale. Primarily, Johan is concerned about the legal and regulatory aspects. Other concern are information security and lastly he mentions business relations.

An application of a new technology such as DLT in the current operations at banks will likely imply new means of interactions with stakeholders. Hence, existing regulations will have to be altered in order for them to stay up to date, according to Johan. Considering that developing new laws and regulations can take a substantial amount time, updating current laws and regulations should be a priority in the near future.

Further, when dealing with sensitive information it is vital to keep the information safe and protected against unauthorized individuals or organizations. Large banks and other major stakeholders in the financial sector today, such as Nasdaq, protects their data with multiple layers of firewalls. If blockchain would be used to transfer information between members of a network, all data would be shared freely with all members. A situation like this generates several questions to Johan. How can a member of this proposed network be certain that the other members handle the shared data the same way that itself does. All members will probably not be able to afford as rigorous cyber

security systems as the largest members of the network does. In turn, a situation like this will lead to the dilemma of what information to share with the other members of the blockchain based network and which data not too share. Johan emphasises that close collaboration with authorities such as Finansinspektionen, that supervises the financial market in Sweden, will speed up the process of finding the best way to answer these questions for all parties involved.

A last concern that Johan mentions is the disruptive effect an application of blockchain and DLT can have for business relations. More specifically, Johan discusses the challenge of convincing all parties of a current business platform to change to a completely new one based on blockchain technology. Moreover, such a transformation would raise questions such as which necessary technology to bring to the new platform and how it is done most efficiently. Johan stresses that since there are substantial costs implied with a potential transformation as mentioned the market must be highly motivated to use the new technology and see clear value for the end-customer.

Regarding the technology itself, Johan mentions that it is working better and better but still needs more testing before being implemented on a large scale. Johan speculates that gradually more and more companies will see potential for the technology as the development continues. However, at the moment it still more time consuming to execute a transaction in a centralized network compared to in a decentralized network, according to Johan. The key for success in this aspect is being able to handle more transactions in a decentralized network. Further, in the only available application of blockchain technology today, Bitcoin, there is no conventional governance structure in place. A consequence is that if a transaction is not correctly executed or someone steals your Bitcoins there is no juridical system to utilize in order to correct the mistakes or improper actions made. Such a scenario implies too great of a risk for financial institutions.

### **Future predictions**

Johan believes that in somewhere between 10 to 20 years we will see a more wide spread application of the DLT technology within the financial sector in Sweden. As mentioned, fragmented markets with a lot of intermediaries will be one of the first operations within the sector to apply blockchain and DLT. Here, all parties involved will see a great potential for cost cutting and as a consequence, Johan believes we will see fewer intermediaries.

### **Concluding thoughts**

To conclude, Johan see great potential for blockchain and DLT in the financial sector. Even though most banks agree on that certain operations within the financial sector, such as trade finance, will surely benefit from blockchain technology the banks are still in a stage where they are searching for profitable applications of blockchain and DLT. Johan also emphasises challenges with application of the technology and flaws with the technology at the moment. For example, current regulations will likely need to be revised, a decentralized blockchain network need to handle more transactions in order to speed up transactions and a governance structure has to be created before blockchain technology can be widely applied in the financial sector. But within 10 to 20 years, this will be a reality. Johan reminds us that it is far more complex to introduce a decentralized infrastructure than it is to introduce a centralized one as the one we have today.

## **A.3 Ville Sointu, Nordea**

Ville Sointu is head of DLT and blockchain at Nordea. He joined in June 2017, in a leading role for maintaining the portfolio of DLT and blockchain projects at a center of excellence for the company. He defines strategies together with other executives, streamlines projects and develops approaches as to how different sections of the company want to collaborate. The group is described as a

kind of "group therapy club" that has focused on the implications of decentralization for financial services. Nordea is part of the R3 consortium since 2015, and was one of the first Nordic banks to join together with SEB.

### Use cases

Nordea sees DLT as another enabler for networking. A large number of financial processes have been evaluated as potential use cases for DLT, but the focus within the R3 consortium has recently shifted more towards platform requirements. Ville describes this as a result of them having a good understanding of what the technology can and cannot do. The company has a general attitude to not go public with prototypes; they will only publically expose projects they actually see going into production. At this time two projects have gone public. In November 2017 the company announced its participation in a project that modernizes the Finnish real estate transaction service. The project involves all major banks in Finland as well as the tax department and the land server. The project uses the decentralized R3 Chorda platform. Second, Nordea is also part of the well-publicised project WeTrade as the ninth and final founding member. WeTrade aims to fully launch its platform for trade finance by the end of 2018 and Nordea foresees it to be the first real application for DLT in trade finance, streamlining trade between small to medium sized companies.

Ville describes how the distributed ledger technology itself is not a reason to do anything. There must be business upsides behind an investment, such as providing improved services for their customers. Any project initiated by Nordea stems from a business need. The WeTrade project, for example, solves several problems. It primarily addresses the issue of trust between two companies without a previous relation. Ville describes a scenario in which a small shop in France wants to order beer from a Finnish brewery. Today, the norm is for the small shop to pay for the full shipment upfront (prepayment). This prompts several issues: there is no real way for the brewer to trust the small shop, and a small shop as such likely faces liquidity issues with its investment. Likewise, the majority of issues are present for the reverse relation. How does the shop know that the brewer will deliver according to what has been agreed? The conclusion drawn by the consortium is that trust issues are a major hindrance to trade. Thus, the aim of WeTrade is to provide a trust network. It does so by sharing KYC for companies on both sides of a trade and bridging the trust in an automated network across multiple jurisdictions.

### Incentives

The main force that drives Nordea's research into DLT is one that creates better, cheaper and/or faster services. Distributed ledgers may primarily provide these qualities because of automation, Ville continues. Customers will never see the underlying network unless they particularly ask. In his opinion, the cost saving element of distributed ledger technology is often misunderstood. There is a need for integration to law as well as for intermediaries to take certain part of the risk in transactions. In fact, Ville concludes that there are not many intermediaries that can be simply removed from the current system. Cost savings for a financial network probably lie mainly in the automation that comes with a more democratic and decentralized governance model. We discuss payments, a commonly mentioned use case of DLT, as an example. The replacing of Bankgirot in Sweden by blockchain or DLT would only be possible if someone administrates the system, Ville says. DLT removes the physical database, but still requires for someone to manage the network: an entity who creates the rules, the governance model and does so in a transparent manner. Further, the rulebook needs to be integrated with local law which creates a complex situation. He summarizes that in the end the advantage of DLT is all about networking; it mainly enables removal of the notion of intermediaries to shift communication to a peer-to-peer level.

Ville is asked to discuss his view on incentives to use DLT over other technology. He mentions three ways of performing transactions between two entities that do not fully trust each other:

1. Traditional way:
  - Today, a third party does reconciliation and processing between the two parties.
  - One problem: the third party must be trusted by all parties to take good care of data.
  - The third party must display transparency of its intentions, which almost never happens.
  - This creates a honeypot of data. There will almost always exist someone looking to take advantage of such data, which is a weakness of the model.
2. Direct integration:
  - The two parties come to an agreement, shake hands, and complete a so-called bilateral transaction.
  - They integrate to each others API's, which when in place is very efficient.
  - But what happens if we want to scale that system? Integrating everything bilaterally becomes messy.
  - It is exponentially hard with each additional party.
  - This method requires maintaining contractual relationships.
3. Distributed ledger technology:
  - Ville describes this method as the best of both worlds.
  - Create virtual central consensus and integrate through your node.
  - All parties agree to the network of rules - the constitution.
  - The network defines consensus, and can provide settlement facilities.
  - The use of an algorithm instead of a centralized server automates and simplifies.

## Challenges

Continuing on, Ville says that some of the greatest challenges for anyone working with the third alternative, distributed ledgers, lie in replicating and providing functions of the other two alternatives, the current system. What should a shared process look like? DLT requires the participants to sign a rulebook for the network - a kind of constitution. Thereby, everyone knows what happens in different scenarios in the network. The contract law where the system is deployed, as well as mapping the regulatory environment onto the network creates for most of the heavy lifting he says.

## Future predictions

In the future, the market will see implementation of DLT, but Ville describes the implementation process to probably not be as fast as you would hope. As a bank customer, you will see some new services and improvement to existing ones. Most customers will not notice whether the underlying technology has transitioned to DLT or not. Ville thinks the future lies in DLT rather than in cryptocurrencies, since they are unregulated and there is no KYC in the public space. In a case where the implementation of DLT does not become as successful as many think today, he says that if nothing else, the technology has very much redefined the work environment and opened up peoples mind into a different way of thinking. Employees are allowed to think differently; there must not always be a processor in the middle. Ville further expresses his interest in permissionless DLT networks. These are hard to implement from a regulatory standpoint, but Ville thinks it is likely that regulators, banks and the participating entities will find ways to create equal playing rules for

people who want to use DLT in public space. He sees a likely convergence in approximately ten years, where participants can expose certain parts of networks into a permissionless space.

To conclude, Ville describes the key lesson with DLT is that it does not really solve any problems by itself - it is not a silver bullet. You still have to do all the work you did before. It can, however, aid in relationship building and opens up new ways to come to agreement as to what you are doing. Ville uses the analogy of bank technology versus the introduction of and transitioning to the internet. He sees similar development for blockchain and DLT, but asserts that connection points to the outside will still require specific permissions. There will always be private and public elements to networks of financial institutions, as there should be. In the upcoming years the elements will just harmonize in terms of technology and interoperability.

## A.4 Paula Da Silva & Kristian Gårder, SEB

Paula is head of transaction services at SEB, a department which includes cash management, trade finance and a mix of other financing products. In the conducted interview, Kristian Gårder from SEB was also present. He has been working with algorithmic trade, both at a software developer but also at several banks and a hedgefond. Currently, Kristian is Head of Digital Banking within the segment Large Corporates and Financial Institutions. When working with algorithmic trade Kristian has been following the development of both Blockchain/DLT and cryptocurrencies such as Bitcoin closely. Currently, Kristian is one of SEBs representatives in the DLT-initiative R3. Further, SEB has already adopted DLT in their daily operations. More specifically through SEBs collaboration with the US FinTech (financial technology) company Ripple. This collaboration provides SEB with the possibility of utilizing Ripples blockchain based protocol for inter-bank, cross boarder transactions.

### Current DLT applications

As mentioned, SEB is an part of the blockchain/DLT initiative R3 and has already started implementing DLT in their daily operations via their collaboration with Ripple. This was a natural starting point of this interview as it would help us to better understand SEBs standpoint on DLT and its potential.

A couple of years ago Ripple contacted SEB and asked of they would like to, amongst several ideas, make their cross boarder payments more efficient by utilizing Ripples blockchain based protocol. SEB saw potential and has been utilizing Ripples technology for intra-bank cross boarder transactions in real-time for some of their clients, more specifically between the clients accounts in Stockholm and New York. SEB launched this service in 2016 and seeks to provide these services to more of their clients and between more SEB branches<sup>1</sup>.

Parallel to the initiation of the Ripple collaboration, SEB has been members of R3 and seeks to implement their DLT, Corda, in the trade related parts of the service offerings of the bank. Kristian sees the initiative as a way to quickly utilize the best parts of the DLT technology, the network effect, as the more stakeholders that agrees on one standard the better. Thus, gathering financial institutions in an initiative such as R3 is very important to SEB. Another reason as to why an initiative such as R3 is important for SEB is the matter of trust. Which is a cornerstone for the services that a bank provides and a reason for why a bank exists. As Kristian describes it, SEB could invest in an internal, private, blockchain and it could serve a purpose but as there is no trust issues internally the benefit would be marginal. Rather, Kristian describes the main question regarding DLT for SEB as how to effectively implement the technology externally, with

<sup>1</sup><https://sebgroun.com/sv/press/nyheter/ny-betallosning-med-blockkedjeteknik-fran-ripple>  
<https://digital.di.se/artikel/seb-expanderar-blockchain-satsning>

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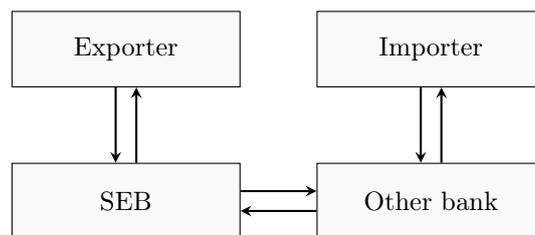
other banks, clients and regulators. In the quest for this answer, both initiatives mentioned are a suitable.

### Incentives

Continuing on, Paula mentions that DLT could be useful for all the departments within transaction services but she points out that implementing new technology has to have clear incentive, why should it be implemented? Paula stresses that cutting costs and increased customer benefits are a central aspects for SEB and one must always pin point how the customer benefits will be affected by planned actions. In the case of the application of Ripples technology for real-time transactions, Paula claims that they have not cut costs at all using this new technology but rather implemented it since SEB saw an large benefits for their customers when using this technology.

When describing the trade fiance operations, Paula concludes that there is great potential for DLT as these operations are based on a complex network of stakeholder which essentially can be translated into a trust issue between the exporter and the importer. This in turn generates heavy workloads for all parties involved and thus big expenses.

Figure A.1: Typical setup for a trade finance operation



Source: Paula da Silva, SEB

Paula concludes that an important question is if the illustrated procedure above will be able to reshape using modern technology or not. Paula thinks so and argues that DLT has large potential here since if the procedure will be transparent and secured in a private blockchain among involved parties it will erase the trust issue mentioned and hence reduce complexity. According to Paula, this reduction could be achieved as the time consuming process of reconciliation could be dealt with autonomously through the blockchain, instead of the process of reconciliation today that is still done manually to a large extent according to Paula. Then SEB could have several private blockchains based networks, each with one client and X other banks.

Apart from trust, cost cutting and decreased complexity Paula mentions another incentive behind an increased adoption of DLT in the transaction services operations, decreased margin of errors. Since reconciliation is to a large extent manually processed as mentioned, there is a risk of a payment isn't successfully completed or sent to the wrong account. These types of errors will be omitted.

### Challenges & problems

Both Kristian and Paula does see some challenges that comes with implementing DLT to a larger extent than already done. Primarily, Kristian mentions how all parties that will be utilizing blockchain technology to send information must unanimously agree on a definition of what is to be shared, what is an instrument etc and how it should be modelled in the infrastructure of a distributed ledger. Kristian stresses that this has to be done before an implementation of blockchain is possible and will be a time consuming process.

On another note, Paula speculates that another challenge will be important in the future. Namely something that can be related to the real-time transactions blockchain can provide, liquidity. Today a bank has one to two days to acquire enough credits for a certain situation. Reducing this time to an instant and the requirement to provide available credits for all parties constantly will put immense pressure on the bank, Paula emphasises.

Kristian points at other challenges as well, one of which are the several new and existing regulatory frameworks mandatory for financial institutions. GDPR is one of these, that states that a financial institution has to guarantee that the personal information saved for a certain use is deleted immediately after usage. As we know, one can't delete information stored in a distributed ledger. This stands in contradiction to the new regulatory framework mentioned and could be a potential problem.

Further, Kristian and Paula see problems with the DLT today. Paula mentions the relatively high costs of implementing the technology today, when it's still in a mature state. Something SEB as a market leader in this matter has experienced with Ripple. Further, something which they both emphasise as a problem is the speed and capacity limitations. Kristian says that even though he is certain these limitations will vanish in the future, the blockchain technology in its current form is not ideal for SEB in general for these reasons. It is better suited for businesses with fewer but more complex transactions rather than many but less complex.

### Future predictions

Paula and Kristian agree on that Trade Finance operations will definitely adopt DLT since there is so much money in circulation in these operations. Apart from this, Kristian believes that mutual funds is something that will see an adoption of DLT as well. The process of investing in a fund is a relatively manual process and paper intensive. Mistakes such as not investing the required amount in a certain fund at a certain price for a client (which is a costly error), could be eliminated. The purpose of these processes was originally to reduce risk but errors such as the one mentioned has shifted focus from the risk reduction Kristian mentions.

Moreover, as a major bank in Sweden, SEB has often acted as a custodian for institutional investors but Paula and Kristian agree on the fact that SEB's role as a custodian is under threat and this service will probably disappear from the service offering. Instead, offering credit and risk management will still be key areas of profit for SEB in the future according to Paula. Further, she stresses that the earnings they have today will not disappear because of these changes but merely shift. Services they don't charge for today could be services they do charge for tomorrow. As an example, a service such as BankID (an electronic ID service) is something they don't charge for today but generates great value to SEB's clients. Exactly how the business model of SEB will look like in the future is naturally something that Paula, Kristian and their colleagues discuss a lot.

### Conclusion

To conclude, both Paula and Kristian have a hard time estimating how the market for DLT and the adoption level of the technology within banks will look like within the next five to ten years but they mention trends they see coming. For example, Paula mentions that the Swedish clearinghouse for mass payment, Bankgirot and similar units in the other Nordic countries are working on a cross-boarder collaboration that could be based on blockchain technology. That is not yet decided as Paula stresses that negotiations are ongoing, but it could imply a much more efficient and rigid infrastructure for payments in the region.

Kristian points out that every operation and process that is not transparent and based on what can be considered outdated technology such as fax will change in some way in the given time frame.

But even if this is the case, if both users and the bank still are satisfied with a certain solution, implementing a blockchain based alternative solution is not necessarily worth it. On the other hand, Paula emphasises that if utilized correctly, the new technology such as DLT could help SEB lower their costs and become better at utilizing their data of the customers. If it were up to Paula and Kristian, they would they would have seen DLT being implemented in a larger scale within the bank today.

As a last note, Paula reminds us that when a new technology is emerging and start being adopted by a sector one typically overestimates what happens within two years but underestimates what happens within ten years. This will surely be the case for the adoption of blockchain and DLT aswell.

## A.5 Bernhard Szablowski, Swedbank

Bernhard Szablowski is head of global transaction services at Swedbank, along with a multitude of other roles. Bernhard joined Swedbank in 2015 after having worked as a consultant in bank and finance and, prior to that, having obtained an economics degree. He started his own business in 2002, but later sold the company after taking part in its stabilization and market integration. Bernhard's other roles and responsibilities within the company are business information officer (BIO), head of securities services (custody services for institutional clients), trade and export finance, bank coverage (institutional bank relations in OECD, foreign banks settling SEK and Swedish banks settling foreign currencies), operations and back office. Overall, Bernhard estimates that his managerial responsibility covers approximately 550 people. Given Bernhard's very extensive managerial role, our interview focus shifted slightly to the future role of banks in a broader spectrum than in other interviews.

### Challenges

We begin by discussing what banks sell. Historically and philosophically, Bernhard says that what banks sell is capital funding and trust. Banks are just an intermediary that is trusted by its clients; the capital that the bank holds is there because people trust the bank to keep track of their money. He exemplifies a situation where the client trust is lost with the crisis that the company went through in 2009. The crisis showed the effect of clients starting to worry about the bank's ability to manage their money, regardless of it being lent or borrowed. It showed the catastrophic effects of losing clients' trust for the bank and for the financial system as a whole; trust is *that* thing they own and must keep.

Continuing on we discuss ledgers, their design, and how banks use them. Bernhard mentions that ledgers have been central in keeping track of countables for hundreds of years. Many, if not all processes in a bank have emerged from a paper-based society. Automatization and digitalization of these mechanisms is an ongoing procedure that does not have a stable end state, Bernhard says. There has been continuous transformation from paper-based solutions to spreadsheets, to traditional databases, to other, differently structured digital solutions such as distributed ledgers. The current question that the bank asks itself is where to put trust, and how to balance that trust versus risk. All regulatory frameworks, and everything surrounding the bank is about trust. Bernhard says that distributed ledger technology is available to the bank, and that it is relatively easy to implement. But once trust is lost, it is very hard to regain. Therefore, the biggest challenge lies in balancing fast, active technological transformation with a working business model, while not compromising the clients' trust. Putting some branch of the business in a distributed ledger would mean a large alteration of the process in a short amount of time.

## Incentives

The main incentives for implementation of a distributed ledger would be efficiency, cost reductions and risk mitigation. In its core business where volumes are large, Bernhard says that Swedbank is already quite efficient. In general, the infrastructures in place for Swedish retail payments are already very digitalized. Therefore, there are not enormous efficiency gains on the customer side associated with a potential transition to DLT-based solutions. Internally he thinks that some intricate processes could benefit from use of distributed ledgers. The company must work to continuously develop its business.

It is mainly for the smaller products where the surrounding processes require more manual input. There are large potential profitability increases in these processes, but Bernhard explains how an investment in such a solution would most probably require significantly larger volumes for that product in order for the investment to carry a positive return. The bank often has to make decisions on whether to phase out its products or services that have not grown as expected, or to further invest in them to for example reduce the amount of manual input needed. In many cases, Bernhard says that the Pareto principle can be applied - eighty percent of the sales comes from twenty percent of the products and eighty percent of the costs are incurred by twenty percent of the products. For example, transactions in shares or foreign exchange carry extremely low variable costs today. The questions raised for "borderline" products are mainly strategic. Do we automatize further? Do we initiate a new segmentation, targeting, positioning (STP) process? Both are costly and incur high fixed costs, but may be worthwhile if it can benefit customer relations and/or a client demands that specific product or service to stay with us.

## Problems

Bernhard further presents the key trust-related issues with distributed ledgers. First, one must assure that the ledger is near impossible to infringe upon for unauthorized parties. Furthermore some issues need to be addressed and mitigated, such as situations where a wallet is lost. In real life, we have security solutions in place for a lot of these situations. We cannot simply walk into a bank and steal other people's money. Last, there must systems in place such that digital identities and assets cannot be stolen. Swedish banks have very specific requirements on them applied by authorities regarding for example knowing their customer (KYC). The blockchain applied by Bitcoin allows for anonymous transactions and is therefore not applicable in a majority of cases. The consensus, Bernhard says, is that there are a lot of questions that are yet to be addressed for distributed ledgers.

One incentive for implementation of distributed ledgers is, as was described above, the cost reduction it can provide. Microeconomic theory suggests that should the marginal cost decrease, people are willing to pay less for a product or service in a competitive market. Bernhard says that thereby, there is a risk of the bank eroding its own business with the implementing distributed ledgers.

## Why Sweden is an interesting case

Bernhard explains how FinTech (financial technology) companies in some ways have an advantage over banks when it comes to development of distributed ledger technology. In FinTech there is a different regulatory structure, and the companies do not commonly take the real risk; they are usually just front-end aggregators or distributors. It does not matter too much if things go wrong, but they are able to attract paying customers. The Swedish system is unique. We have an advanced infrastructure with UC, Bankgirot, Swish, Bank-ID, and the identification and handling of individuals' credit risk. Credit losses in Sweden are very costly for the individual, who receives a permanent disclosure that credit providers can see. The system functions very well, is very

stable, and creates a high "payments morality". The Swedish infrastructure is easily reusable and Bernhard says we must not underrate what we have built. Given the above, he thinks that we must understand which context we operate in, and that companies like Klarna would not have been nearly as successful in other markets. In Germany, for example, credit cards are used to a much lesser extent. In the United States, work is still being done on the digitalization of cheques.

### Current work

We ask whether Swedbank are currently working with blockchain or distributed ledgers. The bank has a technology evangelist employed and watches the development of blockchain and distributed ledger technology closely, Bernhard says. There is limited active cooperation with other banks within distributed ledger technology. The main areas in which the technology has potential uses are securities and derivatives transactions as well as in trade finance. Swedbank actively looks for potential use cases for the technology and monitors progress of the technological development. The difficult part is that while most use cases are good ideas, the inconveniences they bring show up when you start digging a bit. Bernhard says that while applications of distributed ledgers in trade and export finance are fantastic, but that vanilla digitalisation could be just as good. The trade finance process is very paper-based, and it is a secondary question as to whether blockchain or other digitalisation is the correct way to evolve it. Are there even better, more effective ways of developing the process? Bernhard proposes a situation where a ledger is placed outside the bank with a number of nodes. The key questions then become: what is the role of the bank in that network? What value does the bank add? Can the client simply just log in themselves without the involvement of the bank? Bernhard says that it is easy to become fascinated by the technology and stresses the importance of seeing the potential issues that may evolve with its implementation.

### Future predictions

In a perspective of five to ten years ahead, Bernhard is hesitant as to how widespread the use of distributed ledgers in the bank sector will be. He says that the market will need to agree on how to proceed. We already see private networks with parties that trust each other use distributed ledgers, and more solutions as such will be employed in the upcoming year. However, to reach the full potential and maximize the value of distributed ledger technology he says that one must dare to place the ledger outside the bank. To Bernhard, the issue is not that the technology is not mature enough. It is moreover the business model that is not mature enough for a transition. We need to trust the technology and feel safe using it.

Bernhard is asked where he sees the bank position itself in the future and where he believes its business cases lie, a question which he considers key and thinks a lot about himself. What is a bank in the future? Four things were mentioned:

- People will probably need loans to finance their lives
- There will be a need to evaluate people's creditworthiness
- Safekeeping and handling of people's money, depending on how we see money in the future
- Keep track of who owns what

Should the bank engage fully in a transition to blockchain based systems, we continue to talk about how the business model would need to evolve. Bernhard rhetorically asks what their role would be in that case - would it perhaps be to hold some key to the network? In that case, is that really what the bank does best? Are there other actors, with other competencies, that would do that job better than a bank? The conclusion drawn is that at this point it is clear that the business model is not mature for such a transition. It is further very difficult to say how fast the banks'

processes will change in the future, Bernhard says. Some things may happen in five to ten years, whilst some take fifty or hundred years. He thinks small steps will be taken at a time, and that adaptations will be needed after each small step.

If everyone in the entire world knows exactly who everyone is, and we can faultlessly identify who stands behind a digital identity, there really is not much left for a bank to do, Bernhard says. Banks find people who demand money and people willing to lend them money, they make sure the borrower can pay for themselves. If the two parties already know everything about each other and nothing will ever go wrong, then what is the point of an intermediary? Why don't the parties simply agree on the loan together? In the future, banks may or may not be needed. People may still trust the banks' ability to assess creditworthiness for example. Banks also have the advantage of being able to handle risk by aggregating small risks like an insurance company.

### Concluding thoughts

To conclude our interview, we ask Bernhard what he believes the key takeaways are and if there is anything he would like to add or clarify. The key message is that distributed ledgers could be pivotal, and that they are very exciting and technologically interesting. This far, the problems lie in the regulations and complex, demanding structures that exist in a bank today. Sweden's financial supervisory authority (Finansinspektionen, FI) demand extensive reporting from banks such that the authority gains insight on how the bank monitors the assets and liabilities of its clients. Any bank-related event must be documented, and any part of the business that occurs outside the bank must be reported. The authority is generally skeptical towards outsourcing. There are strict routines for information security and further restrictions employed such that information cannot leave the European Union.

Bernhard describes the step from outsourcing to distributed ledgers as not very large. With outsourcing, however, the bank still owns the data and has the liability. When will the regulatory authorities allow us to appoint the responsibilities to some sort of distributed ledger network consensus without a central counterparty? To receive the full value of distributed ledger technology, this must be made possible and we must be able to entrust the network with our own information. The largest step of the transition lies in trust and regulation, he concludes. Who is responsible if my money or assets disappear? Essentially, historical proof of existence and stability provide for example currency trading with trust and stability. A degree of trust must exist similarly for blockchain.

In a theoretical scenario where a global bank controls a global distributed ledger network, everyone could use the same currency abroad and there would be a lot of advantages. However the individual countries lose their ability to control their economics, through for instance fiscal and monetary policies. A proposal as such raises a lot of complex thoughts regarding the structure of the network. Bernhard says that he is convinced the isolated parts of banks' business will see use cases of distributed ledgers, but that a global network seems unlikely. There are already distributed ledgers in some isolated places, for example in a diamond exchange (CEDEX). In this case there exists an underlying asset, and the blockchain supplies the network with a way of tracking the ownership via a ledger. It is important to remember that this representation of the physical reality addresses other questions than for example Bitcoin, where there are no tangible assets involved in the currency itself. Given the lack of tangibility in digital assets, Bernhard sees trust as such a vital aspect. There exists a demand for a third party that guarantees money actually exists, which is partly why it is so troublesome when banks encounter problems. In Sweden, the deposit guarantee (insättningsgaranti) as well as other societal mechanisms are in place to handle such situations. There are no similar functions in place in case of a scenario where a blockchain fails. Prior to a more widespread implementation of distributed ledger technology in the bank, Bernhard sees a need for these functions to be acknowledged.

## A.6 Stefan Carleke, Handelsbanken

Stefan is head of Handelsbankens Trade Finance operations in Sweden, a department offering the products letter of credit, collection and bankguarantees. Before taking this position, Stefan was head of the regional Trade Finance office in Gothenburg. Prior to this Stefan worked at the department of financial institutions, also within Handelsbanken. A position implying frequent contact with other countries and markets, especially developing countries.

### Problems

When describing the process of issuing the products offered at the Trade Finance department, Stefan points out that the technological development has been slow and as a consequence the process has been fairly similar for the last 90 years. The process implies loads of paperwork and manual labour, and can thus be seen as relatively outdated compared to other banking operations. Hence, Stefan understand that banks and other stakeholders see potential in modernizing this process with for example blockchain technology.

However, Stefan believes that focusing on implementing blockchain technology in Trade Finance is to focus on the future development too much and not on increasing customer value and efficiency today. Stefan argues that clients using Trade Finance products are comfortable and satisfied with the current procedures and are relatively conservative. A digital transformation such as the one Handelsbankens is currently working on, which entails replacing the current procedures of requesting, for example a bankguarantee, via email to an online platform can be seen as a change that already should have been in place given the digital maturity of many other banking services. However, even a relatively basic change such as this one is met with skepticism from customers. Further, Handelsbanken doesnt aspire to be the leader of innovation, they see advantages of being second or third when it comes to implementing new technology. Stefan argues that this strategy is good as one avoids spending resources on products and technology not requested by the customers. As a consequence, Handelsbanken has a cautious yet curious position towards new technology.

### Current work & future predictions

So even though Handelsbanken and their trade finance department finds blockchain relevant and sees future potential in the technology, the current trend in trade finance is instead increasing the level of digitization in other ways. For example through digitization projects such as the one mentioned above. Other trends within digitization of trade finance are the possibility of creating digital documents. This could decrease the amounts of paper work required within the procedure of issuing a guarantee or letter of credit considerably. However, reluctance among intermediaries is making this progression slow. Another trend in which Stefan sees great potential is Artificial Intelligence (AI). Stefan believes that an AI-robot could reduce both costs and risk as it could conduct parts of the necessary reviews of documents that otherwise is done manually and is the most time consuming process. Since the market for AI-robots is growing rapidly as the robots is getting more and more sophisticated, Stefan says that this is one of Handelsbankes top priorities today.

### Incentives

Still, the development of blockchain and DLT is something that Stefan monitors closely as he is certain that it will, in some way, be the future of trade finance operations. Especially since the current process is time consuming, not only for the banks and intermediaries, but for the customers as well, as they have to request printed and signed documents from several stakeholders such as the custom authority, shipping companies and relevant chamber of commerce in order to request a

guarantee or letter of credit. As mentioned, Stefan says that customers are satisfied with current procedures but he believes that companies frequently utilizing trade finance products will gradually realize the efficiency enhancement possible in the described process. When that time comes, one has to be ready to offer new solutions regarding trade finance products in order to stay competitive. This will take more time than commonly stated in journals, seminars and news papers according to Stefan. Rather than seeing wide spread application of blockchain in trade finance this or the next year, Stefan believes a time horizon of around 5 years is more probable. The main reason according to Stefan is that the companies and bank divisions that are experts on blockchain technology don't fully understand the complexity of trade finance operations.

### Challenges

Conclusive, Stefan and Handelsbanken sees great potential in blockchain technology in Trade Finance in the future, as a means to make the trade finance operations simpler and less paper intensive. However, Stefan points out that there still are some challenges that needs to be dealt with before a wide spread implementation of blockchain technology in Trade Finance. The greatest challenge that Stefan sees with implementing blockchain is regulations. He stresses that current regulations has to be updated in order for blockchain based Trade Finance solutions to be viable and avoid a situation such as the one seen with Bitcoin, where a significant part of the transactions are illegal. This is partly due to the lack of a governance structure and updated regulations that take Bitcoin transactions in consideration, hence the importance of updated regulations according to Stefan.

Another aspect with regulations and Trade Finance operations that Stefan mentions is the fact that the amount of regulations vary greatly between the markets that Handelsbanken Trade Finance have relations with. Broadly speaking, Stefan describes the situation such as the amount of regulations are greater in the developing countries compared to OECD countries<sup>2</sup>. Hence, Stefan says that even if updated regulations in the Nordics are vital for an implementation of blockchain in Handelsbankens Trade Finance operations, it is as important to consider the regulations in the countries that Handelsbankens customers do business with. If one does not overcome this, Stefan believes it will be tough for new technology to become successful. This will be a great challenge according to Stefan and a reason to why he believes that we will initially see blockchain based Trade Finance solutions between OECD countries.

One more challenge with implementing a blockchain-based Trade Finance solution is external factors such as globalization and free trade agreements. At the moment, we are seeing setbacks to the global free trade and as a consequence Stefan argues that this will impede the development of blockchain based trade finance solutions. Technically though, Stefan speculates that the blockchain technology itself is probably already in place (even though he stresses that he is not an expert in the technology) and mature enough to be implemented. It is other factors such as regulations, mentioned above, that are not in place.

Lastly, Stefan discusses the importance of overcoming trust issues that stakeholders will have towards any new solutions. This is especially relevant within trade finance as these solutions have, as mentioned, remained unchanged for a long time.

### Concluding thoughts

We can conclude that Trade Finance operations will undergo significant transformation in the near future. Digitization is something that Stefan mentions as the main trend within the paper and labour intensive Trade Finance operations. More specifically, Stefan mentions Artificial Intelligence as the most interesting technology at the moment, as a mean to reduce cost and risk. Despite this,

<sup>2</sup>The Organisation for Economic Co-operation and Development (OECD), [www.oecd.org/](http://www.oecd.org/)

he is certain that blockchain will be a part of the future of Trade Finance operations as a mean to enhance efficiency and something that will increase customer value and simplify processes for Handelsbankens themselves.