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# The role of trust in understanding the effects of blockchain on business models

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**Abstract of master's thesis**

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**Abstract**

Blockchain technology is a systemic transaction innovation in information processing. It enables trust-reliant transactions between parties that were previously unable to trust each other by means of an immutable transaction log and verification of order and validity of transactions, among other things. Blockchain technology is a new way to integrate old technologies, such as digital signatures, cryptography, and hash functions, but as an innovation it is just at the start of its evolution. This is an important topic to study, for it is still poorly understood, but anticipated to be a disruptive technological innovation. This work studies how blockchain technology could change business models, and especially what is the role of trust in this change. The theoretical frame for this study comes from trust literature.

This study started with a literature review, based on which two hypotheses were created that were tested with a comparative case study of two companies, one from energy and one from financial services industry. The primary material was collected from 25 interviews, each lasting for about an hour. In addition to the two case companies, the sample included experts from the industries and blockchain specialists. Based on the interviews and other material, I constructed three hypothetical use cases that both illustrate how blockchain technology can be used and present an opportunity for analysis of business models.

The most important conclusions of this study divide into two. First of all, the research clarifies the strategic understanding of blockchain technology by presenting a framework for use case evaluation and by opening the opportunity offered by blockchain to increase trust or to negate the need for it in a transaction. Secondly, this study offers implications both for companies and for further study, indicating that blockchain use cases are very difficult to find. Further, the role of trust in an industry seems to have an effect on what kinds of changes blockchain can cause in business models. Blockchain technology can thus be considered both a technological and a business model innovation, and making a distinction between the two is important. As a business model innovation, blockchain could disrupt business models in a wide range of industries and geographical locations.

**Keywords** Blockchain, business model, digital trust, innovation

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Lohkoketjuteknologia on systeeminen transaktioinnovaatio tietojen käsittelyssä. Se mahdollistaa luottamusta edellyttävien transaktioiden toteutuksen toisilleen entuudestaan tuntemattomien tahojen välillä. Tämä on mahdollista mm. muuttamattoman transaktiohistorian sekä transaktioiden järjestyksen ja oikeellisuuden takaamisen myötä. Lohkoketjuteknologia on uusi tapa yhdistellä vanhoja teknologioita, kuten digitaaliset allekirjoitukset, kryptografia sekä tiivistefunktiot, mutta innovaationa se on vasta kehityksensä alussa. Aihetta on tärkeää tutkia, sillä sitä ymmärretään vielä vähän. Toisaalta sen odotetaan olevan mahdollisesti jopa mullistava teknologinen innovaatio. Tässä työssä tutkitaan miten lohkoketjuteknologia muuttaa liiketoimintamalleja, ja erityisesti mikä on luottamuksen rooli tässä muutoksessa. Työn teoreettinen kehys tulee luottamuskirjallisuudesta.

Tutkimus aloitettiin kirjallisuuskatsauksella, jonka pohjalta luotuja hypoteeseja tarkasteltiin vertailevan tapaustutkimuksen avulla. Tapausyrityksiä oli yksi sekä finanssipalvelu- että energiatoimialoilta, mahdollistaen toimialojen vertailun. Primääriaineisto koostui pääasiassa 25 noin tunnin mittaisesta haastattelusta. Kahden tapausyritysten lisäksi kuului näytteeseen sekä toimialojen asiantuntijoita, että lohkoketjuteknologian asiantuntijoita. Haastatteluiden sekä muun aineiston pohjalta rakensin kolme hypoteettista käyttötapausta, jotka sekä kuvaavat lohkoketjuteknologian toimintaa käytännössä että tarjoavat mahdollisuuden liiketoimintamallien analyysiin.

Tutkimuksen tärkeimmät johtopäätökset voidaan jakaa kahteen osaan. Ensinnäkin, tutkimus selkeyttää lohkoketjuteknologian strategista ymmärrystä esittämällä viitekehyksen käyttötapausten arviointiin, sekä avaamalla lohkoketjuteknologian tarjoamaa mahdollisuutta lisätä luottamusta tai poistaa sen tarpeen transaktioissa. Toiseksi, tutkimus esittää näkökulmia sekä yrityksille että jatkotutkimukselle. Tutkimus osoittaa, että lohkoketjujen käyttötapauksia on vaikea löytää. Luottamuksen rooli toimialalla vaikuttaa siihen, millaisia muutoksia lohkoketju voi aiheuttaa liiketoimintamalleissa. Lohkoketjuteknologiaa voidaan siis pitää sekä teknologisena että liiketoimintamalli-innovaationa, ja näiden erottaminen toisistaan on tärkeää. Liiketoimintamalli-innovaationa lohkoketjun käyttöönotto voi aiheuttaa merkittävän määrän muutoksia liiketoimintamalleissa toimialallisesti ja maantieteellisesti laajalla alueella.



**Avainsanat** Lohkoketju, liiketoimintamalli, digitaalinen luottamus, innovaatio

# Preface

I am grateful I had the opportunity to research such an interesting topic with great guidance. First I would like to thank Professor Robin Gustafsson and Professor Risto Rajala for guiding and supervising my work. Also thank you Professor Timo Seppälä, Juri Mattila and Kimmo Karhu for helping me in defining the topic for this work and thereafter.

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But mostly I want to thank my family – R, A, & A – for enabling this with your loving support.

Jane Seppälä

Helsinki, October 7, 2016

# Abbreviations

| | |
|---|---|
| DCS | Decentralized consensus systems |
| DLT | Decentralized ledger technology |
| | |
| PoS | Proof-of-stake |
| PoW | Proof-of-work |
| SP | Supporting process |
| VP | Value proposition |

# Table of Contents

## List of tables



## List of figures

# 1 Introduction

## 1.1 Thesis foundation

Blockchain is a distributed ledger technology. It acts as a shared database that keeps all of its copies in sync. The distributed ledger technology performs the functions of decentralized decision-making and transaction history tracking. This means that a ledger can maintain consensus while many parties make changes to the content simultaneously. The first, and the only widely tested and proven application of blockchain technology is the virtual currency Bitcoin. Blockchain technology solves the double-spending problem that makes virtual currencies problematic. Blockchain as a technological innovation is currently still in its nascent stage. However, there are many indications that the technology could impact business models across industries and economies in substantial ways. This research focuses on analyzing the potentials of blockchain to disrupt existing business models and to that extent provide insights on how to consider blockchain technology from a corporate strategic perspective.

## 1.2 Motivation

The topic is interesting in its timeliness: there is hype around the blockchain technology, yet very little knowledge of its actual potential and fit. This is exemplified by the fact that Gartner reported blockchain to be close to the peak of the hype curve, speculating that the expectations of the technology are currently exaggerated, while the actual doing is about to start (Rizzo 2016). The industry including both incumbents and startups, professional service providers and governments have all taken interest in blockchain. The incumbent interest is demonstrated by how many companies –banks acting as the forerunners– have started investing in blockchain research and taking part in the growing blockchain ecosystem. There has also been a notable amount of venture capital funding into this space. (Magister 2016) Many professional services providers such as consultancies have taken blockchain under their radar and often mention it as an important technology to watch out for (WEF 2016; Leibowitz 2016). Even governments have taken interest in the technology, as for example in Estonia (Palmer 2016). While the future importance of blockchain is unclear, it could be immense.

Business importance of this research is thus clear, as these new technologies could play a role in defining the business models of the future as well as improving efficiency in existing ones. Some early proof of this comes from platforms and Internet of things. Platforms as a model for conducting business are important, and the trend toward platforms is still strong. When online platforms go from centralized to decentralized, it is crucial for firms to understand the implications of these changes on their business. Furthermore, blockchain technology could play a big role in creating new types of businesses altogether. ETLA report *Blockchain as a Path to a Network of Systems* (2015) emphasizes the potential role of this technology in realizing the actual value of the Internet of Things. (Mattila & Seppälä 2015) By understanding these opportunities, firms can see new ways of creating value. What comes to improving efficiencies, over 50 leadings banks, including the biggest banks operating in Finland, are already part of the R3 Distributed Ledger Consortium that is looking for use cases that could improve banking services with the help of blockchain technology.

## 1.3 Problem area

There is a limited amount of academic research on blockchain, especially from the strategy point of view. Further, the terminology around it is inconsistent, and especially non-technical individuals often misunderstand the value and potential of the technology, which leads to misunderstanding the business case. There is clearly a need for further research of blockchain as a technical innovation that can induce business model innovation. Trust is of great importance when talking about blockchain, mainly for two reasons. First of all, blockchain is an innovation in trust in the digital environment (Leibowitz 2016). But further, it seems that one of the major misconceptions around blockchain has to do with incomplete understanding of what trust means in the blockchain context.

Blockchain may redefine digital trust in business context. Trust in sociology has many different definitions, but defining it in the context of computer science is no more straightforward. Here, the meaning varies from subfield to subfield: "Within computer science, trust has been co-opted by many subfields to mean many different things. It is a descriptor of security and encryption; a name for authentication methods or digital signatures; a measure of the quality of a peer in P2P systems; a factor in game theory; a model for agent interactions [24]; a gauge of attack-resistance; a component of ubiquitous computing; a foundation for interactions in agent systems [28], [4]; and a motivation for online and recommender systems" (Golbeck 2006, p. 134). Interestingly, many technologies such as encryption, digital signatures and P2P systems mentioned above are parts of blockchain infrastructure. This is one reason why understanding trust in the blockchain context can be difficult. To further complicate the issue, there are in fact many different ways blockchain can affect trust. These can be grouped by the type of trust affected or by mechanism; the important take-away being that blockchain can either improve trust or negate the need for it in a transaction.

## 1.4 Research scope and goals

I will focus on commercial blockchain applications, specifically in the financial and energy industries. The scope of this research is limited to studying use cases for incumbent firms in the Nordics. While blockchain has many interesting and important applications that could change the way third world countries get access to banking, my focus is on the developed countries use cases (Tapscott & Tapscott 2016). In this thesis I will look at how blockchain technology could change business models. I focused on trust in the use cases. My research question is:

*How can blockchain technology trigger trust and transaction based business model innovations?*

It further divides into two sub-questions:

1) What are the effects of blockchain technology on trust in business?
2) What kinds of business model innovations can blockchain technology facilitate?

I intend to answer these questions as follows: in the conceptual development and hypothesis part I will answer the first sub-question, in the discussion section I will answer the second sub-question, and in finally in the conclusions I will address the main research question. The second sub-question includes the aim to establish criteria for analyzing the applicability of blockchain technology in a specific business-case.

# 2 Conceptual background

In this chapter I will introduce the conceptual background of this study. First I will discuss the technology at focus, blockchain, and then move on to trust literature.

## 2.1 Technology at focus: blockchain

This section will serve as a short introduction to blockchain technology. I will define concepts, explain briefly the technical side, and discuss a selected set of use cases, and end with pointing out challenges with the technology implementation.

### 2.1.1 Introduction

Blockchain is a term used for distributed ledger technology. This technology is still quite early in its development, making the terminology poorly defined and use cases mostly hypothetical. There is no consensus on what the technology should be called, or how the term should be limited. The most prominent application of this technology is Bitcoin, a virtual currency implemented in 2009 that also introduced the technology. But the possible implementations go much further than that: it has been said to have applications for "any form of asset registry, inventory, and exchange, including every area of finance, economics, and money; hard assets (physical property); and intangible assets (votes, ideas, reputation, intention, health data, information, etc.)" (Tirri 2015, p. 8). So far, Bitcoin is sometimes considered the only proven blockchain, and although there are great things imagined for the technology to do, very little has been done (Rizzo 2016). What the technology does is to maintain consensus over a distributed database. The technology is based on peer-to-peer technologies: a group of computers validates transactions and creates an immutable transaction log, hence enabling systems to be truly decentralized.

### 2.1.2 Defining blockchain

There are many definitions for the term 'blockchain', and one reason for this is that it indeed is used to mean many different things. One way of looking at it is a threefold division: blockchain is a data structure, it is a technology stack, and it is a social phenomenon. (Mattila 2016)

It seems appropriate to start from the Bitcoin white paper that first introduced the technology. There Nakamoto (pseudonym) describes the Bitcoin system as "Peer-to-peer distributed timestamp server that generates computational proof of the chronological order of transactions." (Nakamoto 2008) Interestingly, while bitcoin is the first example of a blockchain application, the term "blockchain" is not mentioned in the original white paper that presents the technology. In earlier texts the term "block chain" is used to describe the technology, which really is a chain of blocks and thus quite logical. It seems to be unclear who used the term “blockchain” for the first time, and further, what exactly is meant by this.

Some argue that blockchain is only a data structure. The term is however used much broadly to refer to the social phenomenon. In recent times, the term blockchain has been deemed ‘colloquial’. (Mattila 2016) Other names for the technology have been suggested, such as distributed consensus systems, distributed consensus ledgers, and replicated shared ledgers. European Central bank publication defines blockchain as “a database structure that can only be updated by appending a new set (or block) of valid transactions to the log of previous transactions. The DLT protocol is designed such that consensus is reached on transactions involving ‘unspent transaction outputs’, i.e. the set of assets available to the initiator of a transaction” (Pinna & Ruttenberg 2016, p. 9). This definition includes many important aspects: valid transactions, consensus, and unspent transaction outputs. Valid transactions are such that do not break the business rules of the specific blockchain. Consensus is the agreement on the valid state of the database, as discussed later in this chapter. Unspent transaction output describes the fact that rather than storing balances, blockchains often can be thought of as being transaction histories, and thus unspent transaction output or what you still have left to spend is meaningful information that can be backtracked throughout the transaction history. In this thesis I will call the technology blockchain. I will not give a specific definition of what this means, since it will likely develop and it is not needed in more specific terms in the context of this report.

Moreover, the concept of smart contracts should be discussed as it is crucial in all blockchain applications and even more so in the more complicated ones. Also this concept holds a lot of misconceptions around it. Interestingly, the idea of smart contracts was introduced already in 1995, while only made possible by blockchain technology (Gord 2016). Smart contracts make changes in blockchain ledgers. They can be programmed to react to or to call other smart contracts. However, having a smart contract react to something in the real world is a tricky issue that cannot be perfectly solved as of the time of this writing.

In conclusion, blockchain is a database structure that can be modified by different parties at the same time and still retain the correct state. It is governed by a blockchain-specific protocol that allows for certain types of changes to be made by certain entities. What is the scope of the term is yet to be seen, but for now it can be assumed that it is applicable whenever we talk about a distributed ledger that stores the transaction history as blocks of data that are connected via hash functions, making the transaction history very difficult to alter.

### 2.1.3 Different blockchain architectures

There are many different blockchain architectures that can be classified for example based on their openness or purpose (Mattila 2016; Buterin 2015). Table 1 following shows examples of different blockchain architectures.

*Table 1. Examples of different blockchain architectures*

| Attribute | Open | Restricted | Explanation |
| --- | --- | --- | --- |
| Access | Bitcoin | R3 | Determines who can read data |
| Publicity | Bitcoin | Ripple | Determines who can write data |
| Purpose | (General) Ethereum | (Specific) Bitcoin | Determines purpose |

The first blockchain application Bitcoin is an example of an open, permissionless blockchain. To some, this is the only kind of blockchain that makes sense as it brings the most value in the sense that there are other easier, faster and cheaper database models for more private data holding. However, these can be thought of as scales rather than binary values, and even if totally private blockchains make little sense, blockchains that are private to a large amount of participants and thus ‘open’ to some extent, could be very valuable. (Buterin 2015)

### 2.1.4 Different consensus mechanisms

Consensus mechanism is a key element of the blockchain technology. Its role is to ‘decide’ on the right order of transactions and this way, retain consensus among the different versions of the database. There are different mechanisms to achieve consensus in distributed ledger systems, three maybe most often mentioned being proof-of-work, proof-of-stake and voting. There are benefits and drawbacks to all of the ones suggested so far, so the selection of consensus mechanism depends on the use case. Often there is a trade-off between cost and security. Further, private blockchains have more options than public blockchains in terms of the consensus mechanism used, as there the participants can be authenticated. While the actual number of different mechanisms can be high, Mattila (2016) presents ten mechanisms by name. Perhaps the best known of them is the Bitcoin’s proof-of-work: here the computers are solving mathematical problems so hard that finding the right answer is bound to take a lot of computing power, but checking the final answer is very easy. This is a good way to achieve consensus, as it is reliable when the nodes do not know each other, and the difficulty is easy to scale up or down. However, it is also very power-consuming. Some altcoins, or Bitcoin derivatives, have tried to overcome this problem by using the computing power for a good cause, like research. Proof of stake is another consensus mechanism. Here, based on the stake the nodes are invested in the system, they get votes. Voting is simply that: voting. Thus, this consensus mechanism is only applicable in certain situations, like when all the decision-making nodes are recognized entities. (Mattila 2016)

### 2.1.5 Applications

While the hype has blockchain being introduced as the answer to many problems it fits poorly or not at all, it is important to understand what type of applications blockchain actually does fit. Vitalik Buterin describes the issues as follows: “Blockchains are useful for decentralized consensus on databases that update themselves according to non-commutative (ie. order-dependent) state transition functions.” (Mougayar 2014) Let’s break up this to understand what it means. Decentralized consensus means that a group of entities agree on something without a central decision-maker. Databases are structured collections of data. Non-commutative functions mean functions that do not result in the same output if order is changed, and state transition is the transition of a variable from one state to another, which can be thought of as a variable changing value to another. Hence blockchains are valuable, when a group of entities needs to agree on a database for which the order of the transactions depends on each other. What this means in practice is still a bit unclear. Many applications have been hypothesized, including property rights management, voting, distributed financial services and sharing economy. Only a fraction has been actually implemented, and probably only a share has been even thought of yet. Table 2 below shows some of these, while table 3 presents some actual blockchain projects.

*Table 2. Potential and realized blockchain applications*

| **Application** | **Goal** | **State** |
|---|---|---|
| Property rights management | To fight corruption and to protect people's rights to e.g. land | Realized |
| Financial services | To enable micropayments, access to financial services | Realized |
| IP rights management | To track and control the use of IP | Realized |
| Voting | To enable transparent voting, online voting | Planned |
| IoT | To enable machine-to-machine transactions | Planned |
| Sharing economy | To offer decentralized platforms for sharing | Planned |
| Smart contract platforms | To offer decentralized platforms for smart contracts | Planned |
| Decentralized organizations | To enable smart optimization of resources | Anticipated |

*Table 3. Ongoing blockchain technology –based projects*[1]

| Case | Type | Description | Centralized Equivalent |
|---|---|---|---|
| Bitcoin | *Protocol Ecosystem* | Virtual crypto-currency that is used all over the world and to some extent accepted as a method of payment both online and off. An ecosystem of service providers and related applications has emerged around it | Euro |
| Ethereum | *Protocol Ecosystem* | General-purpose blockchain cryptocurrency platform. Runs smart contracts, enabling building applications that run decentralized | Dev platforms |
| Counterparty | *Protocol Ecosystem* | Protocol for currency issuance and exchange | Dev platforms |
| Sand Hill Exchange | *Financial* | Envisioned to be the next Wall Street, but was shut down by SEC quite fast | Securities exchange |
| tØ | *Financial* | Platform to issues private bonds. Overstock, who owns the platform, recently got SEC approval to issue stock via tØ | Securities exchange |
| Stellar | *Financial* | Common financial platform | Banks |
| BTC Jam | *Financial* | Peer-to-peer lending solutions intermediated in bitcoin | Banks |
| Swarm | *Crowd-funding* | Crowdfunding platform that allows companies to sell cryptographic shares, planning to be the Facebook of crowdfunding. Powered by the Counterparty protocol | Kickstarter |
| Koinify | *Crowd-funding* | A marketplace for decentralized apps, which makes it a crowdfunding platform | Kickstarter |
| Neighborly | *Crowd-funding* | Community investment marketplace | Kickstarter |
| OpenBazaar | *Market place* | Free peer-to-peer marketplace | Craigslist |
| ChromaWay | *Market place* | Platform for trading that represents assets, including physical, on top of bitcoin | Craigslist |
| Twister | *Other* | Peer-to-peer microblogging platform | Twitter |
| 21 | *Other* | The bitcoin computer | Twitter |

One classification that has been used is to talk about Bitcoin or Blockchain 1.0, 2.0 and 3.0 These describe the level of complexity as well as order of emergence of the different types of applications. Here I will use the term Blockchain 1.0, as I think it better fits this thesis.

[1] Many of these examples are mentioned by Swan (2015)

Blockchain 1.0 refers to the crypto currencies such as Bitcoin, blockchain 2.0 is contracts and blockchain 3.0 is the smart contracts and applications they enable. (Swan 2015)

Bitcoin has to be noted as a special case, as it introduced the blockchain technology to the world, and is the first digital currency to successfully solve the double-spending problem. It was first introduced in a white paper written by Satoshi Nakamoto in 2008, and can be used in place of regular currency to a large extent these days.

### 2.1.6 Challenges for implementing blockchains in business

There are a number of challenges that slow down the adoption of blockchain, including the early development phase of the technology, heavy regulation of potential user industries, and the need of a network to build valuable applications.

Novelty of the technology shows in the number of glitches as well as underdeveloped technology stack. While a lot is already going on, many projects are still very fresh and will need time to get fully functional. This includes platforms that will allow development of applications on top of them such as Ethereum, meaning that until the platforms are ready, applications will not reach their full potential.

Secondly, a lot of the industries where blockchain could make a meaningful difference are heavily regulated, including finance sector, health care and the energy sector. This includes protected monopolies, strict governmental control as to maintain important functions, as well as information security issues. When blockchain technology matures, it could even provide answers for some security issues, such as improved control over personal information. However, in today’s world and today’s regulatory environment, many blockchain use cases are not allowed: for example, banking is heavily regulated, and if a blockchain use case performs a similar function, it could be too. Furthermore, many blockchain solutions fall in a grey area where regulation has not yet been fully crafted. Virtual currencies are one such example.

Further, as blockchain technology is about networks, one cannot do much with the technology in isolation. This makes developing applications difficult in the sense that either a large amount of users is required, or a number of partners is required.  Finally, blockchain seems to be difficult to understand for non-technical people, perhaps stemming from the complexity of some of the underlying technologies such as hash functions and cryptography. There is relatively little blockchain understanding in the world, and hence in the firms.

## 2.2 Definition, types and characteristics of trust

There exist many definitions for trust in social sciences (Chen & Dhillon 2003; Jøsang et al 2005; Aljazzaf et al. 2010). The meaning of trust is familiar to all from the conversational use of the term: it is some form of reliance on another person or thing that cannot be controlled. Before going in to the formal definition of trust, I will discuss some attributes of trust as a sociological construct. Two preconditions for trust are risk and interdependence (Chen & Dhillon 2003). By definition, there needs to be interdependence between the trustor and the trustee. If the trustor is not dependent on the actions of the trustee, trust is not needed as however unpredictable their actions are, they do not affect our wellbeing. Then again if there is no uncertainty in this interdependency, there is no trust as no action by the trustee can change the course of events. This gives the context for what we talk about when we talk about trust. Further, generally can be said that trust is a two-sided, asymmetric relationship between two entities, where the trustor must be a thinking entity and the trustee can be anything. Trust also has a scope in terms of e.g. purpose or domain of action. (Jøsang et al 2005) The two-sided, asymmetric nature of trust means that trust has to be built both ways where required. The recipient of the trust does not have to be a person, but we can trust objects, processes or computer algorithms. The scope of trust restricts how or when we trust something. We can trust someone in a certain domain of action: we trust them to perform well in the scope of their occupation, for example as a doctor, but not otherwise; or we can trust someone more generally to have our best interest in mind. Trust can also be contingent on external circumstances: while we might not usually trust someone enough to transact with them, we might trust them under special circumstances when other options are limited. Finally, trust is a psychological state, an underlying psychological condition rather than a behavior, and developed under conditions of risk and interdependence (Chen & Dhillon 2003). That trust is an underlying psychological condition means that trust is not the action we take that indicates trust.

Two definitions that are often mentioned are reliability trust and decision trust. (Jøsang et al 2005; Aljazzaf et al. 2010). Reliability trust can be defined as "Trust is the subjective probability by which an individual, A, expects that another individual, B, performs a given action on which its welfare depends." (Jøsang et al. 2005) Jøsang et al. (2005) and Aljazzaf et al. (2010) cite Gambetta (2000) as the source for reliability trust, although it is not called that in the Gambetta paper, where he described the concept: "trust (or, symmetrically, distrust) is a particular level of the subjective probability with which an agent assesses that another agent or group of agents will perform a particular action, both *before* he can monitor such action (or independently of his capacity ever to be able to monitor it) *and* in a context in which it affects *his own* action” (Gambetta 2000, P.4).

Jøsang et al. (2005) argue that these two definitions are distinct from each other in context independence, where reliability trust is seen as context independent, and decision trust as context dependent. They state that “decision trust changes as a function of the utility values associated with the possible course of action”, implying that the context is important not only relating to the context or scope of action but also in a larger sense (Jøsang et al 2005). McKnight and Chervany (1996) are cited as one source for the definition of decision trust, which can be defined as: “Trust is the extent to which one party is willing to depend on something or somebody in a given situation with a feeling of relative security, even though negative consequences are possible” (Jøsang et al. 2005, p.1).

Another definition is provided by Aljazzaf et al. (2010) in the paper *Online trust: Definition and principles*. They state that: “Trust is the willingness of the trustor to rely on a trustee to do what is promised in a given context, irrespective of the ability to monitor or control the trustee, and even though negative consequences may occur.” (Aljazzaf et al. 2010.) This definition captures the important aspects of trust in the context of this work, and is relevant since the context of this work is similar to the context of the paper where it was put forward. Hence it will be used as the definition for trust in this study.

Chen and Dhillon (2003) identify three dimensions of consumer trust to be competence, integrity and benevolence, as based on their literature review in the paper “Interpreting dimensions of consumer trust in E-commerce” These three dimensions are also mentioned by others, such as Xiu and Liu (2005). Here, ability refers to the ability or competence or the trusted party to perform as expected, benevolence refers to the trusted party’s concern for trustor’s interest, and integrity to the trusted party acting in a manner that is acceptable to the trustor in terms of for example values (Xiu & Liu 2005). Grandison & Sloman (2000) classify trust into five different classes: provision trust, resource access trust, delegation trust, certification trust and infrastructure trust (Jøsang et al. 2007). These classes are especially about online trust and are summarized in table 4.

*Table 4. Trust classes in internet services (Jøsang et al. 2007)*

| **Trust class[2]** | **Explanation** |
|---|---|
| (Service) provision trust | "Describes the relying party's trust in a service or resource provider" |
| (Resource) access trust | "Describes trust in principals for the purpose of accessing resources owned by or under the responsibility of the relying party" |
| Delegation trust | "Describes trust in an agent (the delegate) that acts and makes decision on behalf of the relying party" |
| Certification/identity /authentication trust | "Describes the belief that an agent identity is as claimed" |

Trust is an important element of business transactions. There are very few instances when the parties of a transaction do not need to trust each other. Trust mitigates the inefficiencies caused by information asymmetry (Jøsang et al. 2007). The importance of trust depends on the industry. Especially important trust is in service business (Coulter 2003). Furthermore, online transactions give further importance on trust: "The degree of uncertainty, dependency, and risk is higher in the online world than the offline world" (Aljazzaf et al. 2010). Since trust is only needed in situations where there is uncertainty and dependency, trust becomes more important than in offline world. Additionally, traditional ways of building trust no longer hold true: for example, a vendor doesn't need to invest in expensive boutique that would indicate the intention of staying in business. But on the other hand, there are new methods for creating trust that have been enabled by the Internet, one example being reputation systems. (Jøsang et al. 2007)

[2] Brackets ('()') and slash (/) denote alternative names mentioned in different sources.

# 3 Conceptual development and hypotheses

In this section I develop the hypotheses of this study and answer the first sub-research question.

## 3.1 Blockchain-induced trust

In this section I propose a conceptualization of how blockchain technology can affect trust in the business context.

### 3.1.1 Different ways blockchain can affect trust in business

One common misconception is to think everything on blockchain is true. This, however, is not the case. Garbage in – garbage out –problem is something that often needs to be taken care of in blockchain projects: if you input incorrect or false information into the blockchain ledger, you will also get incorrect information back. Blockchain verifies that a certain piece of data was inputted at a certain time, but cannot make any other promises as to whether that piece of data is correct or not.

There are at least five ways in which blockchain can affect trust in the business context, although all might not be present in every case. Trust is affected by both the protocol layer and by the business layer of blockchain. The two mechanisms in place that stem from the protocol layer are transparency and security. These are increased by the characteristics of the technology: public-private keys and immutable transaction history increases transparency, as it is clear who has done what to the data. Encryption and decentralization can increase security, as they make the system safer and more private. Transparency and security, in turn affect trust. Further, the rules specific to a blockchain that are part of the business layer can place restrictions on users that can increase trust or make it irrelevant. Here I present an analysis of how blockchain can affect trust as per the different trust classes presented in the previous chapter. Table 5 following summarizes the analysis, that will be discussed in more detail in the following sections.

*Table 5. How blockchain technology relates to different trust classes*

| | Mechanism of influence | Blockchain characteristic | (Main) type of trust affected | Effect on transactions |
|---|---|---|---|---|
| General | Transparency | Public-private keys (digital signature)<br>Immutable transaction history | Authentication trust | Make trust irrelevant |
| | | | Resource access trust, Delegation trust Provision trust (Trusting beliefs) | Increase trust |
| | Security | Encryption Decentralization | Infrastructure trust | Increase trust |
| Case-specific | Restriction | Protocol-governed rules that restrict what kind of data allowed etc. | Provision trust | Increase trust/make trust irrelevant |

### 3.1.2 Increased transparency, security

Trust can be based on information (Aljazzaf et al. 2010). The more information available, the higher the trust. Blockchain could be used to make processes more transparent and information more readily available. The two blockchain characteristics that most are accountable for the potential of increased transparency are public-private keys and immutable transaction history. Because all transactions are signed with private keys, it is clear who has made each transaction: in theory, no one else should have access to one's private key, so if a transaction has been signed with a key, it can be directly linked to a person. And since all transactions need to be signed, all transactions can be linked. Further, the immutable transaction history leads to increased transparency. Since the transaction history is being tracked, all transactions can be viewed. Further, because it practically impossible to make changes to the transaction history, this can be taken as a reliable source of information. Increased transparency could then lead to increased trust.

Kim et al. argue that perceived privacy protection as well as perceived security protection increase trust (Kim 2007). Since blockchain can increase both perceived privacy protection and perceived security, it could hence increase trust.

### 3.1.3 Case-specific rules give further restrictions on transactions

The business layer on top of the blockchain infrastructure can be used to give the blockchain more rules. For example, in the case of bitcoin, the account balances will always be correct and cannot be altered, because the rules of the protocol spell out which kind of changes in the data are allowed. Further, an actor might only be allowed to change data related to a product they have handled. But it is often impossible to prove that any piece of data is truthfully inputted. These restrictions can either increase trust or negate the need for it. For example in case of Bitcoin, one does not need to trust the other users to only make fair transactions, neither is there a trusted third party needed –but the protocol makes it impossible to make false transactions. In other cases, the rules could make the data more trustworthy and hence increase trust. An example of this would be a product database where only certain fields can be changed by certain actors.

## 3.2 Implications of trust on business

In this section I will suggest how the aforementioned effects on trust might translate into business implications.

### 3.2.1 Enabling transaction between consumers, companies: disintermediation and new models of partnership

The combination of the mechanisms mentioned above lead to the "Bitcoin-situation" –a situation where no trusted third party is needed for individuals to transact with each other. The most important concepts for this are the immutable transaction history, public/private keys, and the business rule layer. Depending on the case, people across the country or the world are now able to do different kinds of transactions without an intermediary. This situation allows for disintermediation: when no trusted third party is needed, the systems can become more nimble.

This idea can be further developed to include companies. Enabling transactions between companies can unlock new models of partnership and shared activity. Barrier to network is lowered since the firms do not have to trust each other.

### 3.2.2 Enabling data sharing: data transparency

Another way in which blockchain can increase trust is by increasing transparency. This could be desirable by firms as increased trust could result in increased revenues. But increased data transparency will also have its own implications: as the information asymmetry is lowered, the consumer might gain power over their own information, but also over the value chain. As more information is available, consumers can make more informed decisions, hence being able to affect the consumer's processes. This unlocks potential for business model innovation.

## 3.3 Conceptual model and hypothesis

Based on the analysis presented in this chapter, I propose two hypotheses to be tested in this study. The first one follows from section 3.2 and is derived from analyzing how blockchain can affect trust, and how trust can change business models.

*Hypothesis 1. Blockchain can affect business models in three ways: disintermediation, new partnership models, and data transparency.*

Based on the first hypothesis and the fact that the role of trust is different in different businesses and industries, I propose a second hypothesis:

*Hypothesis 2. The role of trust in an industry affects how business models can change in the industry as a result of blockchain.*

# 4 Methods

The research was conducted as an in-depth case study of two case companies and three use cases. I conducted interviews based on which I perform analysis. Additionally, I created several hypothetical use cases that will be analyzed against the existing research in the field.

## 4.1 Research setting

In this research I will look at two case companies in different industries: Case Energy in the energy industry, and Case Bank in the financial services industry. Two different industries were selected for this case so that industry-specific differences could be observed. In both industries trust has a special role. Financial services is an interesting industry to study also as there can be found most of the first blockchain applications. Energy industry seemed to complement this nicely: it is very different, yet also mentioned as one of the industries blockchain could affect earlier than others. I selected two quite comparable firms: both are Finnish and fairly big in their respective industries.

I approach the cases in two ways in this research: first of all, I will assess the expectations and capabilities of the case companies, in addition to which I will analyze hypothetical use cases that spawn from interview conversations. Unit of analysis will thus be a firm, and within the case firms, a *use case.*

Finland is an interesting setting to this case, as it offers a great blockchain development surrounding: it has the small country advantage, and the social fit for the blockchain technology is fairly good in Scandinavia (Gupta 2016).

### 4.1.1 Case Energy

My first case company operates in the energy industry. Case Energy is a power and heat company whose main markets are in the Nordics and Russia. Energy industry is undergoing large changes that also the case company will experience. These changes stem from the increasing role of renewables in the European energy markets that make supply more unpredictable, as well as the increasing customer expectations and competition resulting from digital disruption. In their new strategy, they are concentrating on new venture development. Blockchain presents interesting options in this era when the traditional economies no longer hold true and new market rules are being written.

### 4.1.2 Case Bank

My second case company is a Finnish bank that offers financial services including banking and insurance to companies and individuals. Case company has been a forerunner in Finland in developing new digital services. Financial services industry is the first one that has felt the blockchain hype. Blockchain presents an opportunity and a threat to this industry perhaps more clearly than any other industry, as its first application, Bitcoin, could be seen as a competitor to the traditional way financial services have been conducted, but also as trust is in such an important role in this industry. The industry is also in the midst of digital disruption.

## 4.2 Data collection

I used several sources of data. Most of my information came from my interview study. That information is used in a few ways in this work: first of all, it is used to scout expectations and capabilities of the case companies what comes to blockchain technology. Secondly, it is used to suggest what the future might look like for the industries, and in this way see what kind of business model developments could be likely to occur. Finally, hypothetical business cases are constructed based partly on this data that will be analyzed based on the theory to see whether blockchain would be useful here.  In addition to interviews, I used other sources such as company web pages, annual reports, presentations and other publicly available data. An overview of all sources used can be found following in the table 6.

*Table 6. Overview of data sources*

| | **Primary sources** | **Secondary sources** |
|---|---|---|
| **Blockchain** | Interviews | Articles |
| | Workshops | Books |
| | Hackathon | Online sources |
| **Energy industry** | Interviews | Online sources |
| | Workshops | Annual statements |
| **Financial services industry** | Interviews | Online sources |
| | | Annual statements |

### 4.2.1 Interviews

I conducted altogether 25 interviews with 26 people in the spring and summer of 2016. Most of the interviews were around one hour in length, with variation ranging from 20 minutes to 75 minutes. The initial list of interviewees was agreed upon with the case companies. It was later augmented with people recommended in the interviews. In addition to case company representatives, the sample includes two types of experts: case/field experts and blockchain experts. This is illustrated in table 7. The case and/or field experts are people who work in the field and could thus bring insight into the field or even a specific case. Other group of experts is blockchain experts, who know a lot about the technology through entrepreneurship and research. In one case, an interviewee was both a field and a blockchain expert. I started out with a directional interview guide that can be found in appendix A. This guide evolved along the way, and interview questions were also tailored to match the interviewee's expertise.

There was also some blockchain expertise within the case firms. I evaluated the blockchain expertise of the interviewees based on how they themselves describe their expertise on the subject, their experience on it and how well they seemed to understand the topic based on our discussions. The "experts" are the ones who received a 5 on the scale from 1-5. There were two blockchain experts within the case firms and four outside of the two companies, resulting in 6 experts.

*Table 7. Interviewees by industry*

| | **Financial industry** | **Energy industry** | **Other** |
|---|---|---|---|
| **Case company** | **9** | **8** | |
| Blockchain expert | 2 | | |
| **Experts** | **5** | **1** | **3** |
| Field/case expert | 5 | 1 | |
| Blockchain expert | 1 | | 3 |
| *Total* | **14** | **9** | **3** |
| *Total altogether* | **26** | | |

## 4.3 Data analysis

### 4.3.1 Interview data

The interviews were recorded and transcribed. I transcribed the first 7 interviews myself, to see how my interview guide worked. The rest of them were done by a transcribing service, as after the first few the additional value of doing it myself started to diminish. In the first round of analysis, I did initial coding as well as evaluated what I could use a specific interview for. I then grouped the interviews in six, overlapping groups. This is represented in table 8. These groups were: Case Energy, Case Bank, energy industry, financial services industry, blockchain experts, and use cases. I then analyzed the data one group at a time. I did a second, more selective round of coding where necessary.

Blockchain experts group was used in two ways: first of all, in coming up with the criteria that was then used for use cases, and for expert findings. For both cases there are two types of groups: industry experts and company experts. The first one was used in industry-wide analysis, such as the role of trust. The latter was used for company-specific analysis, such as blockchain views. Use case group was used in creating the use cases.

*Table 8. Interviews grouped*

| | **Blockchain** (Low-Medium-High) | **Case company expertise** (Case Energy/Case Bank) | **Industry experience** (Energy/Financial Services) | **Use cases** (Energy/Financial Services) |
|---|---|---|---|---|
| 1 | M | E | E | |
| 2 | L | E | E | |
| 3 | M | E | E | |
| 4 | M | E | E | |
| 5 | L | E | E | E |
| 6 | L | E | E | |
| 7 | M | E | E | E |
| 8 | L | E | E | E |
| 9 | L | | E | E |
| 10 | M | B | FS | |
| 11 | L | B | FS | |
| 12 | L | B | FS | |
| 13 | M | B | FS | FS |
| 14 | L | B | FS | |
| 15 | L | | FS | FS |
| 16 | M | B | FS | FS |
| 17 | H | | | |
| 18 | M | B | FS | FS |
| 19 | M | | FS | |
| 20 | H | | FS | |
| 21 | L | | FS | |
| 22 | L | | FS | |
| 23 | M | | FS | |
| 24 | H | | | |
| 25 | H | | | |
| 26 | H | | | |

### 4.3.2 Use Cases

Based on interviews, workshops, ETLA collaboration and external materials, I created three high-level potential use cases for blockchain technology. The criteria on which these use cases are based is presented in the next section. The three use cases are microgrids, data hub, and micropayments, the first two for the energy industry, and the last one for the financial services industry. These use cases are analyzed and compared.

*Note on ETLA collaboration*

I worked together with two researchers from the ETLA research center as well as several people from Case Energy to construct the Microgrid use case. What is presented here in this master's thesis is my original documentation that stems from the collaborative work that at the time of this writing is still a work in progress but will be published as a separate paper.

## 4.4 Criteria for establishing the use cases

I will here present the criteria, which was used to create the use cases.

### 4.4.1 Development process

In this section I will develop and explain a framework that I will use to create use cases. As I have seen there is need for clear criteria[3] for when blockchain is a relevant choice, I believe it is valuable to communicate these criteria as a framework. Juri Mattila, based on a blogpost by Gideon Greenspan, has developed a first version of these criteria that I take as a starting point. I have further augmented that work by reflecting the framework build by UBS. Additionally conversations with people during interviews and otherwise, as well as work done by myself and Mohamed Abdellatif as well as the guidance and feedback received at the HILLA Hackathon in Oulu in June 2016 have gone into shaping my thinking while trying to come up with a framework that would best suit this work as well as hopefully be useful to others in evaluating blockchain use cases.

### 4.4.2 Core factors for evaluating the viability of blockchain technology in business

Gideon Greenspan published a blog post titled “Avoiding the Pointless Blockchain Project - How to determine if you've found a real blockchain use case” on November 22, 2015. The title tells the story: in the post, Greenspan goes on to set eight rules that one should check to determine whether blockchain actually is a fit solution for a use case. I have summarized these rules in the table 9 below.

[3] Many use cases can already be done by existing technology cheaper and easier

*Table 9. Blockchain usages rules (Greenspan 2015)*

| # | Rule | Explanation |
|---|---|---|
| 1 | The database | "Blockchains are a technology for shared databases**.** So you need to start by knowing why you are using a database, by which I mean a structured repository of information." |
| 2 | Multiple writers | "Blockchains are a technology for databases with multiple writers. In other words, there needs to be more than one entity which is generating the transactions that modify the database." |
| 3 | Absence of trust | "If multiple entities are writing to the database, there also needs to be some degree of *mistrust* between those entities. In other words, blockchains are a technology for databases with multiple non-trusting writers." |
| 4 | Disintermediation | "Do you want or need this disintermediation? **...** Good reasons to prefer a blockchain-based database over a trusted intermediary might include lower costs, faster transactions, automatic reconciliation, new regulation or a simple inability to find a suitable intermediary." |
| 5 | Transaction interaction | "Blockchains truly shine where there is some interaction between the transactions created by these writers...In the fullest sense, this means that transactions created by different writers often depend on one other." |
| 6 | Set the rules | "This isn't really a condition, but rather an inevitable consequence of the previous points. If we have a database modified directly by multiple writers, and those writers don't fully trust each other, then the database must contain embedded rules restricting the transactions performed." |
| 7 | Pick your validators | "a blockchain's job is to be the authoritative final transaction log, on whose contents all nodes provably agree" |
| 8 | Back your assets | "If you do want to use a blockchain as an asset ledger, you need to answer one additional crucial question: What is the nature of the assets being moved around? ... The question is rather: Who stands behind the assets represented on the blockchain?" |

Mattila has presented a version of this criteria, as based on Greenspan (2015), modified to read more like a checklist, and verified in industry discussion. Their checklist is presented in table 10 below.

*Table 10. Revised blockchain criteria (Mattila)*

| | **Rule** |
|---|---|
| 1 | A database shared by multiple parties |
| 2 | Enabling multiple concurrent writers |
| 3 | Maintaining consensus regarding the content of the database |
| 4 | Interacting modifications |
| 5 | The absence of trust |
| 6 | The undesirability of intermediation |

With this list as my starting-point, I have further modified this criteria to fit this research. I have included all but one rule from table 10. That is rule number 3: maintaining consensus regarding the content of the database. However, this could be assumed to follow from the first rule, or the first rule could be restricted to only shared databases in consensus. I have also include rule eight from Greenspan. The question "can you back up your assets" is a relevant one, since often times people seem to misunderstand the power of blockchains and especially the fact that there is no link to the real world as such. However, I have modified it a bit more than the others. Table 11 below shows my criteria based on the Greenspan (2015) and Mattila's work.

*Table 11. Updated criteria*

| **#** | **Rule** |
|---|---|
| 1 | You need a shared database on which all parties agree upon |
| 2 | Multiple parties need to edit the database |
| 3 | Transactions by different writers interact or even depend on each other |
| 4 | The parties who can edit do not trust each other |
| 5 | You can't/don't want to use a trusted third party as an intermediator |
| 6 | You have a way to connect the blockchain database to the real world where needed |

### 4.4.3 Disruption Evaluation Framework

UBS has built a framework, called Disruption Evaluation Framework, similarly to see if using blockchain to a specific use case would make sense, and to analyze blockchain use cases. The framework was originally developed by Alex Batlin and Hyder Jaffrey, and final version is a result of experiments and discussions the bank has done. However, this framework is more geared towards established companies looking to deploy blockchain-based solutions, although it can also be used for greenfield cases. Also the financial services industry point of view is quite heavy on this framework.

This framework is well explained in a blog post by Alex Batlin titled "Crypto 2.0 Musings – Blockchain Disruption Evaluation" published January 11, 2016. It also includes a set of check-list type questions, and the whole list can be found in appendix A. Below in Figure 1 the basic idea of the framework, the six lenses through which a blockchain use case should be looked at, is depicted.

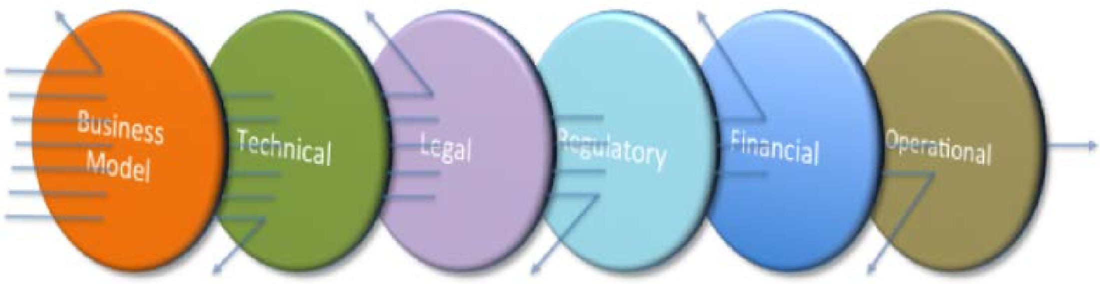


*Figure 1. Disruption evaluation framework (Batlin 2016)*

As explained by a bank representative in an interview: "when you are considering implementing a blockchain solution, you cannot limit your analysis to the technology itself, but you actually need to look at what patterns in a certain sense, business patterns, you are trying to implement with the technology, what business requirements you have, clearly the technology if it offers the capabilities to implement those patterns and those business requirements, but also on top of that, you should always look at operations and legal aspects".

While what this framework considers under each lens is not entirely fit for this study, I think the lens idea is a clear way to represent the analysis needed, and four lenses mentioned are important for this analysis: Business model, technical, regulatory and operational.

### 4.4.4 The Blockchain use criteria (BUC) framework

Bringing together the learnings from the two aforementioned frameworks, I present below the Blockchain Use Criteria (BUC) framework I have created for the purposes of this study. Evaluation of blockchain projects using relevant lenses can be considered a promising way to assess their viability, as there are many different points of view one might want to consider when thinking about starting such a project. Further, it highlights the fact that sometimes we might want to forget about one aspect, or take out the lens. For example, if you are starting the blockchain project as stand-alone, no need to consider operational implications.

I will call my 'lenses' filters, to further emphasize how they filter out ideas as decision criteria are not met. I included four filters: motivation, regulatory, technical and operational. The last three are similar to the UBS framework. Regulatory filter takes into account potential regulatory challenges that shared databases might encounter, such as privacy laws. 'Technical' here refers to the blockchain use case criteria as described in section 4.4.2 above. Operational includes issues that need to be considered if blockchain solution will be a part of existing business. Further, I have included the filter motivation. This is to remind that even though what technically could be done with blockchain is limitless, there needs to be a motivation for someone to do it for it to become a legitimate use case. For example, one use case could be to automate claims processing for missed flights. But would anyone have a motivation to do such thing, as the process is as complicated as possible on purpose? The framework is shown in figure 2 below.

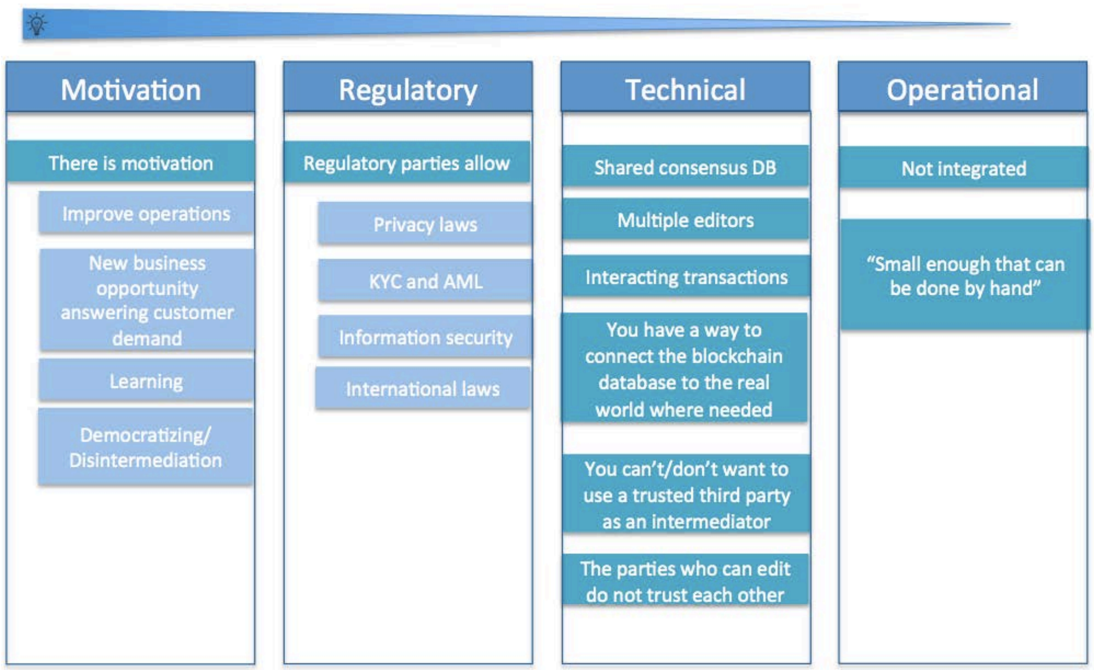


*Figure 2. BUC framework*

## 4.5 Use case development

The framework introduced in the previous section was used as a checklist in creating these use cases, as to make sure that these are viable blockchain use cases. Use cases are presented in a way that it is easy to further analyze *how* good of use cases they are. In tables 12 and 13 following, I have summarized how well each use case fits the BUC framework. Table 12 offers an overall summary of the whole framework, and table 13 gives more details on the technical blockchain requirements. From this analysis it should be noted that all use cases are fairly strong blockchain use cases as based on the BUC framework, however, not perfect.

*Table 12. Use case analysis summary*

| | *Motivation* | *Regulatory* | *Technical* | *Operational* |
|---|---|---|---|---|
| **Microgrids** | Business opportunity | | 5/6 | Ok |
| **Data hub** | Gov't | Potentially problematic | 5/6 | Potentially problematic |
| **Trade finance** | Business opportunity | | 5/6 | Ok |
| **Micropayments** | Business opportunity | | 6/6 | Ok |

*Table 13. Technical analysis summary*

| | *Shared DB* | *Multiple editors* | *Interaction* | *Absence of trust* | *Disinter-mediation* | *Real world connection* |
|---|---|---|---|---|---|---|
| **Micro-grids** | Yes | Yes | Yes | Yes | Yes | ? |
| **Data hub** | Yes | Yes | ? | Yes | Yes | Yes |
| **Trade finance** | Yes | Yes | Yes | Yes | Yes | ? |
| **Micro-payments** | Yes | Yes | Yes | Yes | Yes | Yes |

### 4.5.1 Data

These use cases are based on discussions with industry experts as well as other material, but are still only fictional in the sense that none of these use cases has been implemented yet. I present the use cases here as to give an idea of what blockchain could actually do, on a more detailed level (without going too technical).

The use cases I received from the firms: in Case Energy, it was a dialogue involving a group of people at Case Energy, ETLA, and myself. From Case Bank, one person presented three use cases out of which I chose two for this research that I thought would best fit. These were micropayments, trade finance, and KYC. I chose the first two, later narrowing down to one: micropayments.

For the Case Energy use cases I received a lot of information both from interviews and from external sources. Especially the microgrid case has been thought out quite well in these discussions, but the details about blockchain usage are based on my own knowledge on blockchains. The data hub is an actual project, but one that will be done using traditional technologies. This use case is a hypothesis on what a blockchain solution could look like.

The use case from Case Bank's point of view I wrote more or less on my own. It is a case that Case Bank mentioned as worthwhile at the beginning of the research process, but later noted as potentially difficult. As no one had a very clear picture of what these use cases would look like in practice, I have used data gathered from interviews, data online and my own imagination in writing up these cases. As noted by the bank itself, these use cases might not make sense if done by a bank; I didn't let having a bank in the use case be a restriction.

# 5 Findings

In this chapter I will present the findings of my study. I have divided this chapter into four sections. First three describe different blockchain business model categories, and the last one the role of trust in the two industries. Categories are based on the findings of the literature study.

## 5.1 Disintermediation

One of the emerging business model categories I recognized is disintermediation. Blockchain enables disintermediation by allowing for transactions between individuals to happen in a distributed matter: without the need for a central decision-making entity. This category of business models presents interesting opportunities in terms of gains to be made in more effective use of resources, enabled new services, as well as redistributing value within the value chain. The microgrid use case presented following shows how this might look like.

### 5.1.1 Case microgrid[4]

*Summary*

A group of households can form a microgrid that is either connected to or disconnected from the main grid. In this study I will consider a disconnected case. This could for example be the first step in bringing electricity to areas where it is still lacking, a village in a developing country, for example. Households are connected to each other, and they can share electricity in either direction: devices, or things, in the network can buy and sell electricity as they best see fit. These items could include a solar panel that can produce or sell electricity, a battery, a phone and an electric vehicle that can all buy, sell, or store electricity, or a stove, which can buy electricity. By optimizing selfishly, the items will create a globally optimal situation. This is presented in figure 3 below.

[4] This use case was developed in collaboration with ETLA and the case company, as explained in more detail in the research methods chapter.

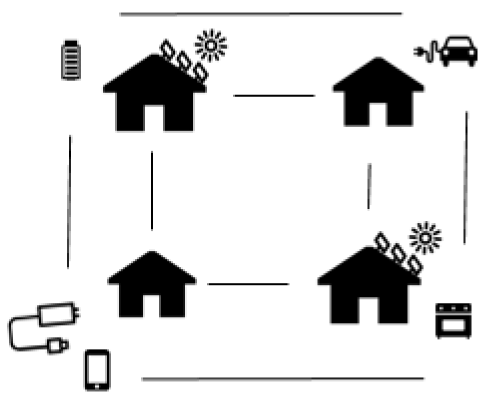

*Figure 3. Microgrid[6]*

*Motivation*

Microgrids are a solutions that fits three challenges: the more distributed nature of production as caused by more and more households incorporating electricity production solutions into their houses, the unpredictability of supply caused by the increases in the amount of renewable energy, as well as the more than billion people still living without electricity. It can be thought of as a thought experiment when envisioning the more distributed future: as distribution increases on a scale from fully central to fully distributed (illustrated in figure 4 following), where there could be an optimum that is between the two bounds.


*Figure 4. Range of distribution of electricity production[5]*

[5] Map of Finland: Fingrid.fi; icons: thenounproject.com/

*Assumptions*

For the sake of simplicity, let us make a few assumptions. First of all, let's assume that the solar panel cannot act alone, but will be one unit with the battery. If the battery gets full, the solar panel will turn off. Ideally, the battery should thus never be more than 90-95% full. There is a market price that will be determined by the demand and supply of electricity. This price is per minute of electricity at the grid voltage. Since the grid is quite small, we will assume that the amount of electricity lost is so small that distribution costs can be neglected. We will also assume that the weather is quite stable: it will be sunny during the day and dark during the night, and seasonal fluctuations are also neglectable.  As there is no wind power in this grid, or any other kind than solar for that matter, only the amount of sunshine affects the amount of electricity produced. All of the devices in the network are smart and can measure their own electricity production. The cost of production (investment costs, maintenance costs) is included in the price of electricity that a participant chooses to charge. By the laws of microeconomics, there will be just enough solar panels in the network to make normal profits.

*Hypothetical technical solution*[6]

The system uses a public blockchain for which all of the devices can join as producers or consumers. Payments are made in electrocoins, which is a cryptocurrency of the Microgrid. SPBs are the validator nodes, and the consensus mechanism will be proof-of-stake.

The solar panel-batter unit (SPB) starts production. After the battery is 5% charged, it will update its status as 5% charged, and this will be time-stamped in the blockchain. The system will check that the transaction is valid: SPB unit is registered as a producer, its previous balance was less than 5% and it is currently producing electricity. If the transaction is valid, it will go to the pool and get validated. It will continue to update its status once every minute.

Someone in the Microgrid wants to heat up soup. They turn on the oven, which sends out a request wanting to buy electricity. It starts from 0 and will increase the price until its request is met or its pre-set limit is reached. (People might value warm soup differently. If someone has a sick child at home, they might really need the soup and be willing to pay more than someone who might as well eat the soup cold.) The battery will accept the request. It makes

[6] Presented for this use case only, a high level description of how blockchain could solve the problem

a new transaction, this time debiting its own electricity balance and crediting the balance of the stove, and doing the same in reverse for electrocoins. Again, some checks are performed: is the stove a consumer, is the SPB a producer? Do the balances of electricity and electrocoins match previous balances, does the stove have enough coins, does the SPB have enough electricity? If the transaction is valid, it will go to the pool and get validated. Transactions from the validation pool are voted on, and accepted transactions are added to the blockchain.

*Regulatory and operational concerns*

This solution will not, as a stand-alone, pose regulatory challenges. However, if this was to become a larger scale venture, there are regulatory hurdles that would need to be tackled. The same goes with operational concerns: this is quite separated from the traditional business operations, and does not cause trouble.

### 5.1.2 Disintermediation as business model innovation

Disintermediation is in the core of blockchain technology. The idea of Bitcoin was to create a currency that cannot be controlled by any one institution, but rather is decentralized and thus free. This kind of ideology could spread, as it has some undeniable positive effects. First of all, both value and power could be redistributed in the network as a result. Further, the microgrid case demonstrates how disintermediation could help the energy industry to tackle the challenges of more and more unpredictable supply of electricity. But this idea could be developed even further to suggest that disintermediation models could be seen as a solution for the more and more unpredictable world, where agility is growing to be more important than stability.

In addition to disintermediation of electricity production, blockchain could support disintermediation of financing, commerce, or health care. What would be common to these cases is that hubs of production or service operation would give way to a more distributed model, where services are offered closer to the consumer, and the roles of producers and consumers could be seen as more concurrent rather than mutually exclusive. This would lead to demand and supply to meet more efficiently, and give consumers more power to choose what kind of services they want to consume.

### 5.1.3 Further evidence

In addition to the case company, also others are looking into disintermediated production of energy with the help of blockchain, such as LO3 Energy. Disintermediation has been suggested as a result of blockchain also by others. Mattila argues: "By offering a technical solution for digital interaction where trusting counterparties is simply not necessary, blockchain technology can render intermediators, or at least their current functions, obsolete. As a consequence, the business mechanics and value creation logics of intermediation platforms may be in for a shock where trust, or the lack thereof, is not enough in itself to ensure customer lock-in anymore (Mattila 2016, p. 20)"

Further evidence comes from other projects that show how blockchain can lead to disintermediation. A sample of these is presented in the table 14 following.

*Table 14. Evidence of disintermediation*

| **Case/Argument** | **Description** | **Presented by/in** |
| --- | --- | --- |
| Bitcoin | Peer-to-peer electronic currency system | Satoshi Nakamoto/ *Bitcoin: A Peer-to-Peer Electronic Cash System* (2008) |
| OpenBazaar | Decentralized market place, launched in 2016 | Amir Taaki, Brian Hoffman; openbazaar.org |
| Swarm | Crowdfunding | Joel Dietz |

## 5.2 Increased transparency

Blockchain can be used to increase transparency. This happens as blockchain offers an immutable transaction ledger, so that consumers could themselves verify the validity of a piece of information. Transparency could lead to increased consumer power as well as ease of sharing data with the ecosystem to increase the services offered to customers. This kind of model is exemplified by the case data hub.

### 5.2.1 Case data hub

*Summary*

Data hub is a project that Fingrid is undertaking. The idea is to improve information sharing between the different industry players, as it is a complicated and error-prone process as of right now. Further, this information will be available to third parties as well.

Here I will draft what the data hub could look like if instead of traditional, third party database, the system was built on top of blockchain technology, illustrated in figure 5 where lines are connections between energy producers, consumers and third party companies such as data analytics service providers.

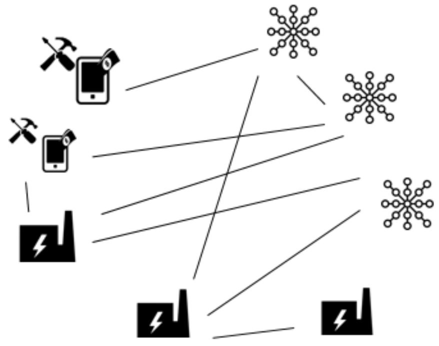

*Figure 5. Data hub as a blockchain project*[7]

*Motivation*

Data hub as a project is quite well justified, as demonstrated by the fact that one is already being built. But what would make a blockchain solution interesting, and thus more valuable, are the efficiencies and transparency that the solution would bring. Blockchain could also be the solution for a real-time data hub system.

*Regulatory and operational concerns*

There could be some operational concerns that make data hub not an ideal blockchain project. As data hub is something that will be highly integrated to everyday business processes, more mature technologies are safer. However, since the information saved to the data hub is historical data rather than real-time, the problems could probably be mitigated.

### 5.2.2 Transparency as business model innovation

There could be a number of reasons why a company would like to increase transparency, including that increased transparency leads to increased trust, which could improve sales. But increasing transparency could also increase consumer power: over their own information, as well as in the value process. Increased power would be the result of greater ownership of their own data. Customers could for example decide who gets access to their information, and what they in turn get for allowing it. If transparency in a supply chain for example is increased, the information asymmetries would lessen, and consumers could make

[7] Icons: thenounproject.com/

consumption decision based on a larger set of information, including factors such as ethics and sustainable development.

Transparency business models could include offering consumers services for a subsidized price in order to get access to information. This information could then be shared in an ecosystem, where the customer retains the control of who can use their information, but gets better services as a result of greater openness. This information could be anything: location data, consumption data, personal data such as heart rate or mood, or data about music preferences. When different sources of data are combined, even better personification can be accomplished both for services and for advertising alike.

### 5.2.3 Further evidence

Further evidence comes from other projects that show how blockchain can lead to disintermediation. A sample of these is presented in the table 15 following.

*Table 15. Evidence of transparency*

| Case/Argument | Description | Presented by/in |
|---|---|---|
| Provenance | Platform that enables firms to increase transparency to supply chain | Whitepaper: *Blockchain: the solution for transparency in product supply chains*; provenance.org |
| Filament | Provides sensors and technology that enables collecting information from remote locations | Filament.com |
| Paper: Fend Tian/*An agri-food supply chain traceability system for China based on RFID & blockchain technology, 2016* | | |

## 5.3 New partnership models

With blockchain technology, firms can partner up in new ways. This enables new models of business: new opportunities are unlocked by the increased ease of partnerships. The cost of partnering will decrease, as expensive mechanisms to build trust are no longer needed. The types of business models that go under this category can be vast. How blockchain enables this is by allowing for the companies to share an immutable ledger – a database that can record the transactions, that cannot be manipulated, and not be controlled by only one of the companies involved.

The next section introduces a micropayments case that exemplifies this business model category. However, this use case could be even more interesting and relevant without the banks, and in fact, some other institution could take their place in this case. They do not act in their 'trust broker' role here: the blockchain protocol takes care of the transaction verification and validity.

### 5.3.1 Case micropayments

*Summary*

A network for making and accepting micropayments for online content and Internet of things (IoT). Banks would provide this service, and third parties could be a part of the network. Potential third parties could include online content providers, such as newspapers, social media sites, or streaming services, IoT service providers such as car manufacturers, home appliance manufacturers or housing service providers, or mobile service providers including applications for gaming, fitness or mobility. In the figure 6 below there is an illustration of what this kind of network could look like. Some of the connections are omitted to allow for clarity. Blue boxes represent nodes that validate in the network. In addition to service providers, there are many mobile and online users who are all part of the network.

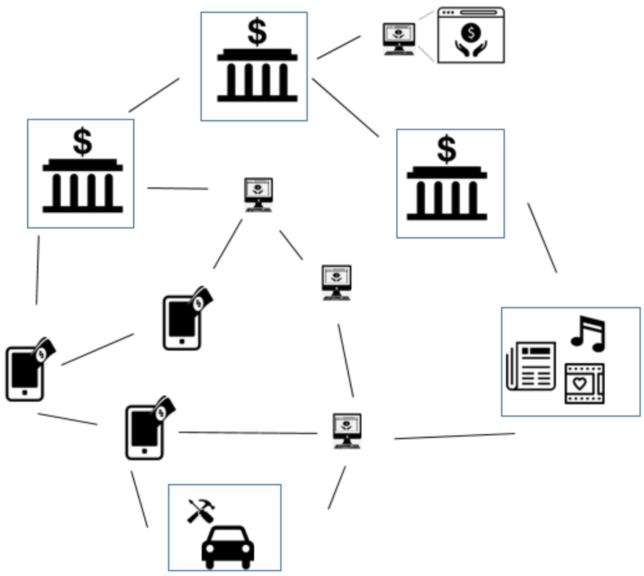

*Figure 6. Micropayments*[8]

*Motivation*

Micropayments are not economically feasible with current systems, as the transaction costs faced by users are high. Micropayments have been a topic for discussion at banks for a long time, but no profitable way to offer micropayments has been devised. However, with the

[8] Icons: thenounproject.com/

increasing amount of online and mobile services used, finding the right monetization models becomes important, and this could be micropayments. Further, as IoT based thinking turns to business, micropayments are needed for many applications. Blockchain could be one answer.

Further, Finland could be seen as a unique petri-dish for financial services innovation, as it is small enough market with participants who know each other well, technically well advanced, and there are no participant too large who would be greatly slowed down by huge legacy systems and reputation. If for example three large banks in Finland were to build a system like this, it would already cover a notable part of the country without anyone having to change banks.

*Regulatory and operational concerns*

One answer to this problem would be to lower transaction costs for small payments or to create this kind of system based on traditional database models.

### 5.3.2 New partnership models as business model innovation

By allowing for new forms of partnership, blockchain unlocks new opportunities to combine value and services between institutions that cannot trust each other. It could also simplify record-keeping where the same set of data is used by multiple firms and needs to remain in sync.

These kind of models could also change the roles of institutions. Since blockchain could take care of keeping data in sync, trusted third parties such as intermediaries between banks in the financial services could become redundant. Further, companies could operate from a more even ground, as no one would need to be in charge of the data. The R3 project would represent the first case, and blockchain in product-centric data management as presented by Mattila et al. (2016) the second.

### 5.3.3 Further evidence

Further evidence comes from other projects that show how blockchain can lead to disintermediation. A sample of these is presented in the table 16 following.

*Table 16. Evidence of partnerships*

| **Case/Argument** | **Description** | **Presented by/in** |
|---|---|---|
| R3 | Consortium of banks working together to utilize blockchain technology | |
| Blockchain in product data management | Joint database for product data management | Mattila et al., 2016 |

## 5.4 Trust in business

In this section I will discuss my findings about trust in the two case companies and their respective industries, first starting with the energy sector and then moving on to the financial services sector. I chose to look into how trust is created in these industries at the time, as well as where and for what trust is needed. The section proceeds as follows: I will start each subchapter with a summary of the main findings, and then include comments and quotes from the interviews grouped appropriately under an observation that distills the main idea of the paragraph.

### 5.4.1 Trust in the energy sector

Table 17 below summarizes my main findings about trust in the energy sector.

*Table 17. Summary table of findings*

| | |
|---|---|
| Observation 1 | Role of trust is important, but fragmented |
| Observation 2 | The importance of trust mostly arises from the importance of electricity |
| Observation 3 | Within the industry, trust is high |
| Observation 4 | Role of regulation underlines the importance of trust |

*Observation 1: Role of trust is important, but fragmented*

Trust was seen as very important for the industry and the company throughout the interviews. Trustworthiness and reliability were mentioned as highly important for the industry. A quote from one interview sums it up: ”Reliability from energy point of view, it starts from the fact that the society runs on it. It has to be reliable”. Interestingly, there were a lot of different reasons and points of view on the cause of this importance. Most important ones –importance of electricity, trust within the industry, and regulation– are discussed further in later observations. In addition to these three, however, there were five other aspects mentioned: trust that the company is benevolent, trust in operative capabilities, trust in customers, trustworthiness of operating environment and data security.

*Observation 2: The importance of trust mostly arises from the societal importance of electricity*

Electricity is a necessity at least in the developed world, and thus the customer needs to be able to trust the electricity company to perform well: ”Very important. Very important, if you think about electricity, it is a basic need for the customers, so there has to be deep trust in that it works, and that everything goes as agreed, as it should. It is a top priority.” In terms of the society, this becomes even more important: even relatively short electricity outages result in panic and losses. While the most critical places probably have emergency systems, these are not the most efficient way to produce electricity. “In any case, energy is such a critical resource to the society, when practically all activity, for example in Finland, has been built on the premises that there is a continuing supply of electricity, and if electricity is off for a few hours, it’s a huge deal.” Because electricity is critical, trust is critical too, by association, as an enabler of electricity production and trade.

*Observation 3: Within the industry, trust is high*

As the roles and rules are clear, trust within the industry is quite high: ”and within the industry I would say that trust is deep. One important reason for that is the clear roles of the players.” One example of this is how companies trust each other’s data on electricity usage and base their own billing on this. There are also very few secrets in the industry. Especially in electricity markets in the Nordic countries, ”the industry is extremely transparent”.

*Observation 4: Role of regulation underlines the importance of trust*

As energy production is such an important part of the society, regulation also pays a large part in the industry and how it works. Trust within the industry as well as in the industry is created by the very clear rules by which the market and the players work. These rules have been adjusted and improved over time, and for misconduct, the fines are quite heavy. Trust within the industry is partly constructed through regulation: ”Trust is practically created through absolutely clear set of rules that have been crafted and adjusted. If you don’t play by the rules, it will be very costly.”

### 5.4.2 Trust in the financial services industry

In this section I will describe my findings about the role of trust in the financial services industry. The main findings are summarized below in table 18.

*Table 18. Summary of observations*

| | |
|---|---|
| Observation 5 | Trust plays an important, multi-sided role in the industry |
| Observation 6 | Banks are trust brokers |
| Observation 7 | Trust-building has been expensive historically |
| Observation 8 | Millenials have a different role with the bank |

*Observation 5: Trust plays an important, multi-sided role in the industry*

The importance of trust in the financial services sector is high, but furthermore, it is quite complex. This complexity partly rises from the fact that the trust relationship needs to happen in two ways: bank needs to trust its customers, and the customers need to trust the bank. Furthermore, trust can be seen to be part of the value proposition, as banks can act as trust brokers. The intricate nature of trust emphasizes its importance to the industry. The importance of trust was clear from the interviews: “It (trust) is the principal thing in banking. Without it banks don’t really have anything else but the role of the infrastructure provider and cash mover.” And further: “I see that trust is extremely, it is a central factor. They say that banks are trust business. Customers need to be able to trust that if they give us money to store, if they want to give us their money to store, that the money will stay there. Customer needs to be able to thrust that if we loan them money and they hold up the deal, that we will not collect the money prematurely. I see that it is very central.” Customers need to trust their banks. A bank is an institution that allows other institutions and individuals to operate, by providing them with basic financial services such as bank accounts, financing and money transferring. Not only does a customer need to trust the bank with their money, but they also need to trust the bank to be there to allow their everyday financial operations. Further, they need to be able to trust that a bank will not call in a loan early. A bank also collects a lot of personal information: they know a lot about a person, and need to be trusted to keep this information private. In monetary terms, this is even more important to firms: banks could learn a lot about a firm’s business secrets and competitive advantages from their financial records, and for firms to be able to use a bank, trust in them needs to be intact.

Bank also needs to trust their customers. This is twofold: bank needs to find an overall desired level of risk by selecting customers (in interest to get their money back), but further, banks need to weed out potential criminals (in the interest of preventing terrorism). The first is quite straight forward, since the risk gets diversified. However, there is heavy regulation in place what comes to the second: Anti-money laundering (AML) and Know-your-customer (KYC) are important processes any bank needs to undertake. In case of a failure, for example if money from an account in a given bank gets transferred to a suspicious source, the bank in question can face a hefty fee. In practice, these sums are so high the banks will go to great lengths to avoid being punished. Banks also need to trust other banks to weed out undesirable customers in a good manner: one bank cannot check all of the participants, especially if the money is to be transferred internationally to a less well-known bank. The extent of KYC is use case dependent: ”It depends a bit on the use case. There are examples of banking services where a lighter set of information suffices, but the more money we are talking about, there is regulation and codes, you need to know more and show your face and stuff. It’s pretty much use case dependent.”

*Observation 6: Banks are trust brokers*

But furthermore, bank is a trust broker: ”Banks are fundamentally trust brokers. They keep your money safe and secure your future by giving you, or enabling you to have things.” This quote exemplifies how the core business of a bank has to do with providing trust. This, again, is even more important when considering B2B banking. Banks create a link between two parties where there is not enough trust to do business otherwise: “Because there needs to be a so called trusted third party, which is the bank, for example in business-to-business trading, for example in letter of credit trading, where someone supplies the goods, the other pays, then it is the bank who  is responsible for that the goods were shipped and payment was reserved, and when the goods arrive, the payment goes through. And we make sure that neither party keeps both.” To summarize: ”Financial services, well, we sell trust.”

*Observation 7: Trust-building has been expensive historically*

This trust has been historically based on regulation, contracts, tradition, track record and values. These ways to build up trust are not only expensive and slow, but also outdated: ”Ridiculously expensive, slow, and not even very secure...Contracts are a quite poor way to build trust, because you don’t practically see if there is any until something goes wrong.”

*Observation 8: Millenials have a different role with the bank*

Role of trust changing: millenials do not automatically see bank as the trusted party, and hence the trusted third party role of banks might be questioned in the future. New generations will not have contact with banks in the same way as people have had for hundreds of years, since branch visits are to a larger and larger extent replaced by mobile apps. Companies such as Facebook and Google are, in turn, trusted more and more. Peer-to-peer validation through processes such as recommendations become the new way to create trust.

# 6 Discussion

In this section I will discuss my findings, suggest hypotheses that should be further studied, and offer some implications both for the industry and for academia alike.

## 6.1 Hypotheses development

In the previous section I presented three different business models exemplified by specific use cases and supported by other examples. These as well as the discussion on trust will be the basis of the hypotheses evaluation. Based on hypotheses evaluation, I will also answer my second sub-research question: *What kinds of business model innovations can blockchain technology facilitate?*

### 6.1.1 Hypothesis 1: Blockchain affecting business models

We get support for hypothesis 1 from this study: all of the suggested business model changes could be envisioned to take place. Further, all use cases that came up could be placed under these three headers: see table 19 following for the summary.

*Table 19. Blockchain use cases categorized under business model categories*

| **Disintermediation** | **New models of partnership** | **Data transparency** | **Old business model** |
|---|---|---|---|
| Microgrid | Micropayments | Data hub | KYC & AML |
| Mobile electricity | Trade finance | Commodities tracking | Reducing manual paperwork |
| IoT payments solutions | International transfers | Carbon footprint tracking | Replacing old infrastructure |
| System democratization | Settlement | Digital share certificates/title deeds | As-as-service -world |
| | | Coded electricity | Making the bitcoin/blockchain world more energy-efficient/environmentally friendly |
| | | | EV charging |

Further evidence we get from comparing the findings of this study to that of other's. Greenspan (2016) recognized four "genuine blockchain use cases" to be lightweight financial systems, provenance tracking, interorganizational record keeping and multiparty aggregation. Three of these cases fit well with my recognized categories: interorganizational record keeping would go under the new models of partnership –category, multiparty aggregation under disintermediation, and provenance tracking under data transparency. The case lightweight financial systems could go under the category new models of partnership or disintermediation: since a financial system is not new as a business model, the proposed categorization holds when comparing to Greenspan. (Greenspan 2016) Hence based on this analysis we do not reject hypothesis 1.

#### 6.1.2 H2: Role of trust affecting business model change

In the energy industry, role of trust is high, for having a reliable supply of electricity is important. Trust within the industry is also crucial, for the balance to remain. Further, the electricity companies handle personal information. Not only is contact and address information necessary to conduct business, but companies also hold energy consumption data, which can tell a lot about the lives of people. However, the role of trust seems to be even higher in the financial services industry. Here, it is first of all more multi-sided. Not only does there have to be trust within the industry, but the consumer places a lot of trust on the bank, and banks also need to trust their customers. The special nature of the industries as being suppliers of two very necessary services: financial services and electricity, is one reason for the importance of trust in these industries.

First of all, people in the interviews referred to banks as “trust brokers”. This exemplifies how they see trust to be very central to what a bank does. Further, in this thesis I suggested that trust is a part of the value proposition if key service is to provide a link between two parties that do not trust each other enough to transact without a trusted intermediary. This is true in many financial services use cases. One example of this is trade finance: companies use banks as trusted intermediaries when conducting trade abroad. Part of the value proposition in this case is the financing of the trade, but part of it is the trust: the two companies could not do the trade without the bank, since they have no way of trusting each other. Banks, however, have methods and processes in place for trusting other banks, and can mitigate the risk for the companies. In the energy industry trust does not play such a role. While it could be argued that energy firms are facilitating interaction between individuals by both selling and buying electricity produced by for example private solar panels, the reason intermediation is needed is not lack of trust, but lack of infrastructure.

From this analysis we can conclude that the role of trust is different from each other in the two industries, and it is different in these industries than in many other cases. As trust is important for both industries, and there are many potential use cases, this would seem to support hypothesis 2. If we then compare the two industries, we can again see that there is a difference in what type of business models can emerge. In the financial services industry, where trust is a part of the core function, the change due to blockchain could be greater: as blockchain can take over a core competency in this industry, it is likely to result in a bigger disruption. We get support for hypothesis 2 and hence do not reject it, but develop it further in the next section.

#### 6.1.3 Hypotheses and the research question

I posed the question: *What kinds of business model innovations can blockchain technology facilitate?* as my second research question in the first chapter of this work. This question can be answered based on the hypothesis analysis. Blockchain is likely to enable at least three kinds of business model innovations: increased transparency, new models of partnership and disintermediation. Further, the role of trust in the industry is likely to have an effect on how these models develop.

What seems to be common among the business models blockchain unlocks is the redistribution of value and power in the ecosystem. Blockchain allows for a reduction in the asymmetry of information between the producer and the consumer that often is present in the market.

### 6.2 Trust affecting business models: a new hypothesis

In this section I will present a hypothesis on what is the role of trust in blockchain business model innovations.

#### 6.2.1 Premise

Trust is an important part of any business. Since organizations usually do not possess all necessary capabilities and resources but are interdependent on other organizations and individuals, trust is needed to enable collaboration in uncertain environments (Xiu & Liu 2005). The importance and role of trust vary within different industries and within different firms. Here I will divide trust in two: trust as a part of the value proposition, and trust as a supporting process. Value proposition is a concept that describes what a firm offers to its customers. Figure 7 below shows value delivery system from paper where value proposition as a concept was introduced. (Frow & Payne 2011) The diagram shows the difference between the value proposition and the supporting processes: value proposition is the higher level offering that is made up of supporting processes. Value proposition can be thought to be the difference between what you get and what you give up for it. (Lanning & Michaels 1988) It is thus a good way to compare even very different types of businesses.

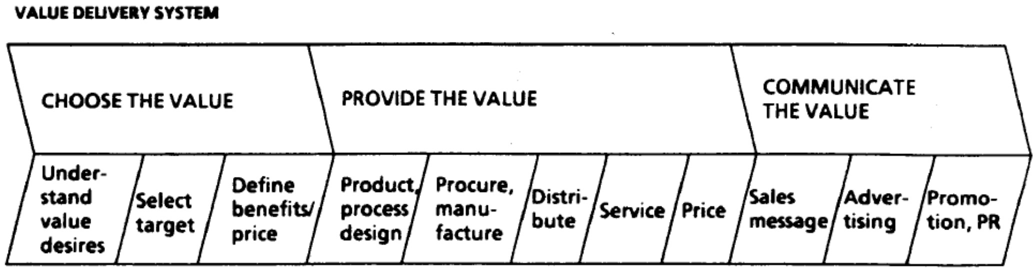


*Figure 7. Value delivery system (Lanning &Michaels 1988)*

It seems clear that trust is often part of the supporting processes of a firm: if the potential customers cannot trust a firm to deliver, they will not become actual customers. Trust can be a criterion for service selection (Aljazzaf et al. 2010). Trust comes up in many ways: we don't want to use a credit card if we fear its data might get stolen, eat food if its origins are questionable, order something if we doubt we will ever get it, buy something that could be stolen or broken, or visit a dentist if we fear they did not actually go to medical school.

Trust can also be more than a part of supporting processes: it can be a part of the value proposition. For example, in some cases, a business is said to be a "trust broker", or a trusted third party facilitating exchange. Here, trust is clearly more important than just a supporting process: it is a key part of the function that the business is performing.

### 6.2.2 Hypothesis: blockchain most disruptive when trust part of the VP

Since we can differentiate between a firm's supporting processes and its value proposition, it would seem that whether there is a change agent acting on one or the other, would different result in terms of changes in the business model occur. The reasoning for this is as follows. First of all, let us define 'change agent' to be a technological innovation in the scope of this research, and consider value propositions and business model change in industry-level rather than for a specific company. Then let us consider the first case: there is a change agent acting on a firms supporting processes. This means that a firm can potentially do what it does more efficiently: it has a new way that can replace a supporting process that has originally been inefficient or expensive, but if not, no changes have to be made. Competition might be intensified, since companies with relatively inefficient supporting processes could stand to gain more from the innovation. However, the original barriers of entry would still likely be in place.

Then again, let us consider the second case, where there is a change agent acting on a firm's value proposition. This means that there is a new way to do what the firm does, which in turn means that the original barriers of entry might no longer hold. In this case, the change is likely to be more radical: if the original barriers of entry are affected, the laws according to which the industry used to work are affected as well. Hence I will suggest a new hypothesis.

*Hypothesis 3. Blockchain results in most disruption when trust is part of the value proposition.*

### 6.2.3 Evidence and implications

First of all, we can differentiate between the energy industry, where trust is not part of the value proposition, and the financial services industry, where trust can be a part of the value proposition. We see that there are differences both in what kind of use cases can be constructed for the industry as well as in what are the industry expectations like. In the energy industry, blockchain does not affect the value proposition of an energy company: it's job is still to produce and distribute electricity. Blockchain does, however, affect the supporting processes. In the data hub case, for example, doing the hub over blockchain would make it more transparent and thus increase trust in the industry, as well as to open the ecosystem up for more diverse services providers to join. In contrast, in the financial services sector, trust is a part of the value proposition. It is very central to what a bank does: acts as a trust broker. This means that blockchain could, in theory, be used to replace that function, leading to quite large industry disruption.

## 6.3 Blockchain as a catalyst for business model innovation

Since blockchain can arguably be both a technological innovation, and a business model innovation, it is a special case. Another special case like this was the Internet, which has enabled many new ways of doing business. It has "acted as catalyst for BM experimentation and innovation" (Massa & Tucci 2013, p.421). They also present a number of other events that have changed the way firms do business, including the advent of post-industrial technologies, firms entering into developing markets, and sustainability. (Massa & Tucci 2013) I suggest that blockchain could be seen as another event like this. It is a mega-innovation: innovation in itself in database technology, but in such a drastic way that it enables many more innovations, such as business model innovations, build upon it that can change how the world works.

As evidence I will present how blockchain and the Internet compare to each other. First of all, both in the blockchain discourse and in interviews, blockchain has been compared to the Internet. Both are networks, Internet of information, blockchain of value. Also the blockchain application stack is similar to that of Internet. Blockchain, like Internet, is a social phenomenon that includes many layers and can be used as a term to refer to many different things. Similarly as the Internet started out with limited services only to grow to what it is today, the industry is only starting to figure out what the applications of blockchain could be. Further, blockchain touches upon every industry: it could transfer the way business works regardless of the service or of location. Internet created new businesses, new business models as well as a new distribution channel for old ones. Similar things could one day be said about blockchain. This thesis already demonstrated how blockchain could help to create new business models, and to support existing ones.

Further evidence comes from the demonstrated cases of blockchain-induced business model innovation. First of all, the cases mentioned in this thesis demonstrate how blockchain could change business models. Some of these are quite dramatic: roles and functions of players as well as customers could change a lot. For example in the case of decentralization as exemplified by the microgrid, consumers gain power and importance while the role of the energy companies might become more consultative, in addition to still providing the existing functions. Further, blockchain could do away with trusted third parties altogether in some cases. A proven case of blockchain-induced business model innovation is Bitcoin. For example, it has enabled micropayments thus supporting new ways for Internet value monetization.

This would seem to indicate that blockchain should be considered as more than a technical innovation. As the role of this technology is likely to differ from industry to industry, it is important to analyze whether it should be considered as a catalyst for business model innovation or as a technical innovation, primarily, in each context. However, whether the potential of blockchain can and will be realized, and thus its revolutionary power released, will be only seen years from now.

## 6.4 Implications

### 6.4.1 Industry implications of blockchain technology

Based on my research, it would seem that firms in any industry wanting to explore the blockchain opportunities should find a way to more tightly bring together industry and blockchain expertise. Ideally, there would be a team with both expertise, but this will not negate the need for industry experts to deepen their technical understanding. This is as while blockchain can be learned, years of industry experience with its tacit knowledge and customer insight is difficult to transform. To find the real pain points, it would be ideal for one person to be an expert in both, the industry and the technology. This being said, blockchain technology is not mature yet, nor will it be for a while. This means two things. First of all, firms are not late yet, and don't need to panic. Finding use cases for the sake of finding a use case can make sense in small scale for the learnings, but the gains can remain slight. But secondly, this means that there are truly big opportunities to be realized, and the early players who are willing to bet big can change the way the world works. Furthermore, people should not restrict their thinking to the rules of today but let constructs such as level of regulation and market rules to vary within a range. How large a range, will depend on the industry, the company and other factors.

Interesting blockchain use cases could be found in industries, where trust has an important role. Furthermore, where trust is a part of the value proposition could be a case prone for blockchain disruption.

### 6.4.2 Implications for academic research

This research puts forward a hypothesis that should be studied further. Also, it suggests that blockchain technology could be seen as a catalyst for business model innovation. In so doing, the present study critically analyzed the conditions in which the technology could be anticipated to have looked-for effects on a business model. Furthermore, this study is among the first to link strategic management concepts to study blockchains. In this study, blockchains are perceived as systemic technological innovations that may have important implications on transactions in the future. The criteria for assessing the feasibility of the blockchain technology in a particular business need to be studied together in greater detail, as technology will become an ever more important part of business models.

# 7 Conclusions

In this chapter I will answer my research question, summarize the study as well as identify and evaluate some limitations of this study and comment on potential areas of future research.

## 7.1 Blockchain changing business models

I will conclude this thesis by giving an answer to my research question: *How can blockchain technology trigger trust and transaction based business model innovations?* In the third chapter of this thesis I put forward a hypothesis based on previous literature that the role of trust in an industry affect business models and how they change. Based on my research, the role of trust did have an effect on what kind of change on business models could be expected, as further discussed in the discussion chapter of this work. Blockchain could change business models by affecting trust as the supporting process or as the value proposition.

I argue that trust could be helpful in further determining which cases blockchain is a useful technology for. There is a demonstrated call for relevant criteria to evaluate the applicability of blockchain, because, in many cases, alternative technology could be used instead. Often, these technologies already exist.

Blockchain is also an enabler of business model innovation. Further, the use cases of microfinance and microgrid would both be business model innovations: they break the rules of the business and introduce new ways of making profit and delivering value. Blockchain could be more than just a technological innovation: it could be a disruption that changes the way things are done, blurs industry boundaries or even enables autonomic applications. Hence it has been compared to the Internet both as a technology and as a disruption. (Tirri 2015; Swan 2015) This analysis would seem to confirm that blockchain could be seen as a business model innovation enabler, as the effect of blockchain on a firm's business model would often be business model innovation. Here, it must be noted that business models are firm-specific, and industries are made up of many different firms. Thus all of these are likely to be found, but on average, what is there a lot of. Based on this analysis I propose that if trust is a part of the value proposition, greater disruption will ensue.

## 7.2 Summary

My main findings include that blockchain knowledge is still quite limited, and use cases that are often cited in the discourse are still on quite high level. Firms are not late to the game, and there are still many interesting potentials to get ahead of it, too. Use cases are difficult to spot, and the value of blockchain is likely to not come from imitating existing business processes on blockchain. It is crucial to combine strong industry expertise with blockchain expertise to find the real sweet spots.

This paper seeks to do two things in terms of contributing to academic discourse. First of all, it helps to clear the business importance of blockchain technology. This research concluded that blockchain can be viewed as both a technical innovation as well as a catalyst to business model innovation. Differentiating between the two is important to understand how blockchain should be approached. This research also presents a framework that can be utilized when working with potential blockchain use cases, both to evaluate an idea and to guide thinking in preparing a use case.

Secondly, the paper offers a way to look at business model innovation and aims to clarify the concept of business model innovation and what factors affect it. This paper contributes to existing literature by offering an example of a business model innovation catalyst *ex ante.*

## 7.3 Reliability and validity of the study

This study is reliable and valid to a sufficient extend. The research methods used are quite valid for the topic. Blockchain is such a new phenomena that there is still little knowledge about it, and interview study was for this reason a good way to find out about it. The research questions are quite relevant to the topic, since the industry is currently looking to see how to use blockchain. Validity was increased by discussing with experts before choosing research questions and methods. To ensure structural validity, I interviewed a large number of people from different organizations and industries. Further, results are compared with existing knowledge of blockchain technology. However, the structural validity of the study might suffer from the fact that many of the interviewees were not blockchain experts. Internal validity of the study was ensured by using coding to rigorously analyze the interview data, as well as in addition to the interviews creating use cases. External validity of the study is increased by studying two case companies from different industries, and the results of the study can be generalized at least geographically, but also to other industries. Reliability of the study was increased by selecting right methods for the study: a semi-structured interview study was appropriate since the topic is so new. Further, reliability was increased by recording and transcribing the interviews so that they could be later analyzed in a consistent and exhaustive manner.

In the energy sector, when asking about trust, I often got answers that addressed reliability. One reason for this probably is that in Finnish, the word trust (luottamus) is very close to the word reliability (luotettavuus). While these are certainly connected, they are different concepts and should have been more clearly distinguished. The problem is that giving specific instructions to the interviewees about what I meant with trust could have affected the results. It is a finding on its own that trust is so highly linked with reliability in the energy industry.

## 7.4 Limitations and future research

Blockchain as a technology is still very new. It could be that it will not turn out as important as now evangelized. Further, blockchain technology is still in its infancy and there could be serious misunderstandings in this work as it depicts the status quo. It would be interesting to visit this topic in the future to see how progression has been made and to validate or reject the hypothesis presented.

As the scope of this research was limited, only two companies from two industries were studied, which is quite a small sample. Both selected industries are special in the sense that both are heavily regulated. This could make the sample biased. It also presents an opportunity for future research.

Many interesting research possibilities await in the future, especially after more blockchain applications have been realized. Blockchain business models could be one interesting source of information that could be used to test the suggestions put forward in this paper. Also doing similar research in other industries in addition to financial services and energy, or by including more companies from these two industries would give some dimension to findings of this work.

Further, there are many interesting research possibilities in business model innovation that does not include blockchain. Further understanding what type of things could be viewed as a business model innovation catalyst could be sought.

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## Appendix A: Interview guide

**Background**

Who are you, what do you do?

How would you describe the changes caused by digital disruption?

**Changes in operational environment**

How do you see the operational environment and what changes are taking place?

What possibilities exist and how are you taking advantage of them? / What is your response to change?

**Blockchain**

How do you understand the blockchain technology? What is important about blockchain?

Is this technology interesting? How do you see it could change your industry? The world?

Where have you learned about this? Have you read any books?

Are you doing something blockchain related?

**Changing roles**

What kind of changes in practices/roles are taking place?

How have things been handled before? How has the new technology changed which actor will do in the future?

Who does it now inside of the organization?

**Role of data and trust**

What kind of data is collected? How valuable is it? Who owns it? Who analyses it?

What is the role of trust? Who is it important to? How is it changing/has changed?

**Case-specific questions**

## Appendix B: UBS Blockchain Qualification Criteria

Qualification Criteria

Business Model Lens

- Is **digital** based?
    - Only digital native, dematerialised or tokenised assets are in scope.
- Is **intermediation** based?
    - Requires lack of trust and/or need for coordination between stakeholders.
- Is **business** viable?
    - Are transaction flows, extent of loss, and probability of successful attack or likelihood of failure high enough to charge sufficient fees for?
    - If a new value proposition, does it meet needs that customers are willing to pay sufficient fees for?
    - Can existing businesses match or exceed capabilities and fees?
- Is near **real-time** settlement required?
    - Is current settlement measured in days but clients, regulators or capital requirements demand near real-time settlement?
    - Blockchain's automation and minute-timed global ledger consensus enables near real-time settlement, so if new capabilities are required, they may be met cheaper with blockchain.
- Is **transparency** required?
    - Do regulators or clients require enhanced data transparency?
    - Blockchain's distributed nature suits cheap data publishing, so if new capabilities are required, they may be met cheaper with blockchain.
- Is **reporting** required?
    - Is there a need to enhance reports to clients, partners and regulators?
    - Blockchain's distributed nature suits cheap data syndication, so if new capabilities are required, they may be met cheaper with blockchain.
- Is **human** intensive?
    - Is current process expensive because it is manual or semi-automated?
    - Even if only a tiny number of transactions require human reconciliation, each intervention may be very expensive.
    - Blockchain forces full automation and associated long term cost reductions, so if additional automation is required, it may be achieved cheaper with blockchain.
- Is **capital** intensive?
    - Is capital locked up due to settlement delays or as operating collateral?
    - Near real-time settlement using blockchains can reduce capital requirements, creating a strong business case for blockchain adoption.
- Is **legacy** technology intensive?
    - Is current implementation of compute, storage and messaging based on complex and legacy technology?
    - If technology refresh is due anyway, it may be a good time to consider a cheaper and more capable collapsed stack supported by blockchain, creating a strong business case for blockchain adoption.

## Technical Lens

- Is **technically** viable?
    - Does the business map to one of the intermediation patterns listed below, or has system requirements that map to blockchain technology capabilities?
- Not strictly **confidential**?
    - Blockchains use pseudonymity for confidentially, so you know how much is transacted but not between which parties.
    - Technology is evolving to improve on this, but for now your business model needs to be compatible with this constraint.
- Not high **throughput**?
    - Blockchains today support very low transactions per second rates e.g. Bitcoin supports 7, Ethereum about triple of that.
    - Platforms like Ethereum and others are aiming for 100,000 TPS, but for now you have to live with existing constraints.
- Not low **latency**?
    - Blockchains confirm transactions in blocks through consensus, which will always take longer than unilateral confirmations.
    - Bitcoin blocks are 10 minutes long; Ethereum's can be as quick as 5 seconds. Aim is for few second blocks, but nanosecond latency is unlikely in foreseeable future.

## Regulatory Lens

- Is conduct **compliance** required?
    - Is there a need to guarantee and prove regulatory compliance?
    - Blockchain's smart contracts, data chronology and cryptographic immutability are suited for compliance enforcement and audit, so if new capabilities are required, they may be met cheaper with blockchain.
    - Conduct based regimes are preferred to prescriptive ones as regulation change may not be required when switching to blockchain as long as conduct equivalence can be proven.