Master's thesis

NTNU
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Faculty of Economics and Management
NTNU Business School

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A Multiple-Case Study on the Strategic Value of Blockchain: A Transaction Cost Economics Model

Master's thesis in Economics and Business Administration
"Siviløkonom"
Supervisor: Marius Andersson
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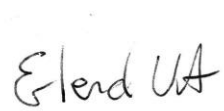
Preface

This thesis was written as a conclusion to a master's degree, M.Sc., in Business Administration and Economics with a specialization in Strategy, Organization, and Leadership at the Norwegian University of Science and Technology. It was written in the spring of 2022 over a period of five months. The content of this thesis is at the author's expense.

I initially was inspired to learn about blockchain when I heard someone talking about it in mid-2020. As I looked into it, I was immediately hooked, and knew right away I wanted to write about it for my master's thesis. It has been my great pleasure to spend this time delving deep into the workings of blockchain technology as it relates to the field of business strategy. I believe that blockchain technology is still only at the beginning of its journey to mass adoption. I am eagerly watching the process as it unfolds around me.

I would like to extend my gratitude to my advisor during this process, Marius Andersson. He is a post-doctorate at the NTNU Business School. The helpful suggestions have been of utmost importance to me in writing this thesis. My heartfelt thankfulness also goes to my family and friends who supported me with thoughtful and emotional support. I am very grateful to my interview informants who offered their reflections and time. A final special thanks goes to Satoshi Nakamoto for throwing the rock that created ripples throughout the pond.

Trondheim, May 24, 2022



Erlend Urstad Ambjørndalen

Abstract

Many predict that blockchain technology will have a similar scope of impact on society as the Internet has had. The technology may affect everything from how we do business, to academic discussions, to how we organize society as a whole. An increasing number of organizations are experimenting with the technology, and it is interesting to look at why they do so. Blockchain's array of applications seem endless and has evolved past the initial proposition by Satoshi Nakamoto as a medium for direct digital payments.

This study embarks on a mission to discover the value of blockchain applications for companies. It employs a multiple-case study design, using interviews with nine organizations who have actual experience with the technology to gather data. A transaction cost economics theoretical perspective is applied to analyze the research question. Existing research taking an empirical approach to studying the value of using blockchain, and employing transaction cost economics is, as of the writing of this article, scarce. The analysis is conducted using thematic analysis.

The findings of this study suggest that the value of blockchain lies in reducing transaction costs through the moderation of bounded rationality, reduction of opportunism, and simplification of execution processes. The findings are visualized in the Blockchain value creation model. The model indicates that the technology is important as it can create great value for companies. The findings are significant as they not only propose a model for value creation with blockchain unlike that of previous research, but also as they add nuance to the transaction cost economics framework itself. The author posits that transaction cost economics needs a revision of its underlying assumption of bounded rationality, though the assumption of opportunism can remain unchanged.

Sammendrag

Mange predikerer at blokkjedeteknologi vil ha et liknende omfang av påvirkning på samfunnet som Internett har hatt. Teknologien kan påvirke alt fra hvordan vi gjør forretninger, til akademiske diskusjoner, til hvordan vi organiserer samfunnet som helhet. Et økende antall organisasjoner eksperimenterer med teknologien, og det er interessant å se på hvorfor de gjør det. Blokkjedes spekter av applikasjoner virker endeløst, og har utviklet seg forbi den initielle proposisjonen til Satoshi Nakamoto som et middel for direkte digitale betalinger.

Denne studien søker å oppdage verdien av blokkjedeapplikasjoner for firma. Den anvender et multippelt casestudie design, og intervjuer ni organisasjoner som har faktisk erfaring med teknologien for å samle inn data. Et transaksjonskostnadsteoretisk perspektiv er tatt i bruk for å analysere forskningsspørsmålet. Eksisterende forskning som tar en empirisk tilnærming til å studere verdien av å bruke blokkjede, og som bruker transaksjonskostnadsteori, er, under skrivingen av denne artikkelen, knapp. Analysen er gjennomført ved bruk av tematisk analyse.

Funnene til denne studien foreslår at verdien til blokkjede ligger i å redusere transaksjonskostnader gjennom moderasjon av begrenset rasjonalitet, reduksjon av opportunisme, og forenklet utførelse. Funnene er visualisert i Blockchain value creation model. Modellen indikerer at teknologien er viktig siden den kan skape stor verdi for firma. Funnene er betydelige ikke bare fordi de foreslår en modell for verdiskaping med blokkjede som skiller seg fra tidligere forskning, men også fordi de nyanserer transaksjonskostnadsrammeverket i seg selv. Forfatteren argumenterer for at transaksjonskostnadsteorien må revidere dens underliggende antakelse om begrenset rasjonalitet, men antakelsen om opportunisme kan forbli uforandret.

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1 Introduction

In 2008, the person or persons going under the pseudonym Satoshi Nakamoto released the Bitcoin whitepaper (Nakamoto, 2008). This short, 9-page document outlined the blockchain technology and its use case as a foundation for the first cryptocurrency, Bitcoin. Bitcoin is a peer-to-peer money transacting system that allows parties to transact securely without a third-party institution to govern the transaction (Swan, 2015; Iansiti & Lakhani, 2017). The technology has since been applied for a number of other purposes due to its distributed ledger functionality and related characteristics such as immutability, decentralization, and transparency. Blockchain could potentially create value for companies in many different ways. From a transaction cost perspective, Ahluwalia et al. (2020) argue that the phenomena could reduce transaction costs. They also say that the novel technology could profoundly affect the framework of transaction cost economics (TCE). Seidel (2018) similarly posits that the fundamental assumption in transaction cost economics needs to be updated because of how blockchain creates distributed trust. Williamson (e.g., 1975) and others developed transaction cost theory under different technological times than those we are in today, and Seidel (2018, p. 42) goes so far as to say that the theory's underlying assumptions no longer hold in such "absolute terms". This article will explore these ideas, and the rest of this chapter introduces the research question, its background, and the outline for the thesis.

1.1 Background for choice of research question

Blockchain has been credited with the potential to disrupt entire economic systems (The Economist, 2015; Tapscott & Tapscott, 2016). While the cryptocurrency application of blockchain has been getting the most attention (Buterin, 2013), the technology is fundamentally a register storing information that can be used without cryptocurrencies and for other things too (Bjoernstad, 2018). It is decentralized, transparent, immutable, and open. Over the years, more and more private companies and governments alike have realized that due to these characteristics, the technology has a wide array of applications. A few examples are tracking value chains, verifying documents, and automating transfer of ownership of goods (NUS, 2018). All these areas and more could potentially enjoy increased trust, transparency, security, and efficiency while decreasing transaction costs and opportunism (Courcelas, 2020; Davidson et al., 2016; Gausdal et al., 2018; Kant, 2021; Schwab, 2018; Werbach, 2018).

Importantly, there are challenges to blockchain applications, such as the prospect of tremendous energy use, governmental regulatory uncertainty, price volatility, lack of people with competency around it, and legacy systems that may work just as well or better. Legacy systems are current systems that some may interpret as also being outdated systems, such as relational databases, banks, and even governmental organizations. The tension between disruptive potential and challenges begs the question of whether the novel technology is just a hype or something more substantial (Carson et al., 2018).

While perhaps not so much highlighted in mainstream media, many companies have already started experimenting with implementations of blockchain in their operations. Examples include IBM (IBM, 2022), Walmart (Vitasek et al., 2022), and A.P. Møller-Mærsk (Maersk, 2021). The likes of the World Economic Forum (Schwab, 2018), the United Nations (Mulligan, 2022), IMF (Bains, 2022), and consulting firms like McKinsey (Carson et al., 2018) and Deloitte (Bjoernstad, 2018) argue that the technology has enormous potential to change how we do things in society and business. Scientists and pundits have even put blockchain on the same shelf as truly disruptive contemporary technologies such as artificial intelligence (AI), machine learning, and the Internet of Things (IoT) (Courcelas, 2020; Karpenko et al., 2019; Meholm, 2021; Schwab, 2018; Swan, 2015). Iansiti and Lakhani (2017, p. 119) go even further and argue that blockchain is a foundational technology with the "potential to create new foundations for our economic and social systems". It is no surprise then that blockchain may harbor an immense potential for impacting economic agents. Should the technology come to saturate society to the point where we can say we have reached mass adoption, it will impact almost every one of our lives in some way or other. While mass adoption is by no means certain, many things seem to point in that direction. Therefore, it is imperative that we research this technology and how it can be used so that we can understand it better and how it would fit in with our lives and businesses.

Notwithstanding the significance of blockchain due to its potential to change businesses and the already applied use cases of it worldwide, there seems to be limited understanding and awareness of the technology in the general public. This insufficient knowledge is likely largely due to how new all of this is. Simultaneously, corporate media and governments have tended to be quite negative (CNBC, 2018; Gobel, 2022). As a result, cryptocurrency and blockchain have for a long time been associated publicly with something that is just for criminals and, more generally, something that it is best to stay away from (Swan, 2015;

Tapscott & Tapscott, 2016). This has likely kept many from exploring it further (Gobel, 2022).

Consequently, because of the technology's potentially major implications, it is crucial to gain a more nuanced perspective on the topic and make more people aware of blockchain and how it can be used. It should also be mentioned that blockchain is still largely considered an immature technology (Litan, 2018; Van Rijmenam et al., 2017), and this may have something to do with the insufficient knowledge. For many, Blockchain has become synonymous with Bitcoin, when in fact, much is possible to do with blockchain apart from cryptocurrencies (Gupta, 2017). More clarity is thus important. It may be especially so for private companies today who wish to gain a competitive edge in the marketplace and increase their success and profitability (Kant, 2021). While not suitable just anywhere, blockchain holds the potential to aid in this pursuit, and companies can no longer afford to ignore it (Carson et al., 2018; Iansiti & Lakhani, 2017; Kant, 2021). If blockchain is like the new Internet, as some say (Tapscott & Tapscott, 2016; Treiblmeier, 2018), it is not unlikely that those who do may find themselves falling behind the curve at some point (Carson et al., 2018; Yuthas, 2021).

This is why the purpose of this thesis is to give readers insight into the many ways blockchain can be used to create value for companies. While not looking to create an exhaustive list of potential use cases, the study will explore some of them. It will examine how blockchain technology fits in with the business models of various companies and how this helps (or hinders) the achievement of their strategic goals. How they use it, why they use it, and the results of its use are all viable and worthy questions this study will try to answer. I hope I have convinced the reader why questions such as these are of utmost importance. Assuming they are, and that the answers are obscure for most, the research question this study will embark on answering should consequently be a logical one. The research question is:

How can blockchain help create value for companies?

1.2 Outline for thesis

This introductory chapter has provided some background to build the rest of the paper. The research question was also presented and reasoned for. The rest of the thesis will aim to answer this research question. In order to do this, the reader will need a basic understanding

of how blockchain technology works as all parts of the paper connect back to this. While a thorough and deep knowledge base of purely technical matters such as cryptograhics and data programming is not necessary for our purposes, foundational knowledge must be in place to convey arguments effectively and for the reader to evaluate them. Thus, laying out the basic characteristics of blockchain technology itself will be the purpose of chapter 2 Blockchain technology overview.

Subsequently, in chapter 3 Literature review, a literature review is conducted to map out prior research findings on the value of blockchain for companies. That way, I can anchor the thesis within this academic debate and position it in a way where I can hopefully contribute with meaningful findings. In chapter 4 Theory, I expound upon transaction cost economics to use this theory to analyze the raw data. Next, in chapter 5 Scientific research methodology, I outline the scientific method I followed to answer the research question of this study. I will elaborate on all choices made here with reasons and implications. In Chapter 6 Results and empirical data, I provide the raw data found through the data collection method of choice, personal interviews. In Chapter 7 Discussion, I proceed with analyzing these data and answering the research question using thematic analysis as outlined in chapter 4 Scientific research methodology. Finally, the conclusion is presented in chapter 8 Conclusion, where the paper is summarized. Moreover, limitations of the paper are discussed and suggestions for future research are made.

2 Blockchain technology overview

This paper is, first and foremost, a business strategy paper, not a technology paper. In other words, we look at how companies can strategically apply blockchain technology to increase their profitability, efficiency of operations, reduce costs of various kinds, and similar matters. However, for companies to achieve these aims, they need at least some understanding of the technology itself. Also, for the discussion and conclusion to make sense to the reader, we need to cover the basics of the functioning of the technology and recurring terminology. This is also important to better be able to answer my research question.

2.1 Background

Blockchain technology, a type of distributed ledger technology (DLT), is a further development of similar cryptographic technologies from the 1980s (Chaum, 1985). The purpose of these older technologies was to find a way to send money *peer-to-peer*, meaning directly from one person to another, without the reliance or interference of third parties. Third-party mediation is how we do most transactions today, such as by using banks to wire our money for us. The problems of third-party mediation are, among others, that there is a central point of failure and that one needs trust in this third party, which they can take advantage of (Gupta, 2017; Meholm, 2021; Tapscott & Tapscott, 2016). Furthermore, it can be time-consuming to go through them, and they usually take a cut for themselves (Gupta, 2017; Meholm, 2021; Tapscott & Tapscott, 2016). However, these older technologies experienced the problem of *double-spending*, meaning when malicious actors spend the same digital currency twice (Swan, 2015). In other words, they get two goods for the same money. Blockchain solves this problem without relying on a trusted third party (Meholm, 2021; Nakamoto, 2008; Swan, 2015). It does this through the nature of how it works, which we will now describe.

2.2 How it works

When an actor wants to make a transaction on a blockchain, the computer code broadcasts the attempt to make it to the whole network of nodes connected to the particular blockchain that the actor uses. Nodes are computers that store a complete copy of the blockchain history of transactions, and miners are nodes who use downloadable software and participate in verifying transactions (Courcelas, 2020; Meholm, 2021). So, nodes are not necessarily

miners, but miners are always nodes. Anybody, node or not, has online access to the blockchain history through the blockchain explorer (Swan, 2015). As users broadcast transactions, they enter a pool of unverified transactions that are not yet accepted or allowed to occur (Meholm, 2021). Miners then check to see that the sender, in fact, has the funds they are trying to send available in their wallet (personal digital account for storing valuables such as cryptocurrencies) and try to reach a consensus on whether the transaction is valid or not (Meholm, 2021). Consensus means that most miners, or 51%, agree (Gupta, 2017; Meholm, 2021). In other words, it is a system of majority rule (Meholm, 2021). If the transaction is accepted it is added to a block, which is like one sheet of paper in a physical ledger book (Courcelas, 2020; Meholm, 2021). It varies depending on the blockchain how many transactions are added to each block. The block is then hashed with a digital signature, meaning it gets a code unique to it that identifies it (Courcelas, 2020; Gupta, 2017; Meholm, 2021). The block is also stamped with the hash of the previous block that was verified in the system and time-stamped (Courcelas, 2020; Gupta, 2017; Meholm, 2021). This lets us see when the transactions were made and in what order they occurred. Hence, we get a chain of blocks - or a "blockchain" (Gupta, 2017; Swan, 2015). Each block is also given information about the sender's and receiver's address and how much/what was sent. An address is much like somebody's account number in a bank or e-mail address that lets somebody send money or an email to another and is called a public key (Meholm, 2021; Swan, 2015). Each wallet is also associated with a private key which is a password that protects the user's funds (Meholm, 2021).

2.2.1 Consensus mechanisms for verifying transactions

Consensus mechanisms are the specific processes and ways in which transactions are verified and added to the blockchain through reaching consensus (Courcelas, 2020). The two most common consensus mechanisms are proof-of-work and proof-of-stake. Proof-of-work is the original one used by Bitcoin and presented by Satoshi Nakamoto in the Bitcoin whitepaper (2008). Miners who want to accept a transaction must solve a complex mathematical problem created by the blockchain algorithm using computer power and electrical energy. The central processing unit (CPU) is the "brain" of the computer, and the stronger it is, the more battery of your computer is drained. The more CPU and energy a miner has available, the more likely they will find the right answer to the complex mathematical puzzle presented by the blockchain (Meholm, 2021). Whoever finds it first gets rewarded the block (Meholm, 2021).

Verifying transactions is thus a race between miners, and those with more computing power available have a higher likelihood of finding the answer first (Meholm, 2021; Swan, 2015). The answer becomes the hash that is signed on the block. Miners are incentivized financially by getting a portion of the transaction fees the sender of funds has to pay to send those funds (Buterin, 2013; Meholm, 2021; Swan, 2015). Miners also get rewarded with new Bitcoin or cryptocurrency (Buterin, 2013; Meholm, 2021; Swan, 2015). This is why they are called miners - just as a gold miner mines for gold by hacking away at the rock in an underground tunnel, the cryptocurrency miner mines for cryptocurrency by computing on a computer. When all the cryptocurrency is mined, miners mine for transaction fees only.

Proof-of-stake is similar to proof-of-work, but instead of a race to figure out the hash first, the one who gets to verify a transaction is chosen at random (Frankenfield, 2021). Miners are called validators, and mining is called minting (Vlachos et al., 2021). The more tokens a validator "stakes" (puts up as a security deposit they cannot touch while participating in the network as a validator), the higher the likelihood they are chosen to validate a transaction (Bains, 2022). The algorithm of the consensus mechanism thus assigns a heavier weight to them when "spinning the wheel" on who gets to validate a transaction. We can trust validators because they lose their stake if they approve false transactions. The staked amount must always remain higher than the value generated from validating blocks.

There is the possibility of a 51% attack for both proof-of-work and proof-of-stake consensus mechanisms. A 51% attack is when malicious actors who want to double-spend or spend the valuables in other people's wallets for their own purposes take control of the network, either by acquiring most of the computing power in proof-of-work blockchains or most of the tokens in proof-of-stake blockchains (Buterin, 2013; Meholm, 2021). If they have this, they can create consensus around false transactions and verify attempts to double spend. However, this is extremely difficult (Buterin, 2013; Meholm, 2021). As blockchain networks grow larger with more nodes, it becomes harder to conduct a 51% attack (Meholm, 2021). In proof-of-work, one would need an inordinate amount of computing power which very few are rich enough to obtain or able to onboard enough people in the cause. At that point, the reward would, in most cases, not exceed the cost regardless. In proof-of-stake, one would need to buy up 51% of all the associated tokens, which would be near impossible and rarely worth it. Now, for smaller blockchains that are new or not sufficiently decentralized with nodes worldwide and with low market capitalization, 51% attacks become more feasible. Therefore,

it is important for blockchains to be widespread and grow as much as possible because that way, the security of the network increases.

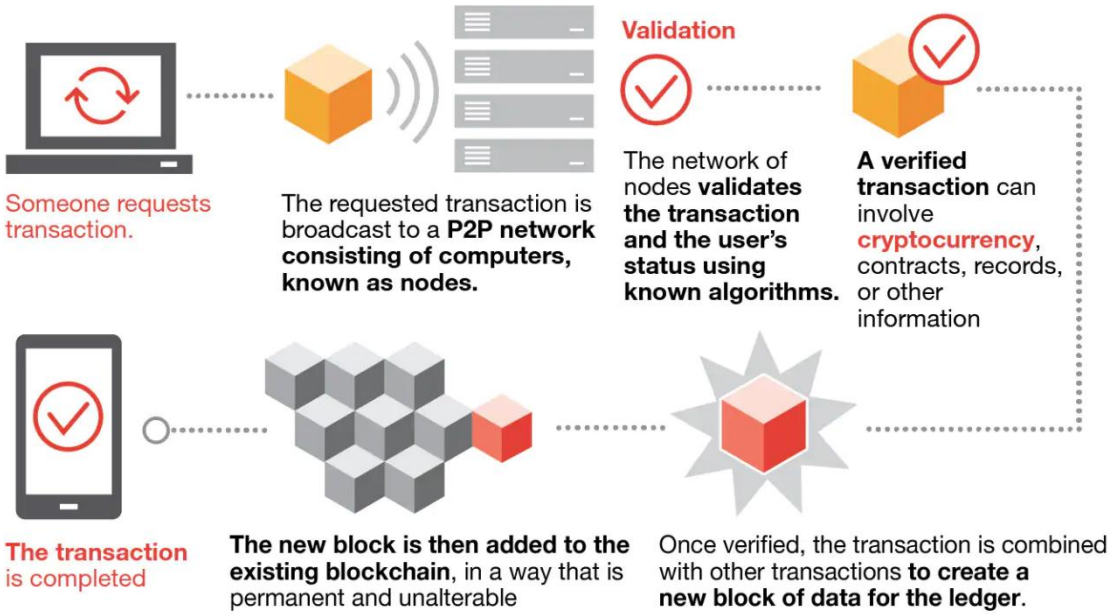

Figure 1: How blockchain transactions occur (PwC, n.d.)

2.3 Definition of blockchain

Now that we understand the essential workings of blockchain technology, we can begin to arrive at a suitable definition. Blockchain has been defined as "a distributed ledger or database of transactions recorded in a distributed manner, by a network of computers" (Wright & De Filippi, 2015, p. 6). Another definition capturing other characteristics is "an incorruptible digital ledger of economic transactions that can be programmed to record not just financial transactions but virtually everything of value" (Tapscott & Tapscott, 2016, p. 435). Put differently, a blockchain is a digital ledger of information about transactions with several characteristics. It is *distributed*, meaning anyone with a minimum of technological and financial means can access it, view or download a copy, and become a miner/validator (Iansiti & Lakhani, 2017; Meholm, 2021). It is *open-source*, meaning anyone can review the computer code used to create it (Meholm, 2021). This means that trust in the technology can increase because many independents with the necessary skills can and often have gone over the code to check its legitimacy and quality. We will revisit the issue of trust later. Blockchain is also, generally speaking, *decentralized*, meaning no central authority has the power or

authority to shut it down or make decisions on behalf of others. Past blocks are *immutable* because there is no (realistic) way for those to be changed after they are put in.

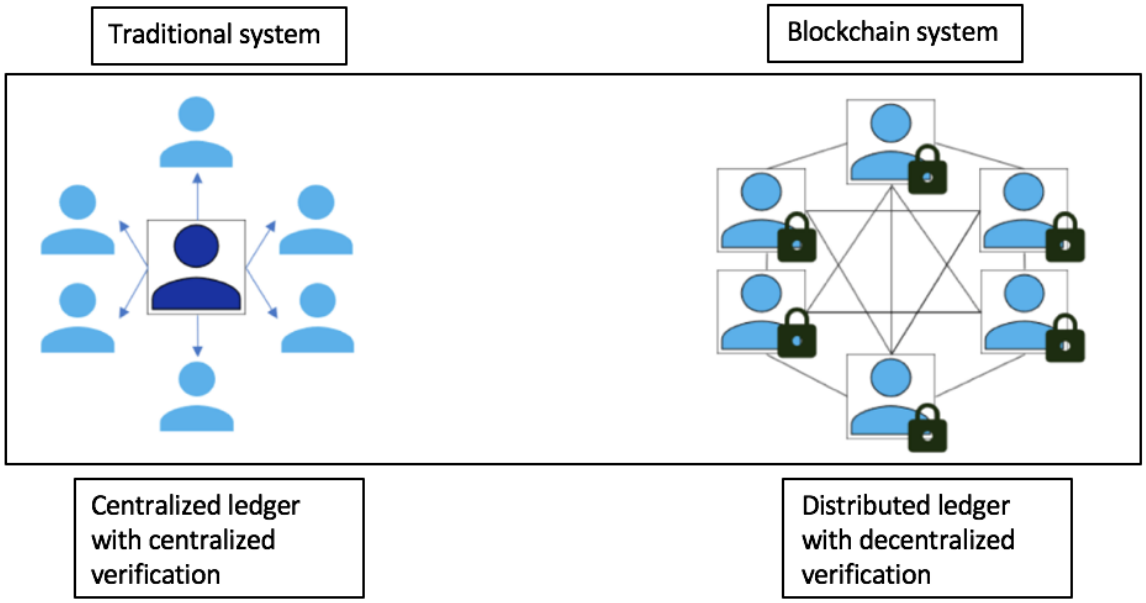

Figure 2: Centralized vs. decentralized ledger (adapted from Chainflux, 2020)

2.3.1 Truth

Fundamentally, blockchain is a way of agreeing about what is true and recording that in a way that is immutable (Courcelas, 2020; Iansiti & Lakhani, 2017; Gupta, 2017). As we will see, the characteristics of blockchain make it suitable for a number of purposes within and across companies and business operations. The distributed registry is *transparent* in that anybody can see what is on it, unless for specific purposes such transparency is limited to only those with permission of for example the owner of some information. Tapscott and Tapscott (2016, p. 56) put it best by saying that "transparency means operating out in the open, in the light of day". It is also *open* in that anybody can join the network either as a node or miner/validator.

2.3.2 Trust

Tapscott and Tapscott (2016, p. 55) define trust as "the expectation that the other party will behave according to the four principles of integrity: honesty, consideration, accountability, and transparency." Blockchain is frequently regarded as a trustless system (Davidson et al., 2016; NUS, 2018; Swan, 2015; Werbach, 2018). Transacting partners on a blockchain do not need to trust each other or an intermediary to govern their transactions (Swan, 2015). Blockchain functions as a neutral and objective middle-man to take the place of human

middlemen that can potentially be biased towards one or the other or themselves. This may remove problems of opportunism and transaction costs related to the use of the trust mechanism in governing relationships (Davidson, et al., 2016; Krishnan et al., 2016; Werbach, 2018). This is, of course, assuming the blockchain was programmed to be fair and objective to begin with. Parties do need trust in the technology itself instead of in each other or a third party (Swan, 2015), so in a way, the term trustless is not entirely accurate. Trust is just moved from people to technology. Perhaps Werbach's (2018) term "trustless trust" is the most accurate for describing trust under blockchain conditions. There is trustlessness because you do not need to "hope" that the other party does as promised, and trust because you instead "know" that the computer code will execute as programmed because it is neutral and does not have the ability to choose not to be. Given consensus mechanisms, cryptography (mathematical codes and computer programming ensuring the network's security), immutability, widespread distribution of the ledger, decentralization, and open-source code, trust in the technology itself is easy for most to develop. With blockchain technology we can effectively "manufacture trust through clever code" (Tapscott & Tapscott, 2016, p. 45). Figure 3 below shows the evolution of trust as it moves from local, to institutional to distributed with blockchain.

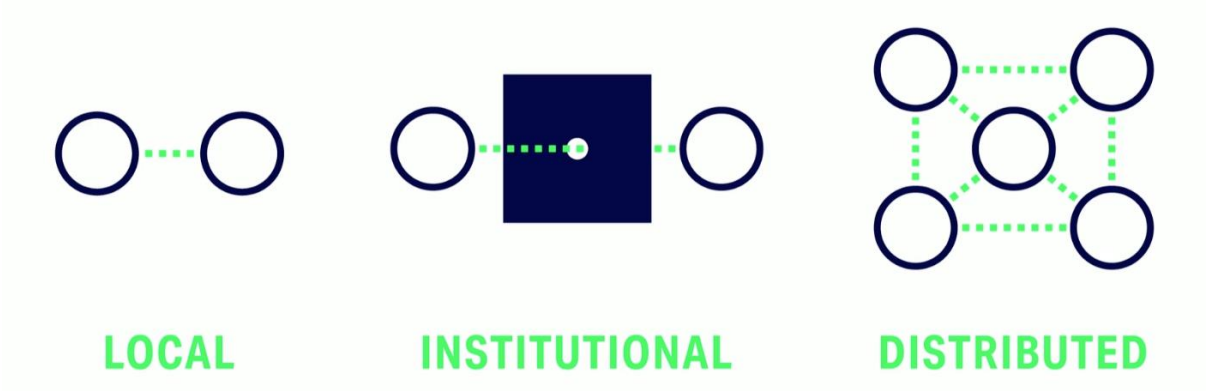

Figure 3: The evolution of trust (Botsman, 2016)

2.3.3 Privacy

Some blockchain wallet providers and exchanges require know-your-customer (KYC) verification in order to use them (Meholm, 2021). This ensures that the public address is connected to your identity and can help protect against fraud. If no KYC is applied, the public address cannot easily be connected to an owner. However, every single transaction that has been made to and fro that address is available for everyone to see on the ledger online. This is the case, for example, with the Bitcoin blockchain. Nevertheless, other blockchains have

built-in privacy features, making it impossible to see the previous transactions of an address. For example, the cryptocurrency Monero has such features (Monero, n.d.). The degree of anonymity and privacy thus varies depending on the blockchain. Therefore, it is not true that all actors and transactions are completely secret, so that cryptocurrency is necessarily a haven for criminals (Courcelas, 2020; Meholm, 2021). Also, computer programs have been developed to identify the owners of wallets, for example by Chainalysis (Meholm, 2021).

2.3.4 Public-Private Axis

Blockchains can be permissionless (public) or permissioned (private). Permissionless blockchains are what I have described up until this point. They are open in that they are accessible to anyone who wants to read or publish data without authorization (Courcelas, 2020; Meholm, 2021). They are 100% transparent and *borderless* (the same no matter what country you use them in). Permissioned blockchains are different and should be mentioned too, because many private companies will consider using this type instead (Gupta, 2017; Yuthas, 2021). Permissioned blockchains are closed ecosystems where all participants are defined (Gupta, 2017). Only pre-approved entities can run nodes (Gupta, 2017; Meholm, 2021). There is usually no anonymity, and they tend to have less decentralization and transparency than public blockchains (Meholm, 2021).

2.4 NFTs and smart contracts

An important concept to know about is non-fungible tokens (NFTs). These are tokens on a blockchain that there are only one of in existence (Meholm, 2021). No other token is exactly like it. NFTs are trendy for digital art these days with celebrities like Katy Perry and Tom Brady selling their own NFTs. NFTs have become somewhat of a collectibles trend, and as with other markets for rare collectibles, like paintings and collectors' coins, the prices these sell for can sometimes be dazzlingly high. Non-fungible tokens also have many other use cases, such as representing ownership of various objects such as a deed to a house, a car, or a ticket to a party (Meholm, 2021). Protected by the cryptography of blockchain, it becomes hard to steal or forge these. They can also efficiently and safely be sold or transacted through smart contracts.

Smart contracts are programs stored on the blockchain that can be used to automatically exchange value when certain predetermined conditions are met (Buterin, 2013; Swan, 2015;

Szabo, 1994). It is a type of if-then Boolean statement. Swan (2015) simply says smart contracts are like traditional contracts, only executed by code. They are autonomous in that they operate on their own without the need for human involvement (Swan, 2015). They are immutable. It is therefore crucial that its designers make sure everything is correct before they deploy it on the blockchain (Van Rijmenam et al., 2017). However, some parameters can be programmed to change over time under certain circumstances (Van Rijmenam et al., 2017). Smart contracts can, for example, automate insurance claims for insurance companies by validating claims and calculating a payout (Gupta, 2017; Van Rijmenam et al., 2017).

Another notable example of the use case of smart contracts is how they may replace companies like Kickstarter (Swan, 2015). Kickstarter is an online fundraising website where those seeking funds open an account for anybody to invest in their venture. Should the fundee reach their funding goals within a set period, Kickstarter, who held the money in their custody up till this point, sends it to them. If the fundee does not reach their goal, Kickstarter sends the money back to the funders. This system sets Kickstarter up as a central point of failure who could get hacked or even commit fraud. The similar organization GoFundMe, recently exemplified this problem. They canceled the $9 million donated to the truckers in Canada rising peacefully for their freedom and human rights (The Guardian, 2022). Smart contracts can solve this problem because there is no human friction or opportunity for gaming the system for personal benefit. The smart contract would simply send the money to where it is programmed, depending on whether the funding conditions are met (Swan, 2015). Again, trust in the technology is all that is needed, not in people. In general, we can say that smart contracts can result in smoother collaboration between people because they automate many transactions and allow for trustlessness (Iansiti & Lakhani, 2017; Karpenko et al., 2019; Swan, 2015). Indeed, smart contracts may make many current-day professions more or less obsolete in the more distant future (Iansiti & Lakhani, 2017).

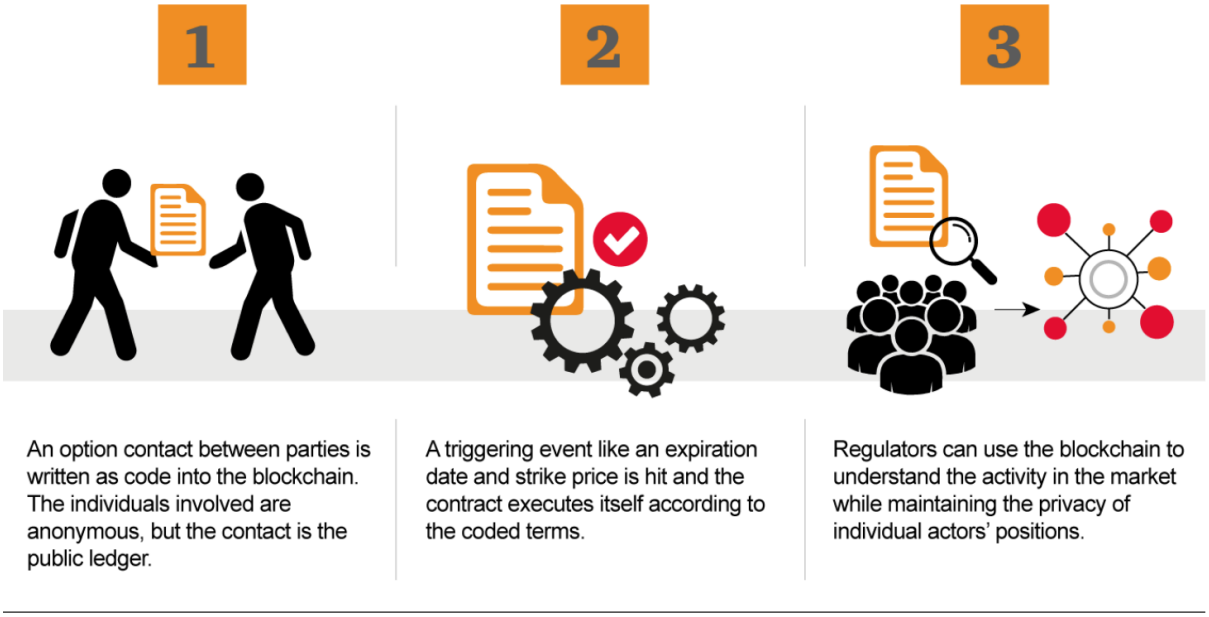

Figure 4: Overview of how a smart contract works (PwC, 2018)

3 Literature review

This chapter will give an overview of prior research on the subject of blockchain as it relates to business applications and value propositions. The purpose of the literature review is to show the reader what knowledge and claims exist in this field (Bell & Bryman, 2011). I mainly included scientific research published in reputable journals to help ensure high quality of contributions. I also included some conference papers that are at the forefront of research in the field, highly cited, or from well-known authors. A few other reputable sources were included. Throughout this chapter I position the thesis in relation to previous literature to make a contribution to the stream of literature.

3.1 Overview

There is broad consensus in the literature on the junction of blockchain and business value creation in that the majority have high hopes for the technology. The literature is strongly optimistic about the potential of blockchain to change and improve the way business is done (e.g., Gausdal et al., 2018; Van Rijmenam et al., 2017). This applies to most sectors in the economy, and many of them have been covered by previous research (e.g., Bhardwaj & Kaushik, 2017; Casino et al., 2019; Konstantinidis et al., 2018). Blockchain has been likened to the Internet with regard to disruptive potential and future trajectory (Iansiti & Lakhani, 2017). However, we are still in the early stages of development (Kant, 2021; Konstantinidis et al., 2018), and the realization of its potential and what it will look like in the future is yet to be fully discovered (Levis et al., 2021). While researchers largely agree that blockchain can disrupt entire markets, most are careful to note that this is still years away (Bhardwaj & Kaushik, 2017; Iansti & Lakhani, 2017; Kant, 2021). It takes time for foundational and transformative technologies to become ingrained into the fabric of society (Konstantinidis et al., 2018).

3.2 Financial sector

Most researchers on blockchain has studied it as a basis for digital currencies or cryptocurrencies and their application in the financial industry (e.g., Crosby et al., 2016; Fanning & Centers, 2016; Peters & Panayi, 2016; Wątorek et al., 2021; Yermack, 2017). In their conference paper, Bhardwaj and Kaushik (2017) argue that cryptocurrencies can help companies reduce costs where banks charge a fee to facilitate transactions as an intermediary.

This benefit may be huge for cross-border transfers where the fees can sometimes be sizable. In the same paper, the authors also posit that blockchain is faster and more secure as it is nearly impossible to hack. Since the cryptocurrency aspect of blockchain and the financial sector has been better covered by past research, I will move the literature beyond the opportunities here to add something new.

3.3 Public sector

The public sector use cases of blockchain have also been a focus for researchers, albeit smaller than the financial ones. Public sector use cases range from storing land titles on the blockchain (Konstantinidis et al., 2018) to securing election votes from fraud (Bhardwaj & Kaushik, 2017) to preventing tax fraud (Hyvärinen et al., 2017). However, the focus of my article is not on the public sector but instead on the private sector. This is to make the scope of the article more manageable. Do note, however, that there may be some overlap in both use cases and value creation opportunities for these two sectors. For example, the secure voting system that governments can apply to prevent fraud and increase public trust in democracy can also be used by companies internally. In fact, NASDAQ already is testing this use case in its shareholder meetings (Bhardwaj & Kaushik, 2017). Van Rijmenam et al. (2017) support this by arguing that blockchain can change the concept of decision-making within companies by removing the need for trust between parties and intermediaries.

3.4 Use cases

Research shows there are a plethora of use cases for blockchain for private companies. It is used to record and track a product's entire journey from raw materials to consumer (Dujak & Sajter, 2019; Kristoffer, 2019). With secure data points along the value chain, companies can more easily identify logistical points of error or inefficiency (Kshetri, 2017) and prevent counterfeit fraud because the blockchain ensures that you know a product has not been swapped with a fake (Tönnissen & Teuteberg, 2020). Protection against counterfeits would, for example, provide enormous value to the pharmaceutical industry, where counterfeit drugs is a rampant problem, costing the industry substantial amounts of money (Hoy, 2017; Tönnissen & Teuteberg, 2020). In the food industry, blockchain can help companies and regulatory bodies figure out where a food contamination occurred and then more quickly put an end to it (Tönnissen & Teuteberg, 2020). Consumers can also scan an RFID-chip or QR-code to verify and trust that, for example, their fish was ethically sourced or that their milk

held a cool temperature in the trucks that brought it to the store. Blockchain is also used to know a product's provenance, or where it stems from originally (Kant, 2021; Kshetri, 2017; Toyoda et al., 2017; Tönnissen & Teuteberg, 2020). Ensuring true information on provenance is one of the reasons Everledger, a blockchain company specializing in transparent tracking of products, employs blockchain. They want business partners and consumers to trust that, for example, diamonds are indeed authentic and ethically sourced (Klein, 2018; Tönnissen & Teuteberg, 2020).

Another ground of ample opportunity for blockchain solutions is within the verification of documents. Certifications, for example, could be verifiably traced back to their issuer to ensure their authenticity (Klein, 2018). This can be used, for example, by educational institutions issuing student diplomas so that future employers of the students can know with confidence that the diploma and grades the applicant is showing them are indeed authentic (Chen et al., 2018). The University of Nicosia already does this as standard practice (Konstantinidis et al., 2018). Det Norske Veritas (DNV) issues many kinds of industry certificates on the blockchain to help ensure authenticity and thereby trust in the documents.

Hoy (2017) argues that blockchain could massively impact the healthcare industry. Healthcare suffers from the inefficiencies of double labor and not knowing what other doctors have found out regarding a patient's health. With blockchain, a person's health record can be available to different doctors in different locations and workplaces because it will be distributed (Hoy, 2017). Since the information is distributed, cost and time savings are realized by not needing to actually send patient data to another practitioner, or do the same medical tests over again. Now, since the privacy of one's medical history is a human right, the blockchain would be programmed to only show the information to those that get approval from the patient (Yue, 2016). In Estonia, blockchain technology is already standard for sharing medical records (Bhardwaj & Kaushik, 2017).

Smart contracts can automate a whole host of business operations, making them faster and cheaper (Swan, 2015). For example, as soon as a shipment of goods has arrived at the company that ordered it, the payment can be automatically triggered by a smart contract and transferred securely on the blockchain network with the speed and low transaction costs of cryptocurrencies (Kant, 2021). B2B sales can occur more securely by reducing counterparty risk. There could be no way to avoid paying the due amount on time or not delivering the

goods because the transfer of ownership does not happen until the conditions in the smart contract are met. The insurance industry can automate settlements and reduce the need for lawyers as smart contracts can trigger when certain conditions are met, making payments automatic (Konstantinidis et al., 2018). Van Rijmenam et al. (2017) envision a futuristic organizational form called the DAO, or decentralized autonomous organization. This is an organization that operates with a whole host of smart contracts to make decisions and vote on how assets are to be allocated. DAOs can in theory be run almost entirely without human intervention by combining smart contracts and blockchains with other fourth industrial revolution technologies such as AI and IoT (Buterin, 2013; Kant, 2021; Karpenko et al., 2019; Van Rijmenam et al., 2017). While very interesting, DAOs will not be discussed at length in this article because it would require its own entire paper, and there are not many of them to sample data from.

Klein et al. (2018) provide a use case identification framework based on extensive research. By working through this, companies can help identify appropriate and inappropriate use cases of blockchain for them. They have some criteria and ratings of importance the user can go through for each of their proposed use cases. The authors built on the work of Wüst and Gervais (2018), who did something similar with their flow chart of yes/no questions. The difference is that the flow chart focuses more on comparing blockchain with other types of database technologies as well as different types of blockchains to find out which is appropriate, while the identification framework adds nuance through the ratings. Both articles, along with blockchain consultant Greenspan (2015), stress the importance of taking great care to find good applications of blockchain and seriously evaluate other potential solutions as well (Klein et al., 2018; Wüst & Gervais, 2018).

3.5 Value drivers

In their comprehensive literature review and conference paper, Konstantinidis et al. (2018) contend that one of the main value-adds of blockchain is data storage. They claim it provides "cheaper, faster, more secure and decentralized storage than the existing cloud storage platforms" (p. 393). Karpenko et al. (2019, p. 3) support this finding by comparing blockchain to a "bank" that stores information that is constant and unchanging "due to the presence of tens of thousands of computer nodes on the network". There is also no central point of failure,

so the information will not be lost when a central database containing all the information is burned, hacked, or stolen (Zhu & Zhou, 2016).

Authors such as Gausdal et al. (2018) and Kant (2021) argue that blockchain generates value from various cost reduction opportunities. This occurs, for example, by eliminating intermediaries (Tönnissen & Teuteberg, 2020), reducing transaction costs (Kant, 2021), and automation through smart contracts (Swan, 2015). Others point out that blockchain helps to reduce human errors, opportunism, and corruption (Gausdal et al., 2018). Cost reduction benefits in terms of easier accounting and auditing procedures have also been noted (Gausdal et al., 2018).

Kane (2016) argues that the technological aspects of blockchain, chiefly cryptography and consensus mechanisms, give rise to the characteristics of blockchain that, in turn, are valuable in appropriate use cases. Tönnissen & Teuteberg (2020) have argued convincingly that transparency and traceability are two of those characteristics that improve supply chains and add value to customers. Another characteristic is immutability, which provides value because it increases the confidence participants in the network can have that the information they are getting is true (Tönnissen & Teuteberg, 2020; Wang et al., 2019). Also, the characteristic of distribution is significant because information is more readily available to all relevant parties without the need for sending it to somebody (Kant, 2021).

Kant (2021) considers blockchain worthy of being called a strategic resource because blockchain is an intangible technological resource with VRIN qualities (e.g., Barney, 1991). It is valuable because of the potential for creating and implementing improved strategies in a cost-effective way, rare because most companies do not use it yet, inimitable despite its open-source nature because competitors may not be able to discern exactly how it is used in practice due to causal ambiguity, and non-substitutable because of unique capabilities such as immutability and decentralization. Blockchain should therefore help companies gain a sustained competitive edge in the marketplace (Kant, 2021).

Yuthas et al. (2021) create a framework for blockchain strategic opportunities and sources of value. They analyze this through the lens of resource-based view theory and theory on strategic alliances. They found that blockchain can contribute to a firm's strategic capabilities and thus their competitive advantage through 1) strengthening and leveraging their existing

capabilities, 2) sharing and building complementary capabilities, and 3) building blockchain-specific capabilities. The authors also call for someone to do a similar study but with TCE: "A Transaction Cost Economics view of blockchain may be helpful for future scholarly work" (Yuthas et al., 2021, p. 8). By using TCE, I provide a different viewpoint and angle to understand the phenomena.

3.3 Challenges with blockchain

While most prior research indicates that blockchain holds a key to unlocking vast business value, the authors of said research are not getting ahead of themselves. Researchers also study the challenges of implementation and barriers to adoption. Some of these challenges include newness (Gausdal et al., 2018) and the high energy consumption of the proof-of-work consensus mechanism, which, for example, Bitcoin and Ethereum apply (Casino et al., 2019). Blockchain has not been tested extensively by hundreds of companies for many years yet, so new players entering do not have experienced companies to learn from (Gausdal et al., 2018). The risk of implementation is thus considerable. The computational energy necessary to run a proof-of-work blockchain can be exceptionally high (Sedlmeir, 2020). This is both financially and environmentally costly. Proof-of-work blockchains are also too slow to be used where settlements need to be reached fast (Konstantinidis et al., 2018), and the more they scale, the slower they get, which would delimit adoption (Van Rijmenam et al., 2017).

Bhardwaj and Kaushik (2017) point out that the transparency of blockchain can pose serious privacy issues. Zyskind et al. (2015) and Puthal et al. (2018), on the other hand, argue that it could actually improve the security of big data. Centralized organizations often control much personal information about people, and if blockchain can protect this data, it would greatly reduce the data liability of companies (Zyskind et al., 2015). Wang et al. (2019) argue transparency could potentially be problematic when companies want to keep certain competitively significant information secret in supply chains. Furthermore, Bhardwaj and Kaushik (2017) discuss the problem of lost or stolen participant wallet keys which can lead to stolen or lost valuables. Another major roadblock to the adoption of blockchain is the regulatory uncertainty surrounding the technology, which is currently the case in most countries (Kant, 2021; Karpenko et al., 2019; Konstantinidis et al., 2018). Not knowing what rules to play by may cause some to hesitate before investing because they might need to change things later. There is also a lack of manpower or people with knowledge about

blockchain to help companies implement it (Gausdal et al., 2018; Van Rijmenam et al., 2017). This is a major hurdle because employees' know-how and experience are crucial for success (Kant, 2021). According to Van Rijmenam et al. (2017), the demand for talent is growing faster than the supply. In some cases, there can also be large initial investment costs for implementation (Gausdal et al., 2018). These costs include educating employees or hiring experts (Van Rijmenam et al., 2017). Another challenge is that all participants have to agree to use a blockchain solution for it to work (Gausdal et al. 2018). In a supply chain, for example, all participants in the chain have to be on board for it to work, which can sometimes be difficult to get (Gausdal et al. 2018).

Gausdal et al. (2018) questions whether being a first-mover into the blockchain space is an advantage or detriment compared to waiting for somebody else to "test the waters" and then learn from their mistakes and best-practices. To this point, Yuthas et al. (2021) is adamant that companies should move as soon as possible to avoid falling behind. Kant (2021) disagrees with this because first movers run the risk of investing in technology that others do not follow.

3.4 Further positioning the thesis

In this chapter, I have pointed out that this paper positions itself as having a mostly non-financial, non-public focus as the former is more studied before and the latter broadens the scope of the article too much. The focus of this thesis is on the ledger function of blockchain, or what Swan (2015) calls blockchain 3.0. Most writings on blockchain are non-scientific and are, in part, made up of whitepapers (blockchain and cryptocurrency projects introducing their protocol, company, and mission), articles by pundits, and reports from universities and international organizations. The scientific literature on the business value of blockchain is characterized by its newness and few contributions. Blockchain is undoubtedly a very new field. As mentioned in the introductory chapter, it all started with Nakamoto as late as 2008. Consequently, there has not been much time to perform research. Many scholars point out this lack of research on the business value of blockchain technology and therefore urge more researchers to study it (e.g., Casino et al. 2019; Gausdal et al., 2018; Kant, 2021; Karpenko et al., 2019; Van Rijmenam et al., 2017). My research aims to answer this call by creating more insight on how blockchain can create value.

Furthermore, most research on the value of blockchain is conceptual rather than empirical. They lack a methods section and do not gather empirical data. Instead they hypothesize and analyze potential use cases and value creation opportunities with or without a theoretical framework. This is too thin and inadequate for an emerging field that may become very impactful on how we do business. I will therefore emphasize empirical substantiation. To the best of my knowledge, this has not been much done before. Ahluwalia et al. (2020) and Treiblmaier (2018) study blockchain in a conceptual way and encourage more empirical grounding in similar research. To quote Treiblmaier (2018, p. 555): "Academically sound research results that are based on empirical findings and well-founded reasoning - rather than speculation - will benefit decision makers at all levels including commercial organizations as well as governmental and nongovernmental organizations". Moreover, only a few researchers have looked at how blockchain can create value from a transaction cost economics perspective (Ahluwalia et al., 2020; Seidel, 2018; Treiblmeier, 2018). This paper aims to begin to fill in these gaps in the literature.

It should also be noted that there is little conversation going on between authors of these articles. Consequently, there is less opportunity for latching my research onto an ongoing debate, though I try to start one such debate by building upon Seidel's (2018) arguments in particular. Lastly, it appears that much of the literature is largely atheoretical, meaning they do not apply a specific theoretical perspective. While a theoretical perspective may not always be necessary to understand a phenomenon better, especially when little is known about it, it helps to deepen our analysis of the phenomena and limit the scope of the research (Collins & Stockton, 2018). Hence, I apply a theoretical framework. Table 1 below outlines past relevant research mentioned in this chapter to help the reader get an overview. Figure 5 below Table 1 is intended to give the reader a visual aid in how this thesis is positioned within the literature.

Author	Theory	Type	Context
Zhu and Zhou (2016)	Crowdfunding	Conceptual	Equity crowdfunding
Bhardwaj & Kaushik (2017)	-	Conceptual	Cross-industry
Hoy (2017)	-	Conceptual	Health-care, libraries
Kshetri (2017)	-	Conceptual	Cybersecurity and privacy
Van Rijmenam et al. (2017)	Organization design	Conceptual	Decentralized autonomous organizations
Wüst & Gervais (2018)	-	Conceptual	Supply chain management, interbank and international payments, and decentralized autonomous organizations
Chen et al. (2018)	-	Conceptual	Education
Gausdal et al. (2018)	-	Empirical	Norwegian offshore industry
Klein et al. (2018)	-	Conceptual	-
Konstantinidis et al. (2018)	-	Literature review	Cross-industry

Seidel (2018)	Trust, institutional economics (incl. TCE)	Conceptual	General
Treiblmaier (2018)	Agency theory, TCE, RBV, network theory	Conceptual	Supply Chain
Casino et al. (2019)	-	Literature review	Cross-industry
Dujak & Sajter (2019)	Supply network	Conceptual	Supply chain
Karpenko et al. (2019)	Strategic management	Empirical	Cross-industry
Kristoffer (2019)	The unified theory of acceptance and use of technology	Conceptual	Supply chain
Wang et al. (2019)	Technology adoption	Empirical	Supply chain
Ahluwalia et al. (2020)	Transaction cost economics	Conceptual	Startup financing
Tönnissen & Teuteberg (2020)	Disintermediation	Conceptual	Supply chain
Kant (2021)	RBV	Conceptual	General
Yuthas et al. (2021)	RBV and strategic alliance theory	Conceptual	Cross-industry

Table 1: Previous studies on the business value of blockchain

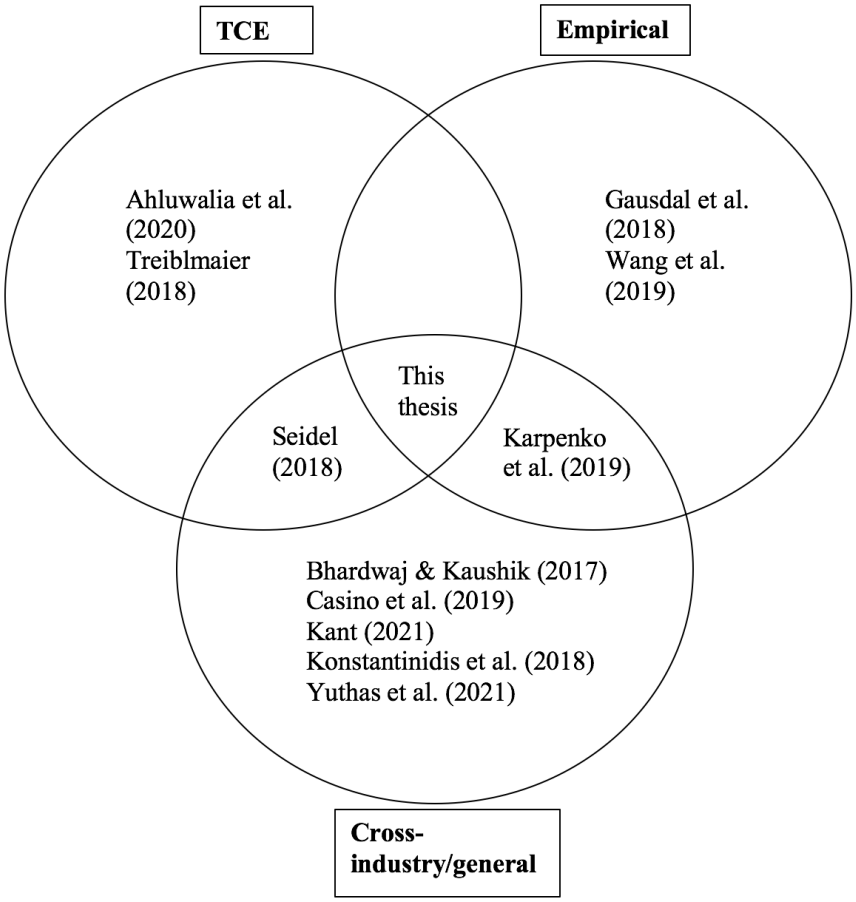

Figure 5: How this thesis is positioned

4 Theory

This chapter concerns itself with the explanation of a chosen theory with which the analysis of the empirical data will be conducted in order to familiarize the reader with it. This theory is transaction cost economics (TCE). Transaction cost economics is useful for analysis of strategic and organizational issues for companies (Ghoshal & Moran, 1996). TCE was chosen due to its relevance to the subject of blockchain and value creation. There are many links between the two, and recurring concepts, such as trust, opportunism, monitoring, bounded rationality, information, transparency, partnering, control, etc. While I had a hunch that TCE would be a fitting choice prior to starting the data collection processes, it became evident during the interviews. Much of the gathered data is contextually similar to the TCE framework. Applying TCE to the thesis can aid in deepening the analysis of said data. Furthermore, TCE is not only relevant because it can help illuminate how blockchain can create value and thereby answer the research question, but also because the phenomena of blockchain can inform the theory itself. This will be elaborated upon in the analysis of chapter 7 Discussion, where we see whether the underlying assumptions of TCE still hold when blockchain is introduced as a factor in the TCE framework.

Since the phenomena of blockchain can be illuminated by many theoretical perspectives, as seen in the literature review of the previous chapter, the choice of one theory is necessarily self-limiting. One cannot hope to capture the complete scope of the subject this way. However, it is helpful to learn about it from this perspective because it can give us one lens through which we can find out how blockchain can create value. TCE theory gives a unique perspective on value creation and where value comes from, which can be used as a guiding framework to analyze blockchain value creation. This perspective is outlined in chapter 4.3 What is value?

4.1 History

This paragraph is inspired by Williamson (1981). Transaction cost economics is an interdisciplinary field consisting mainly of economics, organization, and contract law (Williamson, 1981). John R. Commons advanced the idea that the transaction should be the basic unit of analysis in economic analyses already in 1934. Ronald Coase then created transaction cost economics in 1937. Coase posited in his classic article The Nature of the Firm

(1937) that firms exist to minimize transaction costs because sometimes the market can be more expensive. He argued that the firm's boundaries were set by a decision regarding governance structures - market or hierarchy. Freidrich Hayek (1945) posited, implicitly in transaction cost terms, that the performance of a company is determined by its ability to adapt to the environment. After the war, authors like Kenneth Arrow (1969) helped define how firms could overcome some of the problems of markets that cause them to fail at times. Herbert Simon, a notable scholar in the field of organizational theory, fronted the human behavioral assumptions of bounded rationality and opportunism. This stream of research was built upon by the Carnegie school, of which March and Simon (1958) are notable scholars. James Thompson (1967) built on the aforementioned scholars when he included both bounded rationality and uncertainty in his attempts to find ways to economize on transaction costs. The legal literature focuses on contracts as a governance mechanism, where “hard” and “soft” contracting, as well as “relational” contracting, are of interest. Authors who have made significant contributions here include Steward Macaulay (1963) and Ian Macneil (1974). Nobel Laureate Oliver Williamson is one of the most important contributors to TCE. He integrated the literature stream and work of the above scholars in 1975 and subsequent work.

4.2 Mechanics of transaction cost economics

Williamson broadly defines transaction costs as the costs of running an economic system of companies. Transaction costs include search and information costs, bargaining and decision costs, and policing and enforcement costs (Coase, 1937). Broken down these include but are not limited to time, energy, misunderstandings, conflict, lawyers, fees, negotiations, adaptations, and more. When transaction costs are low, the resulting situation is equivalent to a machine running smoothly with enough oil, meshing gears, and low energy loss. Friction is another word for transaction costs, and by minimizing these, we effectively save money, or “energy” more broadly understood (Williamson, 1981). The theory’s power lies in its ability to economize on transactions, thus providing value to an organization. Therefore, its purpose is to create efficiency around transactions within and without organizations where transactions may occur. Transactions can be of money, goods, services, information, and other perceived valuables. Companies usually engage in numerous transactions every day and therefore have a lot to lose by not actively economizing on transaction costs.

TCE regards the firm as a governance structure rather than a production function (Williamson, 1981, 1998). Commons (1934) defined governance as ways to maintain order and avoid undue conflict getting in the way of realizing mutual gains between parties. A governance structure is typically market, hierarchy, or alliance (Geyskens et al., 2006). Companies can choose to do their transactions, like purchasing goods, on the market. In these cases, the transaction is a one-time deal, contracts are written up for that one time, and there is no obligation for future contact (Olsen et al., 2005). One can easily switch to other actors in the market. Hierarchy is vertical integration where a company chooses to produce a good itself (Rindfleisch & Heide, 1997). They would then set up their own unit doing what that independent market actor from before was doing. With hierarchy, the initial investment costs are much higher, and it might be harder to adapt to changing circumstances if need be (A. Ulvnes, personal communication, October 7, 2021). Over time though, hierarchy can, in some cases, be cheaper than market as the company economizes on transaction costs present in the market (Williamson, 1975). This is why Coase (1937) said that companies exist because and when markets fail. Gulati (1998, p. 293) defines alliances as "voluntary arrangements between firms involving exchange, sharing, or co-development of products, technologies, or services". Put differently, alliance means when two or more companies join forces, usually with relational contracts legally binding them together, to benefit from lower financing costs, complementary resources and competencies, flexibility, and more (Anand & Khanna, 2000; Geyskens et al., 2006; Lunnan & Haugland, 2007). Alliance structures can, among others, be joint ventures, swaps, and franchises. The downside of alliances is that one does not own the resources oneself and loses some control over the company (A. Ulvnes, personal communication, October 7, 2021).

4.2.1 Human assumptions

Williamson (1981) submits that we need an understanding of human nature to be able to use transaction cost analysis beneficially. This is because it is more realistic than the neoclassical "economic man" of microeconomics where humans are assumed to have complete rationality, or a superior mind always capable of analyzing every situation perfectly and arrive at the best possible solution (Thaler, 2000; Williamson, 1981). They are also assumed to have perfect information about everything all the time (Doucouliagos, 1994). For all their merits, such theories do not match reality very well, as things are more complex than that. The human behavioral assumptions in TCE are 1) that humans are boundedly rational and 2) that humans

are at times opportunistic (Williamson, 1981, 1998). Let us unpack these assumptions. Bounded rationality means that we are "intendedly rational but only limitedly so" (Simon, 1961, p. xxiv). Rational would here mean to act in one's self-interest. We have cognitive limitations and heuristic biases that limit our ability always to make the best decision possible (Foss & Weber, 2016). Importantly, we also have limited information about the situations we find ourselves in and must therefore engage in satisficing behavior rather than maximizing behavior (Simon, 1961). In other words, we try our best but have to make do with sometimes suboptimal results.

The second assumption is opportunism, which means that we sometimes take advantage of others for our own benefit and their detriment. "Self-interest seeking with guile" is the definition of opportunism given by Williamson (1985, p. 47). He describes guile as "lying, stealing, cheating (...), and calculated efforts to mislead, distort, disguise, obfuscate, or otherwise confuse" (Williamson, 1985, p. 47). This may be a somewhat negative human outlook, and TCE is frequently criticized for it (Hodgson, 2004), but it is moderated by saying that only *some* people are opportunistic *sometimes* (Williamson, 1993). However, it is a utopian idea that opportunism never occurs (Williamson, 1998). As Williamson (1993, p. 98) put it, "opportunism engages the *realpolitiks* of economic organization". He also notes in a later work (1998, p. 31) that "although opportunism is an unflattering attribute, it is nonetheless basic to the logic of organization". Therefore, examining how to mitigate opportunism is most useful, as its effects can be costly. Opportunistic acts can occur under conditions of information asymmetry, meaning one actor has more knowledge of their own acts and products than the other (Wathne & Heide, 2000). In other words, difference in knowledge of the quality of the product or service transacted is a situation of information asymmetry. Opportunism can occur ex ante before contractual agreement as adverse selection or ex post after contractual agreement as moral hazard (Rindfleisch & Heide, 1997; Wathne & Heide, 2000). Adverse selection could for example be pretending to be better suited for a job than one really is, and moral hazard could be shirking one's responsibilities.

4.2.2 Governance mechanisms

If there was no opportunism, contracts would not be necessary as people would always be trustworthy and act in good faith (Williamson, 1981). We need contracts because we assume agents may act opportunistically. With a contract, we can hold them legally to their promises

and enforce punishment if broken. This is meant to reduce opportunism, but it still occurs. Where contracts fall short as a governing mechanism for ensuring smooth transactions, other such mechanisms may be employed. Trust, for example, is much used and usually regarded as very valuable (e.g., Schilke & Cook, 2015). Trust is, after all, free, and that is great when it works. However, trust opens up for opportunism as the trustee can exploit it (Krishnan et al., 2015). Now, trust suddenly became expensive. Other governance mechanisms include monitoring (Wathne & Heide, 2000), incentives (Olsen et al., 2005), and socialization (Ouchi, 1979). Monitoring is to watch or check on one's transaction partner, broadly understood here to include employees, to make sure they are doing (behavior based) or have done (outcome based) what they said they would (Wathne & Heide, 2000). Incentives are about providing some kind of incentive, such as financial, to make opportunistic behavior less attractive (Olsen et al., 2005). Socialization means socializing workers into the culture at the workplace, so that they become loyal to it (Ouchi, 1979). Due to bounded rationality, contracts cannot be complete and cover all relevant contingencies because the world is simply too complex for that (Williamson 1985). There are also transaction costs associated with writing up contracts and enforcing them (Rindfleisch & Heide, 1997).

4.2.3 Dimensions of transactions

Williamson (1979) explains the critical dimensions of transactions. These are 1) uncertainty, 2) frequency of transaction, and 3) asset specificity. Uncertainty refers to behavioral, environmental, and technological uncertainty (Geyskens et al., 2006). Environmental uncertainty means things out of the company's control, such as political uncertainty, war, pandemics, technology, and other more or less unpredictable things (Williamson, 1985). Environmental uncertainty is when these factors are too unpredictable to be specified in a contract ex ante (Geyskens et al., 2006). As Hayek (1945) and others emphasized (Schumpeter, 1942; Thompson, 1967; Williamson, 1981), the ability to adapt to changing circumstances is essential for a company's survival and competitive ability long term. Behavioral uncertainty means difficulty assessing performance and ex post contract compliance and relates to the risk of opportunism (Geyskens et al., 2006). Technological uncertainty is the risk that one's technology becomes outdated or useless (Geyskens et al., 2006).

Frequency of transactions may be less significant than the other two dimensions because it is less studied (Rindfleisch & Heide, 1997; Geyskens et al., 2006). Geyskens et al. (2006, p. 521) refer to transaction frequency as "the extent to which transactions recur". Asset specificity refers to how an asset can create value under conditions other than its intended purpose, and is defined by Williamson (1985, p. 55) as "durable investments that are undertaken in support of particular transactions". We can divide the term into physical asset specificity, human asset specificity, and site specificity (Williamson, 1981). Low asset specificity means buyers can easily move to other sellers, and sellers can easily move to other buyers. High asset specificity creates a lock-in effect between transacting parties where they will likely interact for some time (Lunnan & Haugland, 2007). The one who carries the burden of the asset specificity becomes dependent on the other party. This opens up for opportunistic behavior by the more powerful party leveraging their position against the other party (Wathne & Heide, 2000). On the other hand, lock-in may encourage "buyer and seller [to] make special efforts to design an exchange that has good continuity properties" because an expectation of future interactions is present (Williamson, 1981, p. 555).

Figure 6 below is included in this chapter because it gives a neat picture on the traditional model of transaction cost economics.

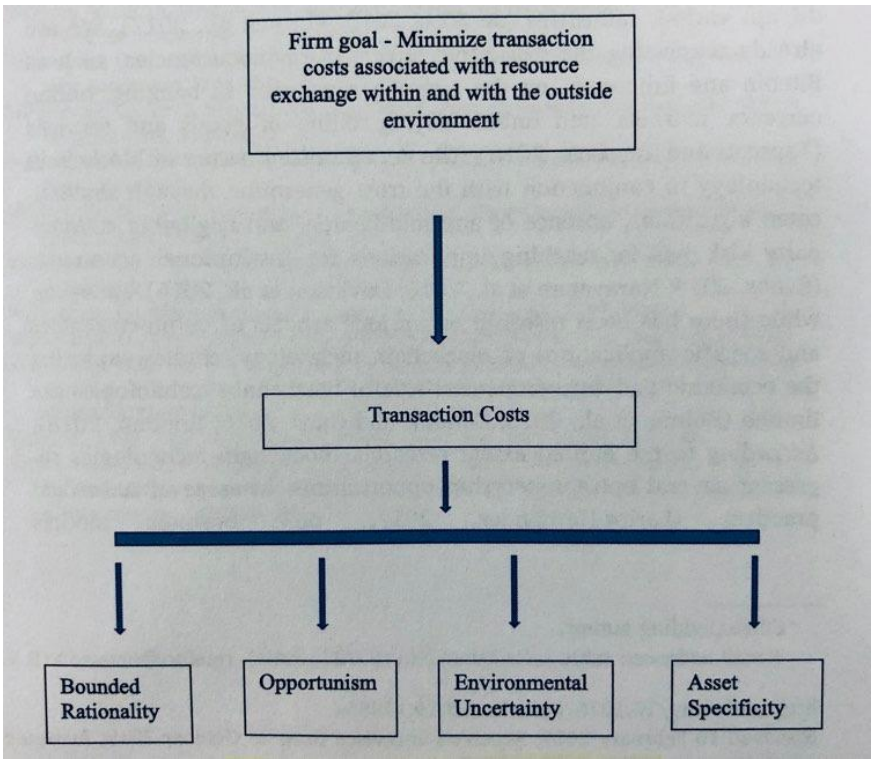

Figure 6: Traditional model of transaction cost economics (Ahluwalia, 2020)

4.3 What is value?

Amit and Zott (2001, p. 509) aptly point out that "value creation strikes at the heart of strategic management". But to understand value creation we must first understand what value is. Various theories hold various perspectives on how value is created and the sources of value creation. Porter (1985) views value creation in his value chain framework as coming from differentiation in every step of the value chain to achieve products and services with a lower buyer's price or higher buyer's performance. Schumpeter (1934) saw value creation as innovation and technological change, taking advantage of "shocks" in the environment. Through "creative destruction", entrepreneurs can take advantage of these major societal and technological shifts and outcompete legacy systems (Schumpeter, 1942). Resource-based view, building on Schumpeter's economic development theory views the firm as a bundle of resources and capabilities where value is seen as combining complementary and specialized resources and capabilities with VRIO qualities (valuable, rare, inimitable, organized). This in turn helps firms create sustained competitive advantage (Barney, 1991). The dynamic capabilities theoretical perspective builds on RBV to understand how valuable resources and capabilities are acquired over time (Teece et al., 1997). Value here is viewed as a firms' ability to change and acquire these useful resources and capabilities. Furthermore, strategic network theory focuses on the value that lies in strategic partnerships and networks. This may include sharing risk, generating economies of scale and scope (Katz & Shapiro, 1985; Shapiro & Varian, 1999), sharing knowledge to aid learning (Anand & Khanna, 2000), and improving coordination between firms (Gulati et al., 2000).

When it comes to transaction cost economics, the theory has its own unique perspective on value creation. Exploring this will inform the types of value that can be created through blockchain applications. Williamson says that "a transaction occurs when a good or service is transferred across a technologically separable interface. One stage of processing or assembly activity terminates and another begins" (Williamson, 1983, p. 104). Transaction costs can also be thought of as friction or inefficiencies in the conducting of transactions, and include planning, adapting, executing, and monitoring (Williamson, 1983). Bounded rationality, uncertainty, opportunism, specific asset investments, information asymmetry, and complexity are underlying contributors or causes to transaction costs (Williamson 1975). Put differently, TCE sees value as transaction efficiency (Amit & Zott, 2001). If transaction costs are reduced, companies can expect greater success in the marketplace through greater bottom lines.

Competitive advantage can be realized through reducing transaction costs in ways competitors do not. Throughout chapter 7 Discussion, I will explore the ways in which blockchain can enhance transaction efficiency, thus create value for organizations. In general, if blockchain can mediate or moderate any of the above-mentioned sources of costs, the technology can help create value.

TCE has been criticized for emphasizing only transaction costs and efficiency but neglecting other important sources of value highlighted by other theories such as RBV and those mentioned above (Ghoshal & Moran, 1996). However, this does not take away from the importance of looking at value in the form of transaction efficiency. And the other theories do not capture all sources of value either. They all provide useful suggestions about value and its sources. It will suffice for the purposes of this paper to limit itself to TCE.

5 Scientific research methodology

This chapter presents the scientific research methodology I have followed in writing this thesis. The intention is to show the reader how and why I made the choices I did so that they can evaluate the quality and reliability of my work (Tjora, 2012). In the interest of transparency and validity, I go over the details of how I conducted the research as much as is reasonably useful. The writing of this thesis was done in five months, between January 2022 to May 2022. There were only minor preparations in the Fall of 2021 (no academic credit points there).

5.1 Research strategy

This thesis is based upon qualitative methods. Tjora (2012) explains that qualitative methods focus on the informant's experiences and formation of opinions. As a researcher, I was interested in the informant's experience and opinions of their business application of blockchain and therefore chose to use qualitative methods for this paper (Tjora, 2012). While the goal with this is not to create absolutely certain knowledge of reality, it is my hope to enable us to explore the research topic in a nuanced way and gain new insight (Tjora, 2012). My curiosity for blockchain led me to qualitative methods because it opens for discovering things not thought of before collecting data (Tjora, 2012). Learning something new about it that adds to the research base of previous literature would be useful for future researchers and help expand it. My findings can also say something about use cases for blockchain that companies other than the ones I studied likely can get some useful information from. I chose a qualitative approach also because it is the research strategy I personally enjoy the most doing and know best (Tjora, 2012).

5.2 Research design

The research design of this study is a multiple-case study. Bell and Bryman (2011) define a research design as a framework for gathering and analyzing data. The design is a general plan for how to answer the chosen research question by connecting it to empirical data (Yin, 2014). Sampling method, data gathering, and analysis are part of the design (Bell & Bryman, 2011). I will write about how I did all of these in a moment. The level of analysis is also part of a research design (Bell & Bryman, 2011) and the level of analysis in this study is the organizational level. Compared to the societal or individual level, the organizational level

allows us to best understand the company as a unit seeking to achieve value creation and strategic success in the marketplace through its application(s) of blockchain. A multiple-case study design is useful for looking at several cases in depth and comparing and contrasting these (Bell & Bryman, 2011; Eisenhardt, 1989). I chose a multiple-case study design because it allowed me to delve deep into the specifics of how each company uses blockchain (Bell & Bryman, 2011; Eisenhardt, 1989). Their unique contexts intrigued me and struck me as a great way to understand better the potentials and realities of blockchain. While a multiple-case study design did not let me draw causal conclusions since I did not test variables over time or controlled for spurious variables, it did let me affirm correlations (Bell & Bryman, 2011).

Due to the novelty of the phenomenon of blockchain, an explorative study seems appropriate (Yin, 2014). The point of an explorative study is to find new information and theory (Bell & Bryman, 2011). The study is conducted inductively, as is common for qualitative research and explorative studies (Tjora, 2012). I base the research on the empirical data I gather to build a new knowledge that answers my research question (Bell & Bryman, 2011). I build the knowledge through thematic analysis, which I will discuss later in this chapter. Put differently, I will not build my study deductively or test theories previously created by other scientists. This is because I believe it will be a more valuable contribution to the research field to add new perspectives to expand it since it is scarce. As Eisenhardt (1989) argues, theory building from case studies is appropriate when little is known about a phenomenon. This is because one does not have to rely on previous literature or empirical observations very much. She also aptly points out that this is an appropriate method under situations characterized by little empirical substantiation, as is the case for literature on blockchain (ref. chapter 3.4 Further positioning the thesis) (Eisenhardt, 1989).

5.3 Data collection

As for data gathering, I used one-on-one interviews. This was an effective way to quickly get a lot of information on the subject. Most of the interviews lasted between 45 minutes to 1 hour. One interview was 1 hour and 20 minutes, while two only lasted 20 and 35 minutes each because that is all the time the interviewees could spare. These interviews were still valuable, and we touched upon all the main topics. I chose the time frame of 45 minutes to 1 hour because it allowed me to get through the whole interview guide with comfort but without asking too much time from the informants. Tjora (2012) recommends that master theses

include interviews with 8-15 informants. After nine interviews, I reached theoretical saturation because I started getting more of the same information and sufficient depth of data to conduct the analysis (Tjora, 2012). This is not to say I exhausted all there is to know about blockchain, but I likely got the majority of what there is to get from my particular interview guide at this point in time.

I used a semi-structured interviewing approach for this research project. This allowed me the flexibility to explore subjects brought up by the interviewee and ask unplanned questions (Bell & Bryman, 2011). Consequently, I could get useful information I did not anticipate beforehand (Bell & Bryman, 2011). Simultaneously, the semi-structured interview provided enough structure to ask the same important questions to everybody (Bell & Bryman, 2011). This helped when comparing the results for the analysis part of this paper (Bell & Bryman, 2011). Interviews were recorded both on my computer and phone for backup in case one stopped working during the interview. Shortly after the interviews, I transcribed them manually, which helped familiarize myself with the data. Furthermore, interviews were held online with video conferencing programs such as Zoom and Teams. This choice was made for practical purposes as it was much easier for me than traveling all over Norway to interview in person. The interviews would probably have been richer if they were held face-to-face, but I believe digital was good enough for the type of data I was gathering. Especially in our time when people are getting more used to digital meetings for work.

I developed the interview guide in the formative stages of planning my research project. Most of the questions were open-ended to provide room for reflection on the topic and better open up for the informants to share their worldview related to the research question (Tjora, 2012). The guide was designed according to Tjora's (2012) recommendations regarding having a warm-up, main part, and ending section. The warm-up helped get the informant "ready" to answer the potentially more difficult questions in the main part. It also helped them feel more comfortable in the interview setting, which is crucial for successful interviews where we need subjects to open up and share their thoughts. The bulk of data used for answering the research question came from the main part, and the ending provided a sense of closure. The interview guide is enclosed at the end of this document as Attachment 1.

During the interviews, I took great care to act with enough self-awareness not to engage in arguments with the interviewees when they said something I disagreed with. The important

thing for me was to understand and learn their worldview, not prove my own. Hence, follow-up questions were asked with that in mind and solely to get them to elaborate on their points. I employed polite persistence to push the subjects to actually answer my questions (Bell & Bryman, 2011). While I followed the general beginning, main part, and ending structure of the interviews, I jumped around between the questions within those sections. This was to achieve a natural flow in the conversation. The informants may have started talking about something that segued nicely into a different question than the next one in my interview guide. I still made sure to ask every question in the guide, or at least cover all the topics, to enable comparison across cases (Bell & Bryman, 2011).

5.3.1 Sampling method

The sampling method I used was based on criteria (Tjora, 2012). These criteria were that the companies were Norwegian, private, and utilized blockchain in some way or had tried it out extensively. More broadly, they needed to have gone far to evaluate and explore the resource that is blockchain in their own company operations. Banking and financial sector companies were excluded. These were the only criteria my informants needed to fill in order to help answer the research question. This means that the companies have great variations in other characteristics such as size, age, industry, and profitability. This may have some implications for my findings. For example, the findings may be rendered less useful for other firms wishing to use them to evaluate their own blockchain strategy because the findings do not originate from a tightly defined group. It can therefore be harder for a company reading my article to know whether the findings can be of help or not. To help combat this, I have included a table (Table 2: Profile of selected companies for interviews) that provides some basic characteristics of the companies I interviewed. The presentation of empirical findings in Chapter 6 Results and empirical data includes what numbered companies (1 through 9) have which quotes. The anonymity of the companies is preserved by giving them numbers instead of their actual names and by only showing an approximate founding year rather than the exact founding year.

I reached out to the respondents through email, phone, or social media, asking them for an interview. I reached out to 22 potential informers, and nine agreed to join. Which companies accepted to join the study may have had an effect on the study's results because they have different experiences and information to offer. The current reality of the Norwegian private

sector is that very few companies utilize or test blockchain. Therefore, I did not have the opportunity to pick and choose any way I wanted. I had to make do with the ones that were available to me. The sampling was therefore conducted based on availability (Tjora, 2012). I did not know any of the informants personally beforehand. I discovered the existence of the relevant companies through online searches, with search phrases such as "companies in Norway using blockchain". Additionally, the informants and some that rejected an interview offered me suggestions for other companies to contact for an interview. This snowball method helped find informants (Tjora, 2012).

Regarding the person or persons I spoke with at each company, the main concern was that they were somebody with a deep understanding of blockchain's role in their company. They had in common that they took part in, or led, the implementation or testing of blockchain in the company or were actively working on its application at the time of the interview. I assume here that they "know what they are trying to do and can explain their thoughts, intentions and actions" (Gioia et al., 2013, p. 17). Thus, they were knowledgeable informants, which was important for getting useful information for answering my research question (Eisenhardt, 1989; Gioia et al., 2013; Tjora, 2012). I found it sufficient to speak with one informant from each company, though two of them decided to bring along another person to help them out in the interview.

The informants held high positions at their company. I interviewed two consultants helping companies test and implement blockchain on three separate cases. One of these consultants worked on two cases with two other companies I also interviewed. This essentially means I had two separate interviews for two of the cases. One consultant was perhaps somewhat of an evangelist for blockchain, which should be noted as it could color his take on the cases he worked on. The other consultant was more balanced as he worked on other technologies as well. One interview was conducted with two informants from a public governmental blockchain effort. While this crosses with the sampling criteria, I made the exception and included them because they happened to be readily available for an interview. They could also provide some meaningful information as they had a deep understanding of blockchain and had unique insight on the public sector's view on the adoption of blockchain. The study limited itself to Norwegian cases as they were more accessible than foreign cases. I do not think this makes a significant impact on the results as blockchain can be used the same ways in other

countries. Table 2: Profile of selected companies for interviews below outlines some main characteristics of the companies interviewed so the reader may connect these to the findings.

Company	**Approx. founding year**	**Industry**	**Informant' role in the company**	**Size**
1	2000s	Waste removal	CEO & CTO	Start-up
2	2000s	Renewable energy	CEO	Small business
3	Late 1900s	Seafood and maritime	CEO	Medium
4	Early 1900s	Industrial raw materials	Sustainability manager	Large
5	2000s	Consultant/real estate/public sector	CEO	-
6	Early 1900s	Recycling	Sales manager	Large
7	Late 1900s	Public sector	Senior advisor & senior advisor	-
8	2000s	Consultant/ agriculture	Partner	-
9	Mid 1900s	Real estate	Director	Large

Table 2: Profile of selected companies for interviews

5.4 Researcher bias

Due to the subjective nature of qualitative research, all such research will be influenced by the researcher (Braun & Clarke, 2013). This can be seen as both a strength and weakness in my case. The potential weakness is that the findings become colored by my personal views and do not accurately reflect the empirical data. However, the strength is that I have a high interest

and feeling of engagement in the subject, which means I know a lot about it from before and have more knowledge to contribute (Tjora, 2012).

In the interest of transparency, my personal view regarding blockchain is that the technology can be a valuable strategic resource for companies and give them a competitive advantage if applied in a meaningful way. I have sought to avoid letting my bias affect my judgment and research. During interviews, for example, I was open to and inquiring about opinions and ideas conflicting with my own (Tjora, 2012). The semi-structured format of the interviews encouraged informants to go off on tangents, so I could learn about what they saw as important and relevant, further diminishing the potential problem of researcher bias (Bell & Bryman, 2011). While reading the works of other scientists, I was more than interested in those who focus on the challenges and problems with blockchain. I made efforts to have enough presence of mind not to let my research be a tool to confirm my pre-determined ideas. Furthermore, I held dialogue with my supervisor, colleagues, and friends and let them read and provide feedback on my work in progress.

5.5 Ethics

Ethics were taken very seriously for this research project. Relationships with informants were characterized by trust, confidentiality, respect, and reciprocity (Tjora, 2012). I acquired informed consent from all participants before commencing data gathering and analysis, and they could pull out or withdraw their consent at any time before, during or after the interview. Their information is treated with confidentiality, and their identities remain anonymous. These considerations helped establish a sense of trust between the informants and the interviewer, which likely helped them feel more comfortable about sharing their experiences and thoughts.

5.6 Data analysis

I used thematic analysis to analyze the gathered data. I chose thematic analysis because it is a helpful way of processing large amounts of data where we synthesize the information into a few overarching themes (Tjora, 2012). These themes and their explanations represent the answer to the research question, and they also cover most or all of the empirical data (Bell & Bryman, 2011). The way I conducted the thematic analysis was by first transcribing the interviews, and then becoming familiar with the data. I read the transcripts carefully, multiple

times, and took notes. This helped me recognize things that could be important to my research question (Braun & Clarke, 2013). I bolded important parts and labeled some of them with potential codes I could later give them. I did this soon after each interview. At the same time, I also asked myself questions such as "What am I learning?" and "How does this case differ from the last?" for better “field” notes (Eisenhardt, 1989). Next, I began coding the data by giving empirically close codes to each piece of information given to me by the informants. In other words, I focused on codes reflecting *what* was said in the interviews, not codes reflecting what their statements were *about* (Tjora, 2012). I made a point of using their terms to help generate novel perspectives at the end of the analysis (Eisenhardt, 1989). After this first round of coding I had approximately 80 codes, which was enough to answer the research question.

I did a second round of coding to further condense the information and help me funnel it into a few overarching themes in the end. I looked for codes that could apply to multiple different sentences without overlapping with each other. This round of coding was more “researcher-centric” and allowed me to abstract the more “informant-centric” 1st order codes (Gioia et al., 2013; Tjora, 2012). Here I attempted to make the codes more *about* the data. I looked for patterns in the data to help establish these codes (Braun & Clarke, 2013). This left me with 15 codes. The next step was to further condense these into themes. I made sure the themes I ended up with did not overlap. The codes, themes, and related empirical data is presented in Figure 7 Data structure in chapter 7 Discussion. Lastly, I took the themes and 2nd order codes and displayed their relationships in a model, presented in Figure 8 Blockchain value creation model, shown in chapter 7 Discussion. Chapter 7 Discussion also explains this model to the reader.

While I may have presented this analysis process as being linear, it was really more cyclical. I was working on different phases at the same time while making sure to stay true to the data evidence at all times (Braun & Clarke, 2013; Eisenhardt, 1989; Tjora, 2012). In this cyclical analysis process, previous literature on the value of blockchain (ref. chapter 3 Literature Review) played a rather small role. As this is an inductive, explorative study, I wanted to remain independent from previous researchers’ findings. However, TCE played a more significant role in the last part of the coding work where I created themes that used terminology from the theory. This was to effectively convey the value of blockchain from a transaction cost economics perspective and connections between my data and theory in the

discussion part of this article. I strived to create themes that were distinctive, made sense in and of themselves, and carried an organizing idea that the codes and data centered around (Bell & Bryman, 2011). The research question was shaped and re-shaped both before and during the process of data gathering and analysis (Eisenhardt, 1989). I did the coding work in Nvivo to help systematically and in a structured way conduct the analysis and relate it to the research question and conclusion (Tjora, 2012).

6 Findings and empirical data

The purpose of this chapter is to present to the reader the raw data found through the data gathering procedures (Gioia et al., 2013). I extract the essence of the informant's insights and then provide fitting quotes that exemplify this. I will provide several quotes to show what the informants said exactly and allow the reader to get close to the data material (Gioia et al., 2013; Tjora, 2012). In chapter 7 Discussion, I clarify how I took this information and turned it into new knowledge and insight (Gioia et al., 2013). Quotes are translated from Norwegian into English by me. I bolded important parts to guide the reader through.

6.1 Overview

The informants bring up many topics of interest. Speaking generally about blockchain itself, one informant noted that blockchain really is nothing new. Instead, it is a new way to fit together old technologies:

"Blockchain technology is really nothing new. It is merely old tech put together in a creative way" - Company 7

It was also on a few occasions called an infrastructure technology. Looking up the definition of the word infrastructure in the Cambridge Dictionary tells us that infrastructure in the workplace means "the basic systems and services that a company or industry needs in order to work effectively" (Cambridge University Press, 2022):

"A part of the project was about exploring whether blockchain could be an ***infrastructure for foundational datastructuring and sharing****"* - Company 8

"Blockchain is an infrastructural network technology" - Company 7

According to the informants, use cases are anywhere you today send something of value elsewhere using a trusted third party and keep a register of the transaction history. As explained in chapter 2 Blockchain technology overview, blockchain lets you both send the ownership of the good (right to own it) and keep a distributed ledger using the same technology.

*"And where else are you dependent upon a trusted third party to execute transactions? Well, real estate, mortgage… **A number of use cases which align closely with the original value proposition in the Bitcoin whitepaper**"* - Company 7

6.2 Reasons to use blockchain

The informants noted they worked with blockchain because it could help them solve problems. For example, some used the technology to help trace their value chains or company activities:

*"Well, **the keyword here is traceability and to have control on our product streams**. We have to have control over our value chains. For us it is interesting with all new technology which can improve, simplify or digitalize streams or tracing"* - Company 6

This traceability was benefited by immutability due to secure data points, which in turn was deemed to create more trust in the data, as succinctly explained by one informant:

*"We use blockchain so that the **data cannot be changed and thereby give trust** in the authenticity of that data so its not just a paper that somebody sends with a signature or something like that"* - Company 1

This trust was leveraged by some for strengthening their customer value proposition, thus increasing customer willingness to pay:

*"One thing when we look outward is about **being open and able to share as much information as possible with the end consumer of our product**. (...) We see that **customers demand more data and information** about the product. They have gotten so conscious of what they eat and the environment. (...) I believe this **increases the customer willingness to pay** a little, though it is hard to calculate exactly"* - Company 3

*"Our clients are getting more and more concerned with presenting their products as sustainable. Then it could be interesting if **we could sort of promise them that we have that**. Because one thing is that you say you have it. We have to give them access to data. That way,*

they can verify on their own *both where it comes from and what has happened in the process"* - Company 4

"It offers the opportunity of storytelling. You will be able to say that with some percentage certainty, their cardboard has left this particular carbon footprint and been recycled by this and that recycler at this and that place. So, ***this offers an entirely different form of transparency and information flow the market cannot offer today****"* - Company 6

Informants emphasized that using blockchain helped signal high trustworthiness of a company because if they choose to submit themselves to the immutable, decentralized, transparent, traceable record that is blockchain, it may mean they are indeed holding themselves to the high standards they say they are:

"And then you signal a willingness to take another step forward and of course that we are confident in our products which we call green" - Company 4

It seemed to be industry-specific, but some companies gained value from blockchain in the form of simply more data. Previously, they did not have as much data on what happened, when and was done by whom. This extra data turned out beneficial for decision-making for some, which they leveraged for increased efficiency. This observation is evident from the two following interview excerpts, where the efficiency gains were related to gradually doing things better and reducing deviation from best practices. The excerpts are from companies within the sea food and farming industry respectively:

"Yes, ***it has helped us gradually do things better*** *by understanding what causes things to get like they do in a sense. We have to kind of gather all the data in one place and in a chain. Then you have kind of been able to say that this and that fish turned out with this or that quality because of those and those temperatures and this and that feed. How can we do what we did good in one place and bring that with us, while ending the things that were less good"* - Company 3

"Absolutely [it helps us learn and reduce deviation from best practices]. I believe it was identified in a project where a company had a value loss of 250 million NOK a year only tied to deviation from best practices in the production of a single good. And that has great climate

ramifications. Because that means you have to produce more food and drive and deliver more and such. There is absolutely a great value in having better insight" - Company 8

More heavy industries and companies are already subject to stringent compliance controls and have the information they need. To them, the benefit was more about traceability and trust, as mentioned by company 4 and 6 representing firms in the aluminum and waste management industries in the quotes given above. Accordingly, they did not reap the benefits of additional data, as they note in the following quotes:

"No, in our situation, in our project, we did not reap that kind of reward from it [more data thus learning and better decisions]" - Company 6

"Regarding data itself, I think that is there already. These industrial processes are quite heavy, and we are required to provide a lot of data to regulators" - Company 4

It was also mentioned in the interviews that companies could save on auditing and compliance issues by using blockchain because the ledger is distributed and open to third parties to come and oversee the history of their operations. Employees or independent contractors did not have to be manually checked to see if they did what they said they would do by the company or a paid auditor. These points are evidenced from the following:

"Its a blockchain. It can help us save a little on auditing and that kind of stuff. (...) Ideally, we will ***have some data points that you don't need to pay somebody to go and check*** *that this is authentic because you have digital signatures right away, simply. Lower costs to verify data than what it otherwise would have been if you didn't use blockchain"* - Company 1

"Tax information, compliance information, customs clearance… I mean, you know, all this can be built in" - Company 4

It was notable that in some cases blockchain helped speed things up impressively. Where processes required many steps, physically signed and mailed letters, and parties to engage in the process one after the other, blockchain served as a digitalizing tool to boost efficiency:

*"**Everything that took several weeks before can now be done in 3 seconds**. Trading real estate is today a complex and time-consuming process involving lots of paperwork, lawyers, and banks. Many meetings between the various parties. Blockchain with decentralized networks and smart contracts can entirely replace this process. Simplifies legal work too with transparent data. Every signature is on a sheet of paper and mailed the old way. Because we can't trust each other, we use a real estate agent or lawyer."* - Company 5

*"The **seamlessness** of blockchain makes it attractive to avoid costs"* - Company 9

Since all informants were still working out how to best use, or if they were going to use it beyond their pilot projects, the blockchain technology they speculated as to how it could potentially be used to create the most value possible. This was for some of them a larger scaling of it:

"What I think is that if this gets traction and one manages to scale this up to work for the big actors in the north; Suez and our firm and all these other actors that are present here, or Viola, and many of these global giants. If one manages to implement this into their systems then that has the potential to give traceability and trust in the industry a boost" - Company 6

*"I think there is **greater value in taking it to the national or international level** where you make an **ecosystem** integrating many different actors"* - Company 8

6.3 Challenges with blockchain

I have extracted the informant's point of view on the reasons for using blockchain, and will now show what they see as challenges with said technology. Despite the grandeur and promises of blockchain, the informants generally did not hold an overly optimistic attitude towards the technology. Most were positive to it but only as one among several potential solutions for how to do things in the company. These sentiments are particularly salient in the following quotes:

"*No, we're **not feeling a "hallalujah" vibe** from blockchain. We are entirely agnostic to blockchain. We've got nothing against it, but it doesn't have to be it. If you catch my drift. But*

that can change! The firm is a big one that doesn't always speak with one voice only" - Company 4

" I have actually gone from being very pro to much more careful, you could say, in those lines of thinking. I have gotten more conservative over the years" - Company 8

Many challenges were raised by the informants. For example, it might be difficult to get partner companies to agree on using blockchain, especially if they do not want to be transparent. However, as pointed out by informants, this is necessary to get the full value out of it:

"This technology was pretty unknown to the parties, and it still is. And when talking about pretty big sums of money it would take quite a lot to get people to join an experiment" - Company 9

"There are some barriers you need to get through. ***Not all stakeholders in a value chain want their books to be transparent****. There are very clear economic upsides for speculative actors to conduct some horse-trading, which at their best are in the gray area for what is allowed"* - Company 6

"And then it gets a little ***difficult to say that it has value in itself unless you can lock more actors to it*** *so that those who depend on selling a green product [can show that] it doesn't come from places you don't want it to come from"* - Company 4

Resistance from people who do not understand the technology may also be a related challenge, as exemplified in the following quote:

"We always get lots of protests that, 'yeah, blockchain I don't understand at all'. It is clear that in a start-up phase, it is experienced as a little dissatisfactory for many" - Company 4

Related to this, the lack of competent workers educated about blockchain may be a challenge:

"If we have not learned to use it we can not succeed with it" - Company 7

However, the need for competency and know-how about blockchain must not be exaggerated because as long as the users know *that* it works and how to use it, knowing *how* it works is not necessary for everyone:

"I think that by the end of the day... You know nothing of what is happening in your cell phone either, but you do use it. As long as you understand what it can be used for then all these technical things are there to solve a problem or capture an opportunity. And ***as long as we know it works…*** *It is of course impossible for us to understand how everything works anyways. So I am not worried about that"* - Company 4

Moreover, in larger firms in particular, scaling blockchain solutions may be challenging and expensive. This was a common issue raised by several informants:

"Its not done just like that to implement it in a big firm like ours. There are systems, then there is integration… So its not that easy to say that now we are going to implement blockchain" - Company 6

"It is expensive to do these things large scale in a company like ours" - Company 4

"The prototype was cheap. But to make it play, other systems around it need to be changed as well" - Company 9

Another challenge mentioned in the interviews is that one cannot know for certain always that true information was put into the ledger to begin with. One can, for all intents and purposes, be sure that the information put in has not been tampered with, but how can we be sure that the people who put it in to begin with were acting in good faith or did it right? As company 8 funnily put it:

"Shit in, shit out. I think that the biggest source of error is not the person operating the datasystem tweaking it. ***The biggest source of error is that things are put in wrong****"*

However, as explained by one informant, there are ways to get around this problem:

"One wishes that as many as possible have an ***incentive to make sure the data are correct****. The more people have an interest in that it is the right number of kilos that get registered in, the more likely it will be correct"* - Company 1

Many researchers have pointed out the problem of regulatory uncertainty surrounding the phenomenon of blockchain. In the experience and perception of the informants, only cryptocurrency seemed to be shrouded in controversy and suffered from the challenge of regulatory uncertainty. Since the political landscape, rules, and regulations can change any day, those who deal with cryptocurrency operate under greater environmental uncertainty and carry the burdens this may bring. However, it seems from the experience of the informants that the ledger and smart contract aspects of blockchain are not subject to this problem:

"No. For we have stayed totally away from things that are controversial with regards to authority-related things. For we have not been within money transactions in blockchains. We see that it can work as ***a pure verification system for information. And that is less controversial with regards to laws and rules****"* - Company 2

6.4 Reservations and advice

In the informants' view, perhaps the biggest thing companies need to keep in mind when looking into blockchain, is that other ledger technologies like platform technologies and cloud-based technologies may work just as good or better in some cases:

"But in other cases as in the agricultural case, I feel a platform which is owned together by some of these corporations and which have both a judicial and common responsibility can be a much easier way to the goal. ***This issue of the data not being secure [in centralized ledger technology] I feel is not realistic****"* - Company 8

"And then we went through multiple criteria which made blockchain actually fall out. A matching algorithm takes maybe 15 seconds in a relational database. While if we had run it on a somewhat mature blockchain it could take several minutes" - Company 2

The majority of informants note the following. There must be a good reason to use blockchain, so one doesn't use it just because one wants to. Many are hyped about the

technology but run the risk of getting ahead of themselves and look for a way to use it even when it might not be the best way to go. In other words, think problem solving first, then technological solution - not the other way around:

"When you see many people coming into this space, they come with an idea that blockchain fits, and then they try to find a use case for it. We do the opposite. ***We have defined a user need and then we try to find a technology that meets this user need*** *as easily and smartly as possible"* - Company 2

"And why should we have blockchain and tried to do a reasonable assessment. ***Not just use it places because it is blockchain****, kind of. Not tokenize everything right away and things like that just because it would have been fun if it is not effective and cost effective and such"* - Company 1

On that note, informants point out that the benefits from using blockchain mentioned in chapter 6.2 Reasons to use blockchain are only achievable in certain cases. Value is only generated when the technology is applied to relevant use cases where such yields are possible. Many times, blockchain will not be appropriate:

"I believe there are some targeted use cases for blockchain. (...) But ***in other cases I feel like a platform [like a cloud] is an easier way to the goal****. If you are going to develop such an infrastructure then it is important to* ***latch it to something which gives immediate use-value*** *for those who are actually going to use it and log data"* - Company 8

"Everybody is quick to say, ***but show me the money****"* - Company 4

"We have investigated pretty carefully over the past three years what the technology can be used for and we have found that (...) ***it has a very limited use case range for us****"* - Company 2

According to the informants, if your firm considers implementing blockchain, it may be beneficial to work with somebody, such as a blockchain consultant. This is to get the competency and know-how needed to use it:

"And then I would be on the lookout for somebody to work together with in a value chain, so you don't sit there alone. A consultancy service, for example" - Company 4

The choice of type of blockchain and which blockchain project to work with is an important one (Wüst & Gervais, 2018). Notwithstanding, the informants did not elaborate on how to make this choice. Hence, comparisons of types of blockchain (ref. chapter 2 Blockchain technology overview) and specific projects is ample ground for further research. The informants did say, however, that the choice seems to often be made for the practical reason of what consultant they chose to work with and what this consultant recommended:

"This other company was the third party because they are our auditors. That is why it was easy to work with Vechain because that company works with Vechain, and then we went for Vechain" - Company 4

Also, regarding the choice of blockchain, the informants were unanimously in agreement that proof-of-work blockchains are simply too energy expensive to be worth it. Especially for those working to reduce their environmental damage:

"In our firm we are working to solve a problem about climate change. We contribute to there being produced more renewable energy, and ***Bitcoin alone uses as much as Ireland. That does not make sense.*** *So that's what did it. We can't use that much renewable energy. It eats itself in the hand"* - Company 2

The most common response to whether companies should be early adopters or come in later was that it is better to be a fast follower. This way, one avoids the problem of path dependency or investing large sums of money in a technology that later becomes outdated. This risk is significant as blockchain is evolving every day, and the political and regulatory landscape has yet to be formed:

"I feel like there is quite a lot of evidence that first-mover advantage isn't really a very big advantage. I don't think Myspace or Friendster are very happy with their first-mover advantage. Bitcoin can be happy with their first-mover advantage, though. ***The cheapest and smartest is just to wait and see. I believe****. That is where there is the least risk. And if you had bet on blockchain three years ago you would have done it a certain way. Maybe made some*

IOTA solutions. But now it is much clearer that Layer 2s or low-fee networks are used etc. I mean, learning is happening all the time, so it is expensive to stay up-to-date all the time so it should be cheaper to just wait and see" - Company 5

Though a bonus to being early was some free marketing from people curious about the technology:

"First and foremost the result has been much free attention and marketing and prizes and some such things. So we have received some prizes and some money and some honor and glory for using blockchain. So there is some free interest in the market. I think probably that is the main thing so far" - Company 1

6.5 The future of blockchain

The informants stress that they do not have a crystal ball to predict the future. Even so, they do have some thoughts. Notably, all informants think blockchain will have a place in the future of society in general. Most think its role will be bigger than it is today, and some take it another step and believe the technology will be as big as the Internet with time. The following quotes and excerpts show this spectrum:

"I don't think this is going to be the Internet 3.0 which is going to revolutionize all of society" - Company 8

"I think that in some form or other this will continue to exist" - Company 7

"I think it will be there also in the future. And I think it clearly has growth potential, so yes, it is going to be bigger than it is today" - Company 6

"All firms with respect for themselves will soon have their own blockchain platform" - Company 4

"We are certain that blockchain technology will change the way we do business in the future" - Company 5

"People always overestimate how fast the changes happen, but they underestimate the scope. They think things will go faster than they do. There are so many small steps, so you don't notice it. But the changes always turn out much greater. I think that is where blockchain is. Before the smart phone, nobody could envision how integrated this gadget would become and how much it would mean. And today you can't think of a life without it. And blockchain is something else, but it can quickly become an Internet variant. Meaning it becomes as big as the Internet i terms of offered ways and solutions to think about." - Company 4

"Yes. I am sure of that. In the beginning, I was skeptical and didn't really understand the purpose of it. But I do see how it can contribute to building security and safety around food production for example. And then it can quickly be built out to apply to furniture production and all sorts of things. More and more is demanded by us who produce. More and more documentation. It's not possible to stay at a paper level on such things. And then it is blockchain that is the best" - Company 3

Informants are still experimenting with blockchain and express that how companies actually end up using the technology remains to be seen. Blockchain is undergoing significant development and change as it is still deemed an immature technology. There is widespread agreement among informants that blockchain's true potential is yet to be realized, and that we need more experimentation before we find its most valuable applications:

"That is where the whole maturing around blockchain makes us very well positioned to do more very cool things and get much out of what we have built and the learning surrounding it. That will be ***the most exciting the next three years to find out what really is the benefit*** *to do things they way we are"* - Company 1

"Here it is only the imagination that sets the limits" - Company 9

The interview data suggest that when one finds these most valuable applications, one can expect, if not industry standards, then some dominant use cases and blockchains to emerge. One might see several blockchains have each their own niche in society:

"There will be many parallel runs ending up with some different systems, but they will be talking together, that's just how it is. You won't get like a silver bullet which saves everything

then its like 'this is how we're gonna do it'. ***You will probably get some dominating actors****"* - Company 4

Most current blockchain companies are likely to crash and bust, as expressed in the following quote:

*"****We are around the dot-com bubble today*** *when it comes to blockchain. Very much of what we see today will most likely dissipate into smoke"* - Company 7

Barriers to adoption identified by informants were mainly the legacy systems challenged by blockchain.

"Their [Norwegian Board of Technology] social mission is to inform the government of coming technologies that will affect Norwegian politics. It said straight out that ***DLT could challenge existing ledgers like ours and make them obsolete****"* - Company 7

"It makes up ***a threat to existing structures****. There are pushbacks from existing systems which have a monopoly on a lot of this, what blockchain wants to remove. Everything from finance institutions to insurance institutions"* - Company 4

7 Discussion

This chapter discusses the empirical findings in light of the theory, keeping the research question in mind as the guiding anchor. The intention is to show the reader how I arrived at an answer to the research question and what that answer is. Figure 7 Data structure shows the codes and themes I developed through thematic analysis, and Figure 8 Blockchain value creation model visually displays the answer to my research question. The rest of the chapter explains this model, reservations about it, and discusses implications for TCE, notes for managers, and future value creation potential of the technology.

7.1 Data structure and model

We have established what value means and where it comes from in a TCE perspective in chapter 4.3 What is value?. Now then, we can begin to analyze how blockchain can create value. Through thematic analysis, I have come up with the following themes: moderate bounded rationality, reduce opportunism, and simplify execution. To demonstrate rigor in my qualitative research, I have included a figure displaying my analysis process (Gioia et al., 2013). It connects some of my 1st and 2nd order codes with the resulting themes. This is Figure 7: Data structure. It is inspired by Gioia et al. (2013).

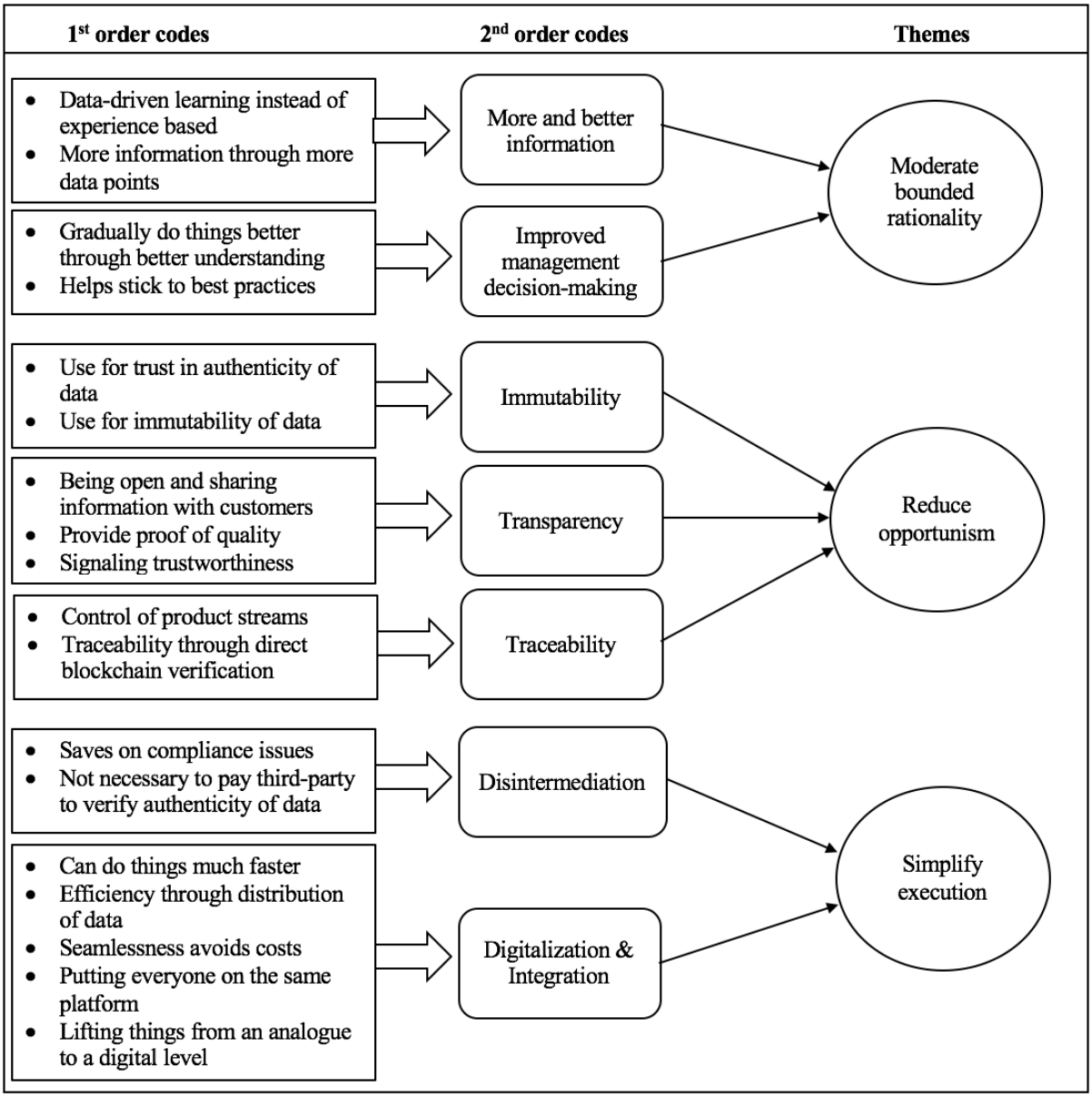

Figure 7: Data structure

Drawing from the data structure, I created a model to show the relationship between the variables. This model is Figure 8: Blockchain value creation model as shown below. This model represents the answer to my research question visually. In the following subchapters of chapter 7 Discussion, I explain the model and the drivers of blockchain value creation; reduce opportunism, moderate bounded rationality, and simplify execution.

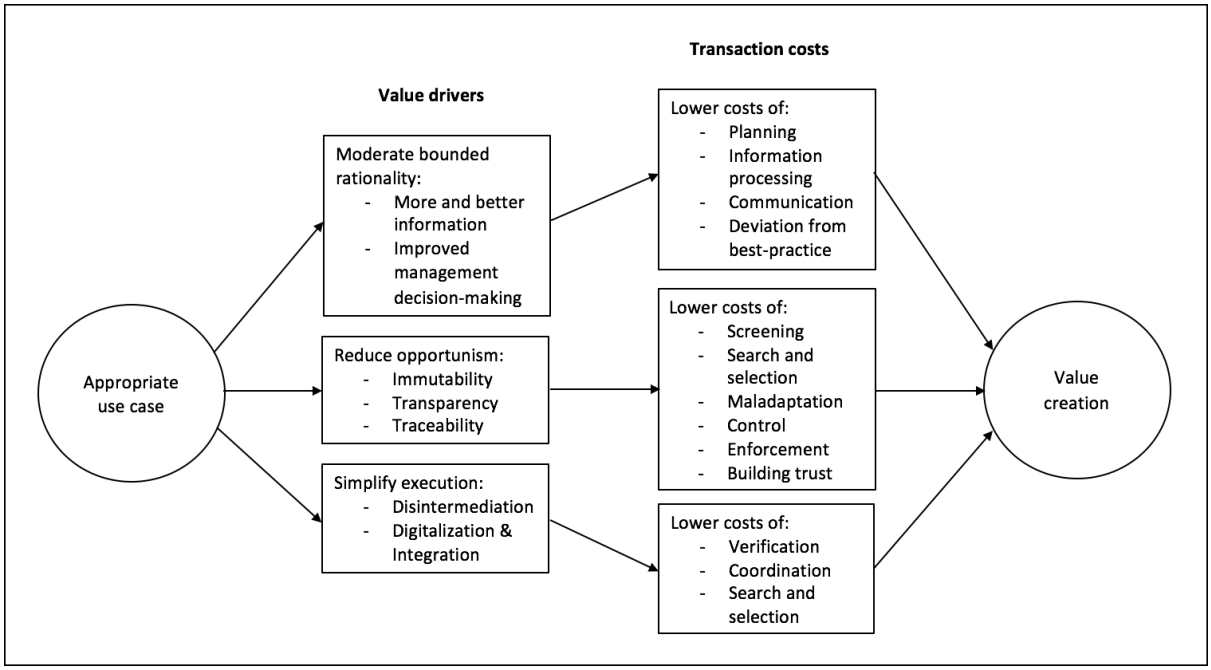

Figure 8: Blockchain value creation model

7.2 Value driver one - moderate bounded rationality

Before we can begin to understand how blockchain can moderate bounded rationality, we need more elaboration on the concept of bounded rationality. Bounded rationality comprises three components; cognitive ability, imperfect information, and time constraint (Boyce, 2021). These three components drive bounded rationality and lead us to make suboptimal decisions by satisficing rather than maximizing (Simon, 1961). This relationship is visualized in Figure 9 below.

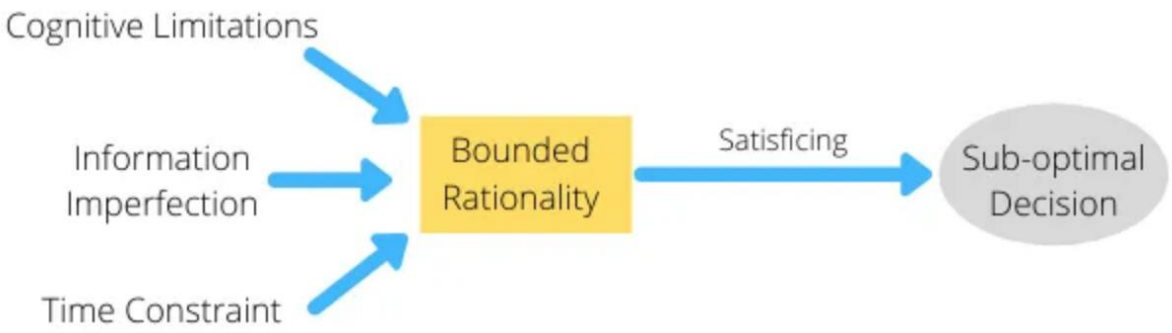

Figure 9: Bounded rationality (Boyce, 2021)

Cognitive limitations refer to the fact that our brains cannot solve just any puzzle or problem in an optimal manner (Foss & Weber, 2016). There are simply too many factors to consider and questions to answer for us to maximize decision-making. Information imperfection means that we rarely or ever have all necessary information available to us to make optimal decisions (Boyce, 2021). There is information we know about but do not have and information we do not know about and that we do not have. The same goes for the consumer or buyer of a company's products or services. Time constraint refers to the fact that we have limited time to make decisions (Boyce, 2021). Consequently, we cannot spend all the time we may need to reach the best conclusion possible. Thus, we must satisfice. If we accept that the addition of cognitive limitations, information imperfection, and time constraint equals bounded rationality, a reduction in any of the three components that make up bounded rationality must by definition reduce the degree of bounded rationality.

I have elaborated on bounded rationality and will proceed by explaining how blockchain can moderate it and in what way. The empirical data gathered for this research paper makes clear that certain industries and companies with less information on their value chains can benefit from using blockchain. By tracking and tracing their value chains, companies acquire more data on every transaction in the process of producing and selling a product. This way, they can know with greater certainty what actions caused which results and replicate these procedures again, both in the same place and elsewhere. More data gives a better basis for decision-making and can reduce deviation from best practices, effectively becoming more efficient and reducing transaction costs. This is seen, for example, in company 3, which found better ways to manage their fish to get better results continually. Having hard data on every step of the value chain rather than "experience-based" opinions from actors in the value chain helped them make healthier and more fish with less waste by learning about things like suitable water temperatures and optimal feeding practices. This not only created value for the company in the sense that it let them solidify their bottom line through more and better products but also allowed them to protect the environment through fewer dead fish. Some companies experienced more and better data allowing for improved management decision-making. The benefit of blockchain here was that it helped improve the efficiency of their operations. The following few paragraphs elaborate on this and how it connects to TCE.

More and better data allowing for improved management decision-making can be connected to the underlying assumption of bounded rationality in TCE. This assumption includes the

aspect of imperfect information, where we, as human actors, do not have all the information in the world to make decisions (Boyce, 2021). The analysis of my empirical data indicate that one source of value is moderating bounded rationality by means of increasing information availability and flow. This way we can get a better basis for decision-making, thus reduce related transaction costs, as supported by Williamson (1975). Clemons and Row (1992, p. 19) would likely agree as they argue that with information technology "information that is too expensive to collect manually can be generated as a byproduct of normal operations and directed to the appropriate point in the organization at low cost". Blockchain can be considered a type of information technology (Swan, 2015). The more specific transaction costs that are reduced due to a moderation of bounded rationality are planning costs, information processing costs, communication costs, and costs from deviating from best practices. Planning costs go down because companies can quicker and easier plan their operations. All or most relevant data is available through a distributed ledger, and not needing to wait to learn from various actors' incomplete experiential information reduces friction related to planning. Information processing costs are reduced for the same reason (Williamson, 1985).

Information processing costs go down also because we lessen our reliance on the unreliable source of information that is the experience-based opinions of workers, as mentioned above. In their article on bounded rationality and TCE, Foss and Weber (2016, p. 62, p. 65) define heuristics as "simplified models of reality that help individuals and groups make sense of a complex world" and cognitive biases as "systematic errors that arise from the use of heuristics". Heuristics and cognitive biases are likely not too uncommon in workers' stories and opinions on why things turned out the way they did. One such bias may, for example, be the recall bias, where workers remember other workers' actions more conservatively than they do their own, "systematically but unconsciously" (Foss & Weber, 2016, p. 71). It follows that blockchain can help overcome these problems as we move to "hard", blockchain-derived data with an immutable, exact record. Accordingly, communication costs go down (Rindfleisch & Heide, 1997). Furthermore, cost savings from conformity with best practices are realized. In one interviewed case, costs from deviation from best practices were estimated to be 250,000,000 NOK a year. This occurs due to more and higher quality information, as explained in previous paragraphs. This data can further be trusted because it is devoid of human error. Consequently, assessing performance gaps from one time to another becomes

easier. Decision-makers learn what best-practices look like for their companies and how to follow them more consistently.

My argument is that it is mainly the information imperfection component of bounded rationality that is moderated here. As a result, a company using blockchain may move towards maximizing behavior and away from satisficing behavior to an extent. Our cognitive ability does not change, and neither does our time constraint for making decisions. However, the time constraint may become less of a pressing issue as the time required for planning and information processing go down. Thus, we see that the value of blockchain is that it can moderate bounded rationality and reduce the related transaction costs of planning, information processing, communication, and deviation from best-practices. How this finding informs the TCE framework is discussed further down.

7.3 Value driver two - reduce opportunism

I further posit that blockchain can create value by reducing opportunism and thereby related transaction costs of search and selection, screening, control, enforcement, maladaptation, and building trust. In essence, this occurs through transparency, traceability and immutability, three of the characteristics of blockchain discussed in chapter 2 Blockchain technology overview. In light of these findings, I concur with Tönnissen & Teuteberg (2020) when they argue that these characteristics enable value add opportunities. Unfortunately, evidence suggests opportunism does occur sometimes. Maitland, Bryson, and Van de Ven (1985, p. 64) observed that "opportunism neither is ubiquitous nor is it very unusual". Plenty of companies do well by doing bad (Tapscott & Tapscott, 2016). Acts of opportunism include but are not limited to falsification of expense reports (Phillips, 1982), breach of distribution contracts (Dutta et al., 1994), and quality shirking (Hadfield, 1990).

The analysis of my empirical data suggests the following. The transaction cost economics link between opportunism and transparency with regards to blockchain can be viewed as information asymmetry. This is because information between actors becomes more symmetric through the use of blockchain, thus diminishing the opportunity for opportunism. This benefit is derived for both ex ante and ex post opportunism. My informants indicate that ex ante, companies using blockchain can signal to potential companies they might want to transact with that they are trustworthy. Signaling is a common way of reducing ex ante opportunism

because you give some information about yourself that signals to the other party that you are trustworthy, such as testimonials from past customers (P. C. Ahlgren, personal communication, September 20, 2020). By using blockchain, companies signal a willingness to submit themselves to transparency and thereby a level of honesty that opportunistic actors typically do not. They also cannot be opportunistic ex post because the blockchain would reveal it, as will be elaborated upon soon, meaning ex ante deceit is less likely. This reduces screening costs, or uncertainty about the reliability of potential suppliers or exchange partners (Jaffee, 1995).

Signaling a willingness to be transparent also functions as a type of self-selection mechanism, effectively filtering out the unfit applicants for a transaction because they choose not to "apply". This is because potential exchange partners will likely be expected to subject themselves to a similar level of transparency that they may not be willing to take on if they have opportunistic intentions. Self-selection means that a company signals required or desired capabilities in an exchange partner, and a willingness to go through a qualification check on them prior to entering an agreement, so applicants who do not feel qualified refrain from applying (P. C. Ahlgren, personal communication, September 20, 2020). Companies that are known for monitoring exchange partners typically enjoy this self-selection mechanism as opportunistically inclined parties stay away (Wathne & Heide, 2000).

Furthermore, as indicated by Williamson (1979, 1983), trust between firms is valuable as well as reputation. The informants pointed out that using blockchain, or even just a willingness to do so, sends a signal to partners and potential partners that your company is honest and fair. This may create trust between partners and also strengthen their reputation because people can see that they have been honest about their past operations (Wathne & Heide, 2000). With open ledgers, exchange partners have great information about each other (Tapscott & Tapscott, 2016). Open ledgers also make it easier for companies to select partner companies and reduce the cost of finding one. This means that search and selection costs are reduced (Tapscott & Tapscott, 2016). Stump and Heide (1996, p. 432) argue that partner selection is an impactful governance mechanism because if it is not practiced, "a buyer may incur substantial transaction costs, due to being locked in with a supplier who causes delivery and/or quality-related problem". By improving the rate at which good partners are chosen, one can reduce costs associated with selecting bad partners, such as maladaptation costs (Rindfleisch & Heide, 1997). One can also increase the benefits of good partnering, such as

superior talent and the innovation that may lead to, helping achieve competitive advantage and success in the marketplace (Tapscott & Tapscott, 2016).

Ex post, partner companies in strategic alliances can no longer, or at least not as easily, transgress on contractual agreements or conduct "horse trading", as company 6 put it. This is because they have submitted themselves to the unforgiving transparency of blockchain. Their actions are put on the blockchain where all parties can see real-time changes in the distributed ledger. The data remains there immutable and traceable forever. So, they cannot export waste material illegally as easily, for example. In other words, ex post moral hazard opportunism becomes less likely because others will know, i.e., information symmetry is achieved. This means that costs of control and ensuring opportunistic acts are not undertaken as much are reduced, depending on the costs of previously used control systems. In other words, blockchain is a governance mechanism that uses transparency to monitor people's actions. Next, I argue that this strengthens the reputation effect.

The reputation effect is an argument made by Sharma (1997), among others, that people will catch wind of opportunistic behavior, and then refrain from doing business with the perpetrator. This should, in turn, reduce opportunism but assumes both efficient spread of information and that relevant parties remember it over time (Sharma, 1997). As Wathne and Heide (2000, p. 46) nicely put it, "for a reputation to be valuable, it is necessary for information to be available to firms about other firms' past and current behaviors. In Sappington's (1991) terminology, reputations require public observability of outcomes". Blockchain can facilitate the spread and secure storage over time of such information, and thereby reduce opportunism. Furthermore, less ex post opportunism would also mean fewer enforcement costs such as lawsuits because fewer acts of dishonesty and failure to comply with agreed-upon terms would occur. Legal fees are thus reduced (Jaffee, 1995). It might also be easier to discern who is responsible for which transgressions of a contract as data is put on the blockchain ledger, where it remains immutable, distributed, transparent, and decentralized in nature.

To explain further my analysis of the empirical data, B2B and B2C sales have to be honest about the history of the product. All the information about where various parts of the product are from, how they are made, the carbon footprint, whether it was made ethically under ethical working conditions, where it was sourced, how it was handled and transported etc. is

readily available for others to look at. This means a company cannot lie to make their product seem better than it is to sell more of it or to a higher price. The information is distributed and transparent, so customers can enter a website or an app through a QR-code on the packaging and learn about the product. Screening costs are reduced because uncertainty about the quality of the product is reduced (Jaffee, 1995). Information asymmetry is reduced, and opportunism along with it.

Through transparency, immutability, and traceability, blockchain likely increases customer willingness to pay, as indicated by company 3 and 4 (ref. chapter 6.2 Reasons to use blockchain). The latter could charge a premium for having "green" products because blockchain allowed them to prove to their customers, not just claim, that the products had a green history. Furthermore, the transaction cost of search and decision-making lowers for customers as they can make faster purchase decisions because the product offers a kind of trust that the products not utilizing blockchain cannot. We see that blockchain made possible a stronger customer value proposition by being able to provide true information that customers trust about the qualities and history of the product. Porter and Millar (1985, p. 19) would likely agree with this point. They state that "the embedding of information systems in the physical product itself is an increasingly powerful way to distinguish it from competing goods". This way, a company can differentiate itself and attract more and higher paying customers (Porter & Millar, 1985).

Trust is central to the value driver of reducing opportunism. Essentially, blockchain fixes the problem of trust. Transaction partners no longer need to trust each other as much. They can "outsource" the need for trust to the technology instead (Swan, 2015; Werbach, 2018). Thus, one removes the need for trust between transaction partners and move their trust to the blockchain, which binds us together (Swan, 2015; Werbach, 2018). Increased trust and decreased opportunism are likely to lengthen business partnerships as a history of trustworthiness tends to foster longer and stronger relationships (A. Ulvnes, personal communication, October 7, 2021). One may also strengthen one's reputation, further enhancing the likelihood of strong and long-lasting business partnerships (Krishnan et al., 2015). Customer trust in the company may also make customers more loyal to the company. Blockchain removes the problem with trust mentioned in chapter 4.2.2 Governance mechanisms, namely that it can be taken advantage of. By removing the problem of trust, one can alleviate the fear that the other party will behave opportunistically. Removing the need for

trust also reduces costs related to building trust, which can often be a long process of continuous communication and successful transactions (Tapscott & Tapscott, 2016).

In summary, blockchain can create value by reducing opportunism and the related transaction costs of search and selection, screening, control, enforcement, maladaptation, and building trust. A nuance here is that the technology does not make us have to change our human assumption that some people are opportunistic sometimes. Rather it acts as a buffer or governance mechanism through which we can reduce the scope for and amount of opportunism undertaken. In other words, blockchain does not change our proclivity for opportunism but reduces opportunistic acts. This is a useful general distinction pointed out by TCE researchers Ghoshal and Moran (1996).

7.4 Value driver three - simplify execution

The analysis of my empirical data indicates that blockchain can help generate value by simplifying execution. This occurs through lowering verification costs, coordination costs, and search and selection costs, as will now be explained.

Regarding verification costs, informants confirm that blockchain makes it possible to verify transactions (i.e., verify that they took place and in the amount said) without using third-party intermediaries. Third parties have to be paid for their work and removing the need for these is a big cost saving opportunity. If each party in a value chain, for example, verifies the transactions in a so-called “chain of custody” system where each party has an economic incentive to ensure true and authentic information, expensive intermediaries become obsolete. Company 1 could, for example, ensure that their independent contractors all over the world had indeed done what they said they had done of work because they used blockchain to verify it. Company 6 enabled verification by separate actors before and after each individual step in the value chain. Essentially, blockchain allows for disintermediation. This argument concurs with Tönnisen and Teuteberg’s (2020) argument that blockchain can create value by saving on costs related to intermediaries.

Interestingly, the reason the intermediaries such as auditors have a job is because of a lack of trust between exchange partners (Tapscott & Tapscott, 2016). With a transparent and distributed ledger that uses this different type of traceability through chain of custody rather

than third-party verification, the problem with lack of trust attenuates significantly. The trust is moved to a technology from an independent third party (Swan, 2015; Werbach, 2018). Since the code is open-source and its governance and structure is decided upon by all actors in the beginning of the blockchain venture, actors can trust the information on it without trusting each other nor a third party (ref. chapter 2 Blockchain technology overview). Hence, blockchain offers great cost savings in terms of auditing and regulatory compliance issues because it creates a condition of trustless trust. Thus, verification costs are reduced, and execution is simplified.

Regarding coordination costs, blockchain can also serve as a means for digitalizing and integrating processes that before were more analog and fragmented. Clemons and Row (1992) argue that information technology reduces coordination costs, and that this is widely recognized by researchers. I posit that this includes blockchain for the following reasons. Problems and inefficiencies related to paper-based business can be mitigated. Company 9, for example, saw great efficiency improvements from integrating a fragmented and analog system in the real estate market. They could put all the relevant players such as lawyers, banks, real estate agents, etc. on the same blockchain system and thereby make processes related to buying and selling houses on the exchange date incredibly quick. Putting everyone on the same platform and getting rid of physical letters that need to be sent multiple places in original copy form significantly sped up the process. The main costs saved here were time and effort for all parties involved. Speed was enabled by simplification of execution processes. This was possible with the help of NFTs and smart contracts (ref. chapter 2.4 NFTs and smart contracts). Houses were represented on the blockchain as NFTs and transacted through smart contracts for automation and security purposes, as supported by Kant (2021). Similarly, company 8 could coordinate transactions of farming inputs much more easily, also lowering the related transaction costs of search and selection considerably. Farmers and others in their ecosystem got a better overview of who had these inputs and how much, so they could find and select each other more easily. Thus, we see how blockchain can create value by improving coordination through digitalization and integration functionalities that simplify execution.

7.5 Reservations to value drivers

The interviewees identify multiple reservations to value creation with blockchain. For example, it can get expensive to scale a blockchain within an organization or network of organizations. This finding concurs with claims in previous research that "blockchain could help operations for sure, but may be too expensive" (Gausdal et al., 2018, p. 8). Oftentimes, related systems need to be adapted to fit with blockchain. However, to really increase the information access and flow meaningfully, organizations need to scale the technology. If this is viable or worth it must be measured against the costs of implementation. If scaling is not possible or attractive enough, moderating bounded rationality cannot be achieved through blockchain. Similarly, to get a meaningful scope for transparency and consequently reduce opportunism, scaling is necessary. Additionally, scaling is necessary to increase the benefit derived from digitalization, integration and disintermediation, and consequently simplify execution. The scaling costs of implementing blockchain must therefore be weighed against the benefits from reducing opportunism and simplifying execution.

Also, some industries, typically heavier ones such as aluminum production and waste management, and companies do not benefit as much from the moderation of bounded rationality because they already have affluent information availability and flow. This could be because of strict compliance controls or by choice. Managers need to keep their industry and company information situation in mind when evaluating their blockchain strategy.

A challenge to overcome in order to realize value from reducing opportunism through blockchain is to convince partners and relevant actors to use blockchain. This argument supports Gausdal's et al. (2018) empirical finding of the same. Not all parties, and especially those who have a tendency for acting opportunistically, want to submit themselves to the transparency that comes with blockchain. Actors who have clear financial and legal incentives to avoid blockchain may be harder to get on board, as pointed out by informants. Assuming certain countries have more "shady" actors than Norway because Norway is known for relatively high levels of trust, this challenge of onboarding transaction partners may be most apparent for companies with international value chains. Informants also point out that convincing actors to join a blockchain network is also challenging sometimes because people do not understand the technology and are not comfortable "experimenting" with it for this reason. Especially in industries where the sums of money can get large, such as in real estate.

If there is a problem convincing actors to join, the value derived from reducing opportunism is reduced because the transparency function is no longer exploited. My empirical data further suggest that to facilitate conversion, managers can emphasize that not everybody needs to fully understand the technology as long as they know that it works and how to interact with it. If governments choose to become a driving force behind the adoption of blockchain, various market participants are more likely to open up to the change, as indicated by a few informants.

Furthermore, the value gains from moderating bounded rationality through blockchain are only accessible to the extent implementation is undertaken. The more actors join a blockchain network, the more data the focal firm can get. As I have argued in chapter 7.2 Value driver one - moderate bounded rationality, more data is a central part to value creation with blockchain in some instances. Likewise, digitalization, integration, or disintermediation, and thereby simplification of execution is only possible if relevant actors both inside and outside the firm agree to join a blockchain network. Hence, we see that converting actors is indeed a big obstacle for companies interested in utilizing blockchain.

The transparency feature of blockchain presents its own unique challenges, as also found by Wang et al., 2019. How much information should be made available on the blockchain for which participants are questions companies using blockchain need to figure out. As blockchain allows for storytelling, companies must figure out how to tell this story, what information the counterparty is interested in, and what not to say. Potential company secrets such as supplier identity and partners may not be desirable to reveal to, say, the competition. Similarly, Wang et al. (2019, p. 232) argue that "the transparency of publicly distributed ledgers would clash with the supply chain objective of a competitive edge based on information privacy". Managers may need to conduct market research to learn what customers want of information, how to best present it or tell its story, and think about what information is better kept under wraps due to its function in creating competitive advantage. Transparency through blockchain is thus both a gift and a challenge to companies.

There are some reservations regarding the value driver of simplifying execution. As discussed in chapter 7.4 Value driver three - simplify execution, verifying data without having to pay an external third party such as an auditor to do so is a great value creation potential for blockchain. However, difficulties doing this in practice may hinder this potential. The

blockchain creates trust in the data by its immutable nature, but the biggest source of error is still the data being put in correctly to begin with, according to my informants. People, sensors and machines can make mistakes. Without successful measures in place to ensure trustworthy information, simplifying execution through disintermediation may not be possible. As mentioned above, a chain of custody incentive system is one possible way to deal with this problem for managers. In other words, applying the governance mechanism of incentives along with blockchain may enhance security and functionality of the technology. Wathne and Heide (2000) point out that incentives like this help because we align parties' interests such that the pay-off from acting in good faith exceeds that of opportunistic acts long term. Notably, if one cannot ensure true information is put into the blockchain in the first place, one cannot either disintermediate because one would still need an independent, paid third party. This is because the data is no longer trustworthy.

By the same token, if one cannot ensure true data is put into the blockchain in the first place, the data quality will not be better. Better quality data is important in moderating bounded rationality and realizing the associated values (ref. 7.2 Value driver one - moderating bounded rationality). Lastly, if the data is not true, a company's actions are not transparent outward to the reader of the ledger. Thus, the benefit of reducing opportunism is largely lost in this case. Ensuring true data inputs is indeed a major challenge for blockchain (Wang et al., 2019).

7.6 Implications for transaction cost economics

Now that this paper has analyzed the value drivers of blockchain as a distributed ledger technology, we can begin to discuss the phenomena's implications for theory. As mentioned in the introduction, the phenomena of blockchain and distributed trust may have an enormous impact on institutional economics and related theories like transaction cost economics. My findings draw our attention to the underlying human assumptions in the TCE framework. We see that both opportunism and bounded rationality are put into question. Are these assumptions still valid and realistic for people when blockchain is included in the mix? My answer is *mostly* yes, they are.

As discussed earlier in this chapter, blockchain becomes a technology for controlling actors in a network and ensuring truthful data on activities. I have shown how the technology can reduce the number of opportunistic acts undertaken, not how opportunistic tendencies in

people change. I do not see how blockchain would alter some humans' proclivity for being opportunistic sometimes. However, *the scope for opportunistic acts tightens* as information asymmetry is reduced through computer encoded transparency. Moreover, people do not suddenly become the "economic man" of microeconomics with hyperrationality and maximizing behavior, but *they do get more and better information from which to draw their decisions upon*. Cognitive limitations and time constraints remain unchanged, but *information imperfection reduces*. By logical necessity then, so does bounded rationality. Hence, we become slightly more rational actors, though we still satisfice, as we get less of an information burden. Transaction costs stemming from a lack of information can thus be mitigated to a degree. Consequently, the assumption of bounded rationality does need a slight revision in the TCE framework.

TCE still holds as a valid theory and we can still use it to analyze value creation and transaction costs. However, when blockchain is included as a factor we add nuances to the theory by moderating bounded rationality and reducing the negative effects of opportunism. Seidel (2018, p. 42), as mentioned in the introduction, argued that "the core tenets of the key organizational theory paradigms were created in different technological times with underlying assumptions that no longer hold in such absolute terms with these shifts in technology". Due to the advent of "distributed trust", or trustless trust as I have called it in this article, core arguments within TCE may no longer hold as strongly because they rely on a different notion of trust "which [is] becoming outdated" (Seidel, 2018, p. 40). My response to him is that opportunism still holds, but the negative effects of it can be counted on as being smaller. This is because blockchain functions as a governance mechanism (ref. chapter 4.2.2 Governance mechanisms) controlling for opportunism. However, I do agree with Seidel (2018, p. 42) in that bounded rationality no longer holds in such "absolute terms" as more and better information helps us deal with our "imperfect" nature.

I would like to emphasize that my findings are not at all intended to attack or disparage transaction cost economics or the outstanding work of respected authors contributing to the framework. Rather, I merely wish to suggest that TCE does need to be revised to an extent, or at the very least reexamined, given that we now live in a new era of novel technologies, notably blockchain.

7.7 Notes for managers

Managers and leaders of companies and organizations can read this article to learn about the potential of blockchain technology. The findings and analysis may provide helpful insight into blockchain and transaction costs that managers can use to make informed decisions about their own blockchain strategy, and whether the technology is for them. My findings add credibility to Ahluwalia's et al. (2020) and Kant's (2021) claim that blockchain can help reduce transaction costs. The Blockchain value creation model shows that the technology is, in fact, very significant because it can create tremendous value for companies.

This article shows what kind of value they may experience if they employ blockchain themselves, not how to find an appropriate use case. To find an appropriate use case and figure out what type of blockchain to use, or whether to use a CLT instead, I refer the reader to Greenspan (2015), Klein et al. (2018), and Wüst and Gervais (2018), who do a great job on this. A note I do have regarding this is that proof-of-work blockchains such as the one behind Bitcoin were strongly downvoted by all informants due to excessive energy use. Multiple previous authors have pointed out the same (Casino et al., 2019; Sedlmeir, 2020). This is important for managers to keep in mind in an age where seemingly everything is going "green". Furthermore, CLTs may work just as satisfactory or better in many cases. Managers may want to remain agnostic towards blockchain so as not to implement it until a convincing use case has been found and tested well in a pilot project. Sandbox pilot projects may be critical before going "all in" for implementation to ensure you actually have a good use case planned. Tapscott and Tapscott (2016) argue the same thing. If organizations determine blockchain is not right for them, which may well be the case for many, this article will help them understand better their competition who do employ it, so they can position themselves accordingly.

A meaningful additional finding in this article is that "regulatory uncertainty" seems not to be a problem with using the ledger function of blockchain alone. This finding contrasts with previous researchers who pointed out regulatory uncertainty as being the most prominent challenge to blockchain implementation (Kant, 2021; Karpenko et al., 2019; Konstantinidis et al., 2018). However, difficulties may arise when including cryptocurrencies, as they seem to be more controversial. Informants indicate that being a fast follower is the preferred course of action for those wanting to employ the technology but also point out that the first movers have

already made their move. This finding reconciles the contending arguments of Yuthas et al. (2021) and Kant (2021) (ref. chapter 3.3 Challenges with blockchain) by saying that while it is best to wait with implementation till the first-movers have made their move, those actors have already done so. Hence, now may be the right time to take action. However, if governments issue their own blockchains or blockchain recommendations, organizations are likely to follow along so that previous blockchain investments may turn out redundant. This argument is proposed by Wang et al. (2019) as well. Furthermore, managers may also consider working with expert consultants for aid in discovering, testing, and implementing a use case.

The TCE framework can admittedly be somewhat abstract (Zajac, 1993), but I hope the findings in this thesis can still be useful for managers and that the findings were explained with enough concreteness regardless.

7.8 Some speculation on future value creation potential

This article takes an empirical approach to the value of blockchain. This means that it bases itself only on the current applications of the technology and the experiences knowledgeable agents already have with it. Consequently, any look at what the technology could do in the future is hypothetical and not the focus of this study. Notwithstanding, the informants discussed the future value creation potential a little, and some things are worth pointing out. If anything, just to tickle the imagination of the reader and perhaps help future researchers generate research questions.

The greatest value of blockchain is probably realized when it is applied to large scale situations. This way economies of scope and scale could be achieved. Ecosystems of various government and private actors could interact on the same blockchains to have one or a few common platforms where “everything happens”, and all data is stored. This could potentially boost efficiency and coordination extraordinarily, much the same way Altinn, a non-blockchain-based digital platform in Norway, streamlines a number of government functions for individuals. This reduces bureaucracy and its costs. Furthermore, in the advent of external uncertainty, blockchain can create value by helping actors more easily coordinate with each other. For example, in the case of a drought, farmers can organize to best manage through the shocks by distributing inputs swiftly and fairly. The level of overview is much greater with

blockchain, and the farmers can be more adaptable because of it. On a more political level, the prospect of putting “all” information about individuals and their actions on a blockchain may be a recipe for tyrannical control and power where individual freedom is severely limited, and privacy is a thing of the past. However, if the right mechanisms are programmed into the blockchain individuals can possibly even gain privacy, as they can control what information about them goes where. Technology can be used for both benevolent and malevolent purposes (Tapscott & Tapscott, 2016).

Smart cities can integrate blockchain functions in many different ways for security and efficiency. Self-driving autonomous vehicles can drive more safely by getting information about the surroundings from other cars. Energy can be distributed transparently, peer-to-peer, and efficiently. Toll clearance can happen very fast. Daily activities related to banks and ID-management can be simpler for individuals. The potential for automation and the redundancy blockchain may bring to human workers is intimidating (Tapscott & Tapscott, 2016). In combination with other fourth industrial technologies such as IoT and AI, the world may look very different some time from now, and how businesses operate and create value may follow suit (Tapscott & Tapscott, 2016). This is similar to how the Industrial Revolution substituted machines for human labor so that companies could achieve competitive advantage (Porter & Millar, 1985).

The technology is certainly evolving and maturing every day and new use cases and value capture opportunities are likely to arise. However, whether we are at the beginning of another dot-com bubble like that of the Internet remains to be seen.

8 Conclusion and implications for future research

8.1 Summary

This research paper sought to explore the value of blockchain as it pertains to companies. A multiple-case study with eight cases and nine personal interviews was undertaken with the intention of unearthing the informants' direct experiences with blockchain. They were seen as knowledgeable informants with the necessary knowledge to provide useful information about their own blockchain applications, why, and how they used it. The raw data was presented in chapter 6 Findings and empirical data. Chapter 7 Discussion then analyzed it up against transaction costs economics, as per the suggestion of previous authors (Ahluwalia et al., 2020; Seidel, 2018; Treiblmaier, 2018). I thus build on two distinct literature streams; TCE and the intersection of blockchain and value creation.

The research question in this thesis is: *How can blockchain help create value for companies?* My answer to this question is that blockchain can help create value for companies by reducing transaction costs through moderation of bounded rationality, reduction of opportunism, and simplification of execution processes. This answer is visualized in the Blockchain value creation model and represents my main contribution to the literature stream on blockchain and value creation. To the best of my knowledge, no published research has come up with a model quite like this before. Furthermore, it connects value drivers with types of transaction costs that can be expected to reduce when employing blockchain in a relevant way. I identified several reservations that need to be taken into account when finding out how to realize these potentials. These include the fact that all organizations are different and will not have the same need for blockchain (e.g. heavy vs. light industries), convincing relevant parties to use blockchain (e.g. to reduce opportunism), and ensuring true information is put into the chain (e.g. to capitalize on simpler execution).

I argue that transaction cost economics as a theory experiences an attenuation of its underlying human behavioral assumption of bounded rationality when blockchain is part of the context. Bounded rationality needs a moderation in the sense of assuming that human actors are a little less boundedly rational and a little more perfectly so because blockchain may provide more and better information to make decisions. In other words, we satisfice a

little less and maximize a little more. Also, opportunistic acts are reduced, though opportunistic proclivity is not. This is because blockchain is a governance mechanism like contracts, socialization etc., that removes the need for trust and helps govern exchange partners within and without organizations. These are significant findings and contributions to transaction cost economics. In particular, they provide further refinement to Seidel's (2018) propositions. A further contribution of this study is adding empirical substantiation to the largely conceptual literature base, as shown in Table 1: Previous studies on the business value of blockchain, and Figure 5: How this thesis is positioned, chapter 3 Literature review. This makes the research closer to reality and checks up against practice to see how things actually work.

8.2 Limitations of this study

There are several limitations to this study. First, blockchain is only in its nascent stages of development. As pointed out by most informants and supported by Levis et al. (2021), blockchain and its use cases are likely to evolve over time and we will not figure out until later what the true value and where its greatest potential lies. This may impact my findings in that they may become outdated at some point. Also, it means that my findings are based on only a small subsection of what is possible with the technology. To this point, the second limitation of this study is that I mostly investigate the third of Swan's (2015) categories of blockchain functionality - register keeping. The other two she discusses are cryptocurrencies and smart contracts, though I mention smart contracts to a minor extent. I also do not look at Web3 or IoT. These omissions are important to take note of as my findings will only apply to the studied domain and not necessarily to the other domains of blockchain, where the findings may be very different. This is, by the way, important to note for managers reading my thesis so they connect the potential to the relevant domain when evaluating their own blockchain strategy.

A third limitation of this study is that it only looks through the lens of one theoretical perspective, transaction cost economics. This is helpful for understanding value creation from this angle, but other angles will come up with other answers which can help illuminate the phenomena more fully. By incorporating more theories, we can gain a more complete picture of it. Fourth, this study takes a fairly broad approach to studying blockchain value, looking at it from a cross-industry and multiple use case perspective. This may cause the findings to

miss out on some important nuances only discoverable through in-depth analysis of particular cases. Lastly, this study sampled from a limited number of informants. Other informants may have different experiences with blockchain, so if they had been interviewed, the results would be different. My findings are still relevant as they pronounce one possible and valid answer to the question of how blockchain can help create value for companies.

8.3 Future research

Future researchers may test my model deductively to see if it holds true. A quantitative perspective would be interesting to put numbers on the approximate value of the reduction of transaction costs. This may only be partially achievable, though, as transaction costs are very broad and include things that are difficult or impossible to quantify, such as energy expenditure in making a decision. Almost no previous studies take a quantitative approach to finding the value of blockchain, and as such, quantitative studies on this are very welcome. This would help gain deeper insight into the topic from alternative approaches. It would also be helpful to the stream of literature on the junction of blockchain and business value creation to study particular industries and use cases in depth. Studies matching use cases with different types of blockchain and specific blockchain companies are needed too in order to gain a full understanding of the phenomena and its implications for managers and theory.

Furthermore, researchers may want to explore blockchain from other theoretical perspectives such as resource-based view (Barney, 1991), dynamic capabilities (Teece et al., 1997), Schumpeterian innovation (1934; 1942), Porter's (1985), Stabell and Fjeldstad's (1998) value creation frameworks and configurations, and others. After enough such articles have been made, scholars could integrate the findings from these articles into one integrative framework for the value creation opportunities of blockchain. Most importantly, it would be interesting to see somebody build on my research and findings related to the new understanding of the underlying human assumptions in TCE by looking at how this affects the classical choice between market, hierarchy, and alliance for the conduction of transactions. It would also be interesting to see how we may change our understanding of the firm's boundaries. Both of these questions are beyond the scope of this study. I agree with past researchers that the TCE framework requires additional development and testing due to the onset of blockchain (Seidel, 2018; Treiblmaier, 2018). As Seidel (2018) and Ahluwalia (2020) indicate, not only TCE has to be fundamentally reinvestigated, but also other institutional economics and organizational

theories should be reassessed. Examples are organizational ecology (Hannan & Freeman, 1977), institutional theory (Meyer & Rowan, 1977; Scott, 1987), resource dependence (Pfeffer & Salancik, 1978), agency theory (Jensen & Meckling, 1976), and network theory (Burt, 1995). Once the studies suggested here are made, managers will have a rich academic knowledge base to help them determine their company's blockchain strategies.

8.4 Concluding remarks

Blockchain is special because it holds real potential for changing the very fabric of society while few have in-depth knowledge of it at this time. This unique situation was what got me interested in writing about this topic. Just like Porter and Millar in 1985 wrote about the strategic significance of new information technology of that time, and others after them have written extensively about the Internet and its implications for management and strategy, organization and leadership issues, this study looked into the strategic value of blockchain technology as we enter into a new era of fourth industrial revolution changes. I hope the reader has gained valuable knowledge about the phenomena as it may play a role or other in their life at some point.

There has been much hype around blockchain, and not all of it may be well-founded. However, the hype seems to have moved down to a more serious level in recent years. It is safe to say blockchain is here to stay and offers something important to the world. Only the future will reveal blockchain's place in society. I predict the phenomena will hold great significance in how scholars and academics further develop and refine theories of strategy, organization, and leadership. Much the same way the Internet forced us to rethink our theoretical foundations. To end with a fitting quote from Tapscott and Tapscott (2016, p. 92): "So hang on to your seats (...) We are at one of those critical junctures in human history".

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Attachments

1. Interview guide

Introduction

- Thank you for letting me interview you
- Introduction of myself
- My thesis is about how blockchain is helping or not helping Norwegian companies succeed in the marketplace
- The interview remains anonymous, I am recording it and will delete the recording when I'm done with the paper
- What is your position in the company and when did the company start using blockchain?
- How large is your company and how many employees do you have?

Main part

Strategy

- In a short overview, how do you use blockchain in your company and why?
- What problem does it solve?
- How does it fit in with your strategy and business model?
    - What are your goals in the company and how does it help you reach those?
    - How does it help you increase profitability?
    - What are the costs to using it?
    - How does it help you spare the environment or benefit social causes?
    - Does it change how you deliver your value proposition to your customers?
- Does it give you competitive advantage? How and why (not)?
- Do you use smart contracts? If so, how and why?

Implementation

- How was the process with implementing blockchain? Easy, hard? How about costs?
- What kinds of hurdles did you meet and how did you circumvent these?
- How does your actual usage of blockchain differ from how you first envisioned using it?

Relationship with the government

- How has the government been relating to your using blockchain?
- Do you have any concerns regarding "regulatory uncertainty"?

Choice of a particular blockchain

- What blockchain(s) do you use? Your own or somebody else's?
- If you teamed up with an existing blockchain project, what is your relationship to that company? How much contact do you have with them?

    - Do you have to pay them a fee to use them?
- Do you use permissioned or permissionless blockchain(s)? Why?

Result

- What has the result been so far from using blockchain technology in your company?
    - Regarding costs, efficiency, security etc.

Future plans

- How do you plan to use blockchain going forward? Any new ways?
- What do you expect the future of blockchain to look like for society as a whole?

Other people's perceptions

- For now, I suppose it is largely considered against the grain to utilize blockchain in a company. How are other people perceiving and reacting to your using it?

Ending

- Naturally, it depends on specific situations and conditions but would you, generally speaking, recommend other companies to implement blockchain in their business operations somehow?
    - How is it easy/hard to use it? Can others be able to do it too?
- Anything else you would like to add?
- Do you know about any other companies in Norway currently using blockchain I could ask for an interview?
- Thank you for the interview

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