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Blockchain Business Models

- a case study of incumbents in established industries in the Nordic region

MSc in Innovation and Entrepreneurship

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Sammendrag:

Blockchain er en distribuert databaseteknologi som muliggjør digitalt eierskap og verditransaksjoner gjennom å tilrettelegge for tillit mellom brukerne. I denne studien har vi undersøkt etablerte virksomheters arbeid med å kommersialisere blockchain gjennom en eksplorativ studie. Vi stilte følgende forskningsspørsmål:

Er blockchain en disruptiv teknologi, og hvordan håndteres teknologien av etablerte virksomheter?

Hvilke aspekter av forretningsmodeller påvirkes av blockchain-teknologien, og hvordan vil dette føre til et nytt spekter av muligheter?

For å avdekke blockchains effekt på forretningsmodeller har vi analysert funn i gjennomførte intervjuer i lys av Osterwalder´s teori om forretningsmodeller. Avhandlingen viser at blockchain delvis kan betraktes som en disruptiv teknologi. Blockchain påvirker alle dimensjonene av Osterwalder´s forretningsmodell. Den største påvirkningen er blockchains evne til å endre på maktstrukturer mellom produsenter og brukere. Blockchain muliggjør digitalt eierskap, og gir brukerne større muligheter til å ta del i verdiproduksjonen av produkter og tjenester. Osterwalder´s «Business Model Canvas» har gjennom studien vist seg å være et utilstrekkelig verktøy for å bygge forretningsmodeller basert på blockchain. Dette antas å være en konsekvens av at verktøyet er fokusert på sentraliserte forretningsmodeller, mens forretningsmodeller basert på blockchain krever fokus på økosystemet den omhandler.

Stikkord for bibliotek: Blockchain, business models, disruptive innovation, business model innovation, disruptive business models

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Summary:

Blockchain is a distributed database technology that enables digital ownership, and transaction of values through facilitating trust for its users. In this study incumbent company efforts to commercialize blockchain has been investigated through an exploratory design with the following research questions.

Is blockchain a disruptive technology, and how is the technology handled by the incumbents?

What aspects of the business model are affected by blockchain technology and how will this lead to a new specter of opportunities?

To unveil blockchains effect on business models, the findings in the conducted interviews has been analyzed in light of Osterwalder´s theory on business models. The thesis shows that blockchain partially can be considered a disruptive technology. Further, blockchain affect all dimensions of Osterwalder´s business model framework. The most significant affect is blockchains ability to change the power structures between producers and users. Blockchain enables digital ownership, and empowers its users by involving them in the value production of products and services. The Business Model Canvas has through the study proved to be an insufficient tool for constructing blockchain business models. The authors of this study believe this is a consequence of the tool being focused on centralized business models, whereas blockchain businesses require an ecosystem focused business model.

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"You never change things by fighting the existing reality. To change something, build a new model that makes the existing model obsolete."

- Buckminster Fuller

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1 INTRODUCTION

Introduced by the pseudonym of Satoshi Nakamoto in 2008, Bitcoin was presented as a digital payment system that could solve the double spending problem of today's digital cash systems. Bitcoin was constructed by combining several well-known technologies. Together these technologies formed a completely new technology, known as blockchain. The blockchain technology enabled direct transactions between its users and removed the need for intermediaries, such as banks, to act as a trusted partner between them. Blockchains ability to transfer value and to enable trust led to expectations that it will disrupt not only the financial industry, but other industries as well.

Fast forward to August 2017, the technology consultancy and research company Gartner released the *"2017 Gartner Hype Cycle report"* (Appendices I: Gartner's Hype Curve). This is an annual report predicting the technology trends and their expected time to become mainstream. This report has been proved remarkably accurate over its 20 years of existence. Gartner researches a lot of emerging technologies and the most promising ones get included in the study on their hype curve. In 2017 blockchain technology found itself at the end of the second stage, the *"peak of inflated expectations"*, the phase where the hype is at its greatest and expectations and reality are the furthest apart. The Gartner report expects blockchain to become mainstream technology within five to ten years. Further, Gartner stated that in the near future digital platforms will enable companies to go from compartmentalized infrastructures to ecosystem-based infrastructures. The consequences of such a radically technological shift are completely new business models that bridge humans and technology closer together (Walker, 2017).

Through the work conducted in a pre-study on blockchain in the autumn of 2017 we can confirm some of Gartner's statements: many incumbent companies and start-ups have released whitepapers where they reveal idealistic, grand plans for

the usage of blockchain technology and its potential for disruption (Hoff et al., 2017). However, most of these plans are still in the research phase or the proof-of-concept stage. In this study, we will further investigate incumbent company efforts to commercialize blockchain technology: how far they have come, how they work to exploit it and how it will affect their business models. Through a literature search we can conclude that the topic of blockchain´s effect on business models has not been thoroughly explored (Appendices II Previous research on the field and gaps in the literature)

1.1 Research question

Based on the above we have chosen the theme "Blockchain Business models" with the following research questions:

> *RQ1: Is blockchain a disruptive technology, and how is the technology handled by the incumbents?*

Disruptive innovations are known for completely changing "the rules of the game" within the industries it disrupts. Therefore, we wish to assess whether blockchain is a disruptive technology or not in line with the theoretical definitions of the subject. Further, we will explore how incumbent companies work to commercialize this technology, and how they handle the technology in relation to their existing business model.

> *RQ2: What aspects of the business model are affected by blockchain technology and how will this lead to a new specter of opportunities?*

To determine the effect on business models we will discuss the technology´s attributes, and how they can be used to create new opportunities. This discussion will be based on a theoretical framework for business models.

1.2 Thesis structure

Chapter 2 provide the theoretical framework for this thesis. Firstly, we will provide a presentation of theory on business models. At the end of this subsection, we will present our choice of framework for describing business models. Following this, blockchain technology is presented, what it is, how it is constructed and how it works. The presentation of blockchain is divided into subsections. First, we will present an overview of the concept of blockchain in an easy matter. Following the overview, we will dive more technically into its different components. At Last, we will describe the different types of blockchain based on their architectural design. The last section of chapter 2 present theory of disruptive innovation, how and when blockchain technology can be seen as a disruptive innovation.

Chapter 3 provides a description of the research design and methodology chosen to conduct the study as well as a presentation of the cases in this study.

In Chapter 4 the research questions are analyzed and the findings are discussed. First, we will discuss how incumbents work with blockchain technology based on their choice in blockchain architecture. Thereafter, we will evaluate blockchain technology in relation to disruptive innovation theory and conclude if blockchain can be viewed upon as a disruptive technology. Finally, a we will present how incumbent companies work with blockchain technology in relation to their existing business model.

In chapter 5 we will conclude on our findings, and lastly, in chapter 6, the weaknesses of the study, future work and position in literature will be discussed.

2 THEORY

This chapter will provide a theoretical framework based on the theme of the thesis and the constructed research questions; business models, blockchain technology, and disruptive innovation. The presented theories will later on be used as tools for describing findings in the analysis.

2.1 Business models

The purpose of this chapter is to examine the concept of business models and what the concept comprises of by reviewing research on the subject. From the theoretical findings in this chapter we will choose a framework for business models which will be used to determine blockchains effect on business models.

In recent years, business models have gained a lot of attention by both academic researchers and industry practitioners (Zott et al., 2011, Wirtz et al., 2016, Osterwalder et al., 2005, Dasilva and Trkman, 2014). Although the field of business models has developed substantially in recent years, researchers have not managed to develop a commonly accepted language and definition that captures the concept of business models (Zott et al., 2011). In the academic paper "The Business Model: Recent Developments and Future Research" Zott et al. (2011) argues that this is partly caused by researchers adopting definitions distinctive to the purpose of their own studies. Consequentially, the research is developing in silos. However, there are some similarities between the different research perspectives on business models: 1) even though the business model has a focal focus in the business, its boundaries goes beyond those of the firm; 2) business models explain how companies do business in a holistic way; 3) the activities of the focal company and its partners is a central part of the business model; 4) in addition to value creation, business models also explain value capture (Zott et al., 2011).

In the study "Business Models: Origin, Development and Future Research Perspectives" business model is defined as *"a simplified and aggregated representation of the relevant activities of a company"* (Wirtz et al., 2016, p. 41). Further, they suggest that a business model consists of three main categories of components: strategic components, customer and market components, and value creation components. The main categories are divided into subcategories. The strategic components are strategy model, recourse model and network model. The customer and market components consist of customer model, market offer model, and revenue model. The value creation components consist of a manufacturing model, a procurement model and a financial model. Although the components in the business model are presented as separate units, they should be viewed as interrelated. Wirtz et al. (2016) emphasize that especially the strategic components could be seen as a linkage between the Customer and market components, and the Value creation components.

Dasilva and Trkman (2014) argue that business models and strategy should be held separate and not be mixed. In their opinion, business models focus on short-term consequences, while strategy has a focus on long-term consequences. In other words, it is the company´s strategy that enables it to develop capabilities that can change their business models. Therefore, a business model does not provide strategic insight but instead *"it paints a picture of the company and reveals how the various elements of the business work together at a certain moment in time"* (Dasilva and Trkman, 2014, p. 386). This argument builds on work by Casadesus-Masanell and Ricart (2010) who states that *"business models are reflections of the realized strategy."*

Osterwalder also distinguish business models from strategy (Osterwalder, 2004, Osterwalder et al., 2005). It is argued that even though execution, implementation and competition are integral parts of a successful business model, these aspects are part of the business strategy, not the business plan. The business plan should be seen as a plan for how to design and realize the business logic. Thereby, *"the business model can be seen as the conceptual link between strategy, business organization, and systems"* (Osterwalder et al., 2005, p. 10). Osterwalder defines a business model as follows:

> "*A business model is a conceptual tool that contains a set of elements and their relationships and allows expressing a company's logic of earning money. It is a description of the value a company offers to one or several segments of customers and the architecture of the firm and its network of partners for creating, marketing and delivering this value and relationship capital, in order to generate profitable and sustainable revenue streams." (Osterwalder, 2004, p. 15).*

In this definition, Osterwalder states that a business model is a tool for explaining how a business makes money, what product or service the business offers its customers, how the value is offered to its customers, and what infrastructure is needed to be able to deliver this value to its customer. Osterwalder´s definition of business models is influenced by Kaplan and Norton (1992) and the work that lead to the balanced scorecard approach (Osterwalder, 2004, Keane et al., 2018). His business model concept has four dimensions (Table 1). Product: What industry does the business operate in, and what is their value proposition to the market?; Customer interface: Who are the customers, how do they deliver value to them and build and maintain a relationship with them?; Infrastructure management: What infrastructure is needed to deliver value to its customers?; Financial aspects: What are the costs related to the business and how will it price its products or services to attain revenue?

Table 1 : Description of the building blocks in the business model canvas (Osterwalder et al., 2010) (Osterwalder, 2004)

Dimension	Building block in business model canvas	Description
Product	Value proposition	The value proposition is a clear way of describing what problems, pains and needs the enterprise solve for its customers.
Customer interface	Customer segments	The customer segments block describes who the enterprise aims to reach.
	Channels	How an enterprise reaches and communicates with its customers is described by the channels
	Customer relationships	Customer Relationships describes what kind of relationship an enterprise has with its customers.
Infrastructure management	Key activities	The key activities are crucial activities an enterprise need to do in order to able to offer their value proposition, earn revenues and reach markets.
	Key resources	The key resources describe the most important resources for creating the product or service that is being offered.
	Key partners	The key partners show who the business can cooperate with to perform the value creation
Financial aspects	Cost Structure	When the business models infrastructure, activities, recourses and customer relationship has been mapped it is possible to calculate the cost structure.
	Revenue streams	The revenue streams describe how a product is priced to make customers willing to pay for the product or service.

The four dimensions are further divided into nine sub-categories of interrelated building blocks affecting a business model (table 1). These nine building blocks have in later studies been structured into one canvas forming what today is known as the Business model canvas (Osterwalder et al., 2010), Figure 1.

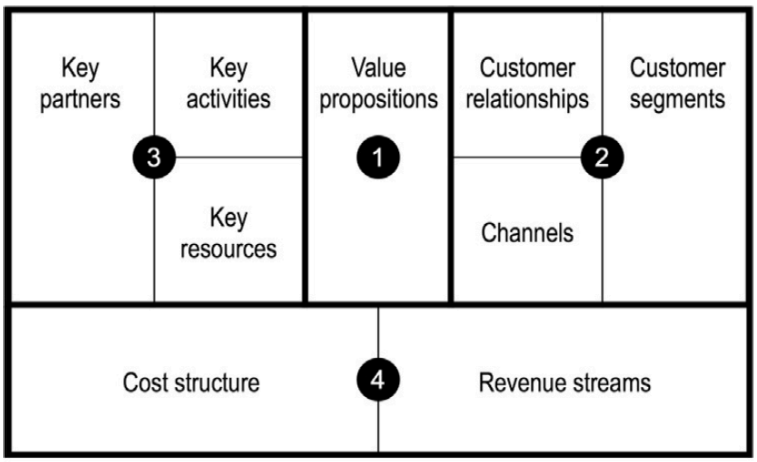


Figure 1: The four dimensions of a business model mapped in a business model canvas. Adapted from (Osterwalder, 2004; Osterwalder et al., 2010) Source: (Keane et al., 2018).

The Business Model Canvas (from here-on referred to as the BMC) has gained a lot of traction and is arguably one of the most known and commonly used tools for modeling, designing and analyzing business models. The blocks are filled out with short, informative texts, often in the form of "post-it" notes, which makes it easier to describe the business model. The BMC is an agile tool made to be used iteratively to discover challenges and opportunities, making it possible to render and change the business model as the company evolves. After creating the BMC, Osterwalder´s definition of a business model was modified accordingly: "*A business model describes the rationale of how an organization creates, delivers and captures value"(Osterwalder et al., 2010, p. 14).* As previously described the BMC makes it possible to describe how companies "do business". In other words, this updated definition of a business model is complimented by the content in the BMC.

Summarized we see that research on business models have been developing in silos. The consequence of this is a variety of definitions and a lack of commonly accepted language regarding business models. However, there are some underlying similarities between the different views and opinions. Researchers differ in their opinions about the relationship between business models and strategy. Osterwalder (2004) argues that a business model has four dimensions. Based on these four dimensions he has developed a tool consisting of nine different, but interrelated building blocks for describing business models. This tool is known as the business model canvas and is arguably the most known tool used for constructing business models.

2.1.1 Choice of framework

The blockchain technology (Chapter 0) and the cases in this study (Chapter 3.5) are still in early stages of development. The concept of a business strategy and its content has not been properly discussed, nor is it an area we want to look further into in our thesis. Osterwalder´s BMC and its content is a fairly known framework for business models that we are familiar with. His concept of business models does not include strategy. Based on these conditions we have decided to use Osterwalder´s four dimensional concept and the BMC as a framework to answer the research question of blockchain technology´s effect on business models.

2.2 Blockchain

In the following chapters, we will explain what blockchain technology is and how it works. First, we will give a general overview of the technology and its purpose. In later subsections, we will go more into detail of how the different components of the technology work. We will also present how blockchain can have different architectures. It is important to understand how the technology works to be able to understand its business opportunities. Similarly, the construction of the blockchain architecture is important for business opportunities. Both technology and architecture will be important elements of the analysis and discussion.

2.2.1 Overview

At its core, blockchain is a shared database that allows its users to transact and trade assets such as money, information, and other values in a way that assures that nobody can interfere with or forge the transactions and/or ownership of these assets. In other words, blockchain is a technology that can facilitate trust for its users.

All users of a blockchain run the same software on their computer, together they form a distributed and decentralized network which has no central owner. Each transaction is publicly announced to the network of computers. The computers that run the system are incentivized to validate the authenticity of the transactions. The transactions that are verified and approved will be stored in a bundle of other approved transactions. This bundle of information is known as a block. The blocks are stored chronologically, forming a chain of blocks, thereby the name blockchain. The blockchain is a ledger that contains information about ownership, which makes it possible for all participants in the network to agree on who owns what.

To ensure safety of the system, blockchain utilizes a form of mathematics called cryptography. Cryptography makes sure that only the owner of a specific asset is able to use them in a transaction. The cryptography also ensures that nobody can to change the content of the ledger and cheat the system. If someone wants to the change the content of a block, they need to change the content of all previous blocks. Consequentially, it is almost impossible to cheat the system. A graphic presentation of the steps in a blockchain transaction can be viewed in Figure 2.

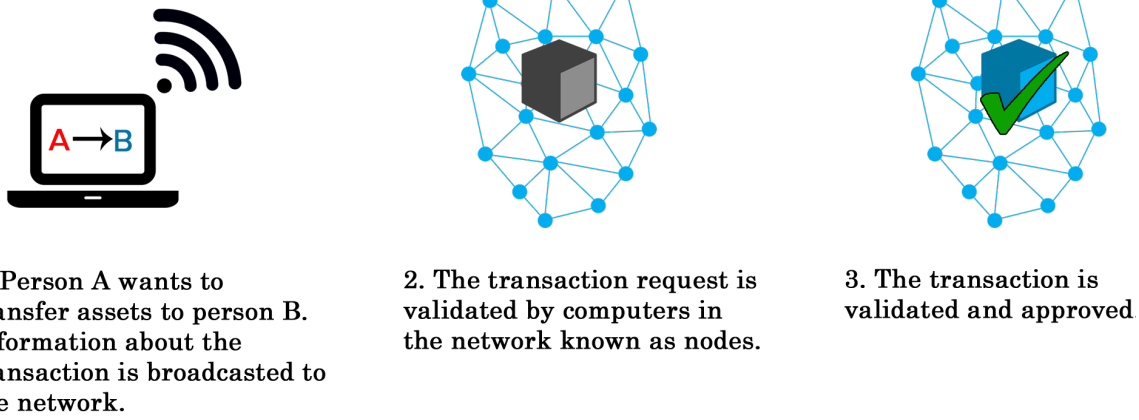


Figure 2: A simplified explanation of a blockchain transaction (based on (PWC))

2.2.2 Cryptography

Cryptography is the science of linguistics and mathematics, the techniques are used to ensure that information aren't tampered, modified or accessed without permission (Ogiela and Ogiela, 2010).

2.2.2.1 Asymmetric cryptography

Asymmetric cryptography is a way of encrypting and decrypting data by using two keys that are different but connected: a private and a public key. Blockchain uses asymmetric cryptography to be able to verify and approve transactions while keeping the identities of the users safe. Because the identities of the users are kept safe, it is possible to announce all the transactions publicly on the ledger. Every user in the network has both a private key and a public key. Only the user has access to the private key, but the public key is available to the whole network (Fielder and Light, 2015). One of the keys encrypts the message, while the other key decrypts it (Drescher, 2017). As seen in Figure 3 below, the white key is used to encrypt the message, while the black key is used to decrypt the message.

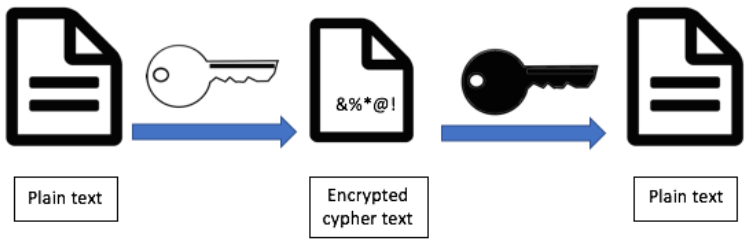


Figure 3: Illustration of encryption and decryption using the private and public keys (Hoff et al., 2017)

The cryptography in blockchain serves three main purposes:

1. Identifying the send-to address.
2. Ensuring that nobody can send messages from other user´s accounts.
3. Verifying that the sender has the funds he is sending.

2.2.2.2 Identifying the send to address

When the sender announces to the network that he is sending money to an account, the recipients public key serves as his or hers send-to address (Karlsson Lundström et al., 2016).

2.2.2.3 Ensuring that nobody can send messages from other user´s accounts

The use of asymmetric cryptography ensures that nobody, but the user, can create messages from his account. To show how this is ensured we use a general example of a message that is encrypted and sent, Figure 4. The message contains two elements: the message itself and an encrypted, signed version of this message. The transformation of a string value (the original message) to a string value with a predefined length (grey circle) is called hashing. The string value in the grey circle is called a hash value. This transformation is performed using a mathematical function called a hash function (Silva, 2003). To create the encrypted, signed message, the sender first creates a hash value of the original message (grey circle). The hash value is then signed with the private key to produce the encrypted, signed message in the black box as shown in Figure 4.

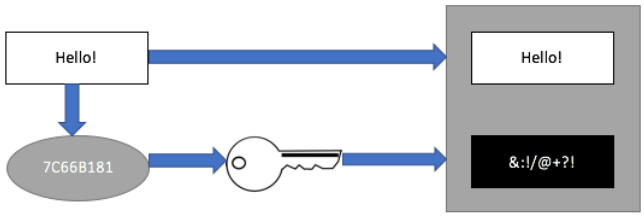


Figure 4: Creation of a digital signature (Hoff et al., 2017)

To verify that the transaction was in fact sent from the sender, the recipient of the message first creates a hash value of the message, Figure 5. He then uses the sender´s public key to decrypt the encrypted, signed message. If the two hash values correspond the conclusion is that the sender did, in fact, send the message and the transaction is approved. In other words, approval of the digital signature (Drescher, 2017), see Figure 5. The process makes the network able to verify the authenticity of the message, without the sender having to reveal his identity.

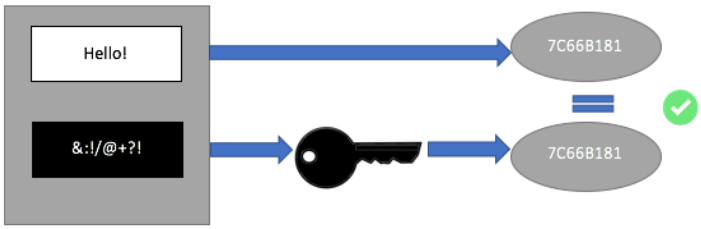


Figure 5: Verification of a transaction (Hoff et al., 2017)

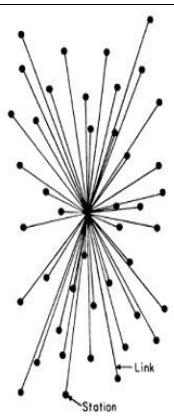
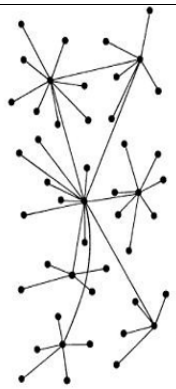
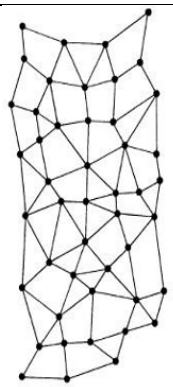
2.2.2.4 Verifying that the sender has the funds he is sending

Unlike physical money, the values that are sent in blockchain are intangible. Blockchain utilizes transaction history to verify that a sender has the funds he is sending. The first step in making a transaction is creating a hash value of this transaction. This hash value serves as a transaction record for the assets that are being sent. When signing the hash value, you verify your intent to transact these assets. Since all transactions are publicly announced, the network is able to tell if you were the last owner of these assets or if you have already sent them to somebody, in an attempt to double spend (Khan-Academy, 2013).

2.2.3 Distributed Network

Blockchain in its unaltered form is a distributed ledger (database), with a decentralized consensus process, in contrary to a centralized system (banks etc.) where all transactions go through an intermediate which makes the system vulnerable for attacks, see Table 2 (Nakamoto, 2008).

Table 2 Centralized, Decentralized and Distributed network (Goyal, 2017, Hoyt, 2018)

Illustration			
	Centralized	Decentralized	Distributed
Point of failure/ attack resistance	Single	Finite	Difficult
Fault Tolerance	Highly unstable	Split into many	Very stable
Scalability/Max. population	Low scalability	Moderate	Infinite
Ease of development	Fast	Up front cost	Up front cost
Evolution / Diversity	Evolve slowly	Tremendous	Tremendous

Buterin (2017) lists three main benefits for a decentralized system.

1. Fault tolerance – **"***decentralized systems are less likely to fail accidentally because they rely on many separate components that are not likely."*
2. Attack resistance – *"decentralized systems are more expensive to attack and destroy or manipulate."*
3. Collusion resistance – **"***in decentralized systems it is much harder for participants to collude to act in ways that benefit them at the expense of other participants."*

2.2.4 Consensus

Consensus can be explained as generally accepted agreement about an opinion or decision among a group of individuals (Tranøy, 2017). Distributed Consensus means that all nodes in the system use identical history of data to decide which ledger that represents the truth (Drescher, 2017). Distributed consensus secure that everyone has the same truth, what I see is the same as what you see. There are two main types of consensus processes, permissioned or permission-less. In a permissioned consensus process, only selected entities are allowed participate, and opposite in a permission-less where anyone can contribute to the process.

2.2.4.1 Consensus algorithms

> *"A consensus algorithm is a process in computer science used to achieve agreement on a single data value among distributed processes or systems. Consensus algorithms are designed to achieve reliability in a network involving multiple unreliable nodes."* (Rouse, 2017).

There are many different consensus algorithms, the choice is often determent by the architecture of the blockchain; public, private or consortium. But they all have one main purpose *"… ensures that the next block in a blockchain is the one and only version of the truth* (Castor, 2017)." Since the consensus algorithms incentive the users in the network to agree upon one version of the truth, it solves the double spending problem: *«On a blockchain the double spending problem is solved by publicly announcing the transaction to all miners in the blockchain such that all miners verify all transactions».* (Hua and Notland, 2016). The different consensus algorithms all have there "pros and cons", some use vast amount of computational power and electricity, while other algorithms use almost none, and the security varies depending on how the blockchain network is set up.

The most known type of consensus algorithm in relation to blockchain technology is proof of work, which is used in the cryptocurrency Bitcoin. "*In proof of work, miners compete to add the next block (a set of transactions) in the chain by racing to solve a extremely difficult cryptographic puzzle..."(Castor, 2017).* The "puzzle" is extremely difficult to solve, but at the same time, it is easy for the other nodes on the network to verify the solution (Blockchainhub, 2017). The miners invest electricity and special mining computers in processing the consensus algorithm proof of work. As a reward for solving the "puzzle", the miners get rewarded with lottery tickets. The bigger investment in electricity and computational power the more tickets for the lottery. The price in this lottery is new Bitcoins and transaction fees from recent transactions (bitcoin-dev and Blitzboom, 2017). Proof-of-work provides security to the network. The cost to disrupt the network scales with the amount of computational power and electricity spent by all participants (Antonopoulos, 2017). You can´t hack the system unless you provide enough computational power to get consensus amongst more than 51% of the network, which means that you must simultaneously hack 51% of the computers in the network or provide more computational power. This makes the system more or less unhackable (Drescher, 2017).

2.2.5 Different types of blockchains

Blockchains comes in many forms, but one of the fundamental aspects with blockchain is that there is always a network of nodes (computers/actors) participating in the network. A blockchain is often distinguished between three different types: private, public and a consortium. They have many similarities, but the difference lies in who is allowed to participate in the network, how the agreement of truth (consensus) is established, and the maintenance of the ledger. In blockchain the network of nodes is also called peer-to-peer system.

> "*Peer-to-peer systems are distributed software systems that consists of nodes (individual computers), which make their computational resources directly available to another (Drescher, 2017, p.33).*"

The advantage of a peer-to-peer system is that it allows users to interact with each other directly. Peer-to-peer system replaces the intermediate, reduce cost and increase the speed of the system. The members can interact with each other without having central coordination. The relation between a peer-to-peer system and blockchain is that the system uses blockchain as a tool to achieve and maintain integrity (Drescher, 2017).

2.2.5.1 Public blockchain

In a public blockchain anyone is allowed to participate, anyone can send transactions and participate in the consensus process. The ledger is publicly available to all participants, which means that everyone in the network has the same information at all times (Jayachandran, 2017). Public blockchain benefits from disintermediation, due to the architecture of peer-to-peer network were the central actor in the middle is removed. Most crypto currencies in the blockchain sphere are built as public blockchains, they draw the benefits of value transaction without going through a bank, and thereby have lower transaction costs.

2.2.5.2 Private blockchain

In a private blockchain you need an invitation and a validation from the other participators in the network to be accepted as a part of the private blockchain. The user is typically restricted to only certain transactions and does not have access to transactions where the individual or organization is not involved. The rules for participation, consensus, and restrictions to the ledger may vary from each private blockchain (Jayachandran, 2017). In a private blockchain write permission are normally centralized and kept to one organization, while the read permission can be either public or restricted to selected participators (Buterin, 2015).

2.2.5.3 Consortium blockchain

A consortium blockchain is a constellation of participators that have pre-selected a set of nodes that control the consensus process, illustrated with red nodes in Figure 6. A consortium blockchain is a hybrid of a public and a private blockchain, that utilizes the benefits from both. A consortium makes it possible to restrict rights to certain users, such as write and read possibilities. Consortium blockchains can be considered as partially decentralized, which gives the advantage of providing multiple defaults for the transaction process (Buterin, 2015).

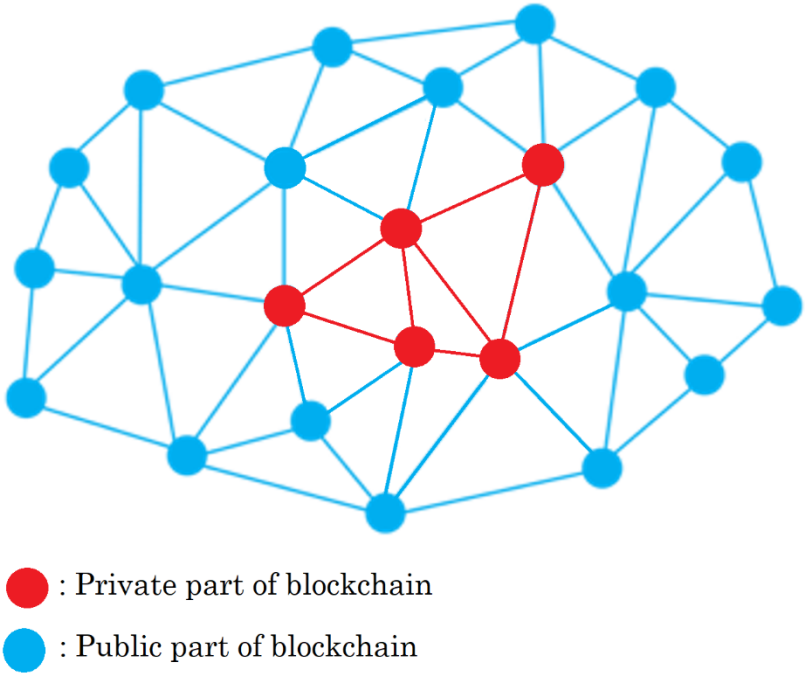


Figure 6: Illustration of Consortium blockchain

Summarized, blockchain can be explained as a shared database that allows its users to have digital ownership of assets, and to transact and trade assets without the need for intermediaries. In other words, blockchain is a technology that can facilitate trust for its users. Blockchain is able to provide this functionality by utilizing known technologies like cryptography, a distributed and decentralized network, and consensus algorithms. Depending on its purpose, blockchain can have different architectures.

Based on the theory presented, we have categorized blockchain attributes into three different categories: blockchains ability to facilitate trust, its ability to provide digital ownership, and the network effects that comes from the distributed network. We have named these categories: Trust, Internet of value, and Network. Further, we will use these three categories as a framework in the analysis and discussion when answering the second research question of how blockchain affects business models.

2.3 Disruptive Innovation

In order to explain if blockchain can be seen as a disruptive innovation this chapter will clarify the concept of disruptive innovation, by first presenting the evolution of disruptive innovation theory. We want to explain if blockchain is disruptive or not, and to subsequently explain the link between a disruptive innovation and the affect it will have on business models. The theoretical findings will further be used in the analyses to discuss if blockchain technology can be seen as a disruptive innovation, and if so, how this will affect business models.

The term disruptive innovation was introduced by Clayton Christensen in the article *"Disruptive technologies: Catching the wave"* (Bower and Christensen, 1995), and has later been popularized through his works "*The Innovator's Dilemma" (Christensen, 2016) and "The Innovators' Solution" (Christensen and Raynor, 2004).* According to Yu and Hang (2010) the theory around disruptive innovation has its origin from Schumpeter in 1942, and have evolved through time, Figure 7. "*Discontinuous innovation"* was extensively used before academia embraced the term *"disruptive technology*." Even though the two terms are very similar, discontinuous is a weaker and less tangible qualifier than disruptive, which might be a reason to why disruptive gained popularity within some fields.

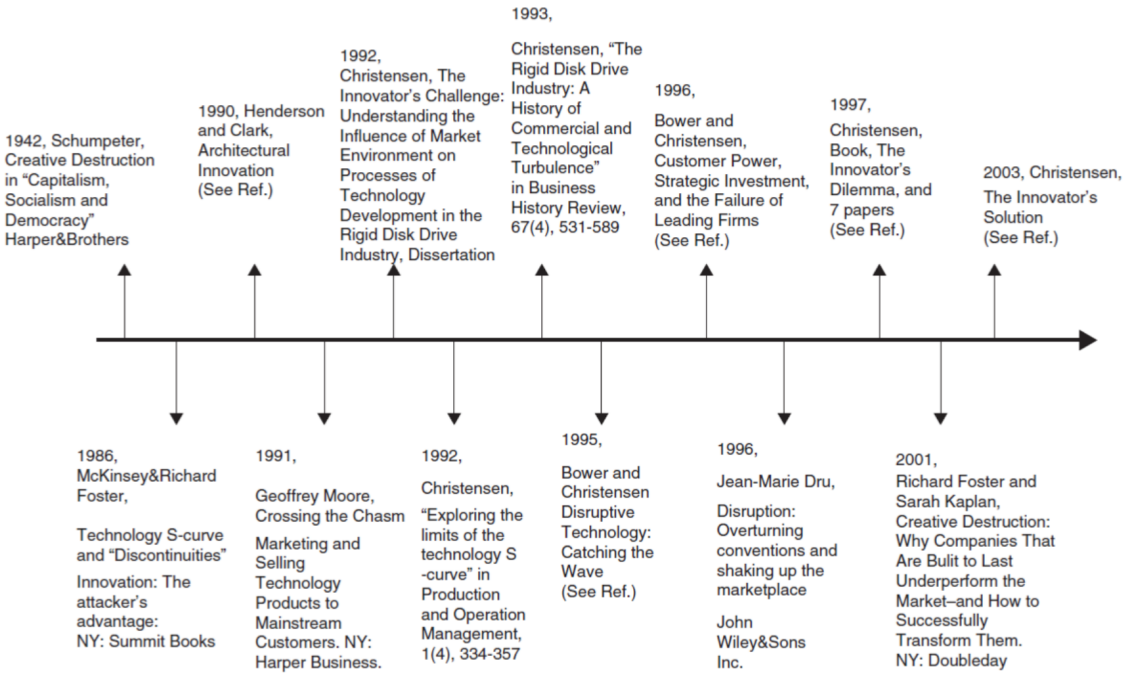


Figure 7: Timeline of evolution of Disruptive Innovation Theory (Yu and Hang, 2010)

In the article "Catching the Wave" Bower and Christensen (1995) state that when a market or technology is changing, a consisting pattern of failure appears for businesses to maintain their position at the top of their industry. Further, the authors discuss the difference between sustaining and disruptive technology. Sustaining technologies are seen as the markets expected evolution of a product that is already appreciated and in use. Disruptive technology however, introduces a very different set of attributes from the ones the mainstream customer historically value. A disruptive technology tends to perform significantly worse on one or two attributes that are important to the customers.

2.3.1 Low-end or new-market footholds

Christensen et al. (2015) also introduces the terms low-end and new market footholds. Low-end footholds exist because incumbent companies have their focus on the most profitable and demanding costumers, thereby they pay less attention to the low-end market where a disruptive innovation can gain popularity. New-market footholds are as simple as it sounds, a new market that has not previously been attended to *(Christensen et al., 2015)*.

> *"As a rule, mainstream customers are unwilling to use a disruptive product in applications they know and understand. At first, then, disruptive technologies tend to be used and valued only in new markets or new applications; in fact, they generally make possible the emergence of new markets"(Bower and Christensen, 1995, page 45).*

According to Bower and Christensen, a customer is unwilling to replace a known product with a disruptive one. They argue that a customer does not see it as a substitute for the product they use today. An example of this is Sony's early transistor radio which sacrificed sound fidelity, but gained other attributes, such as lower weight and size reduction. The new product did not replace the old stationary radio with high sound fidelity, but a new market arose for portable transistor radios (Bower and Christensen, 1995). Whereas the sustaining technology innovation is an improvement of an existing product, the disruptive technologies, bring a new and different value proposition to the market. In the initiation, the disruptive technology can be inferior to other established products in the market, but they also bring new customer values, such as being cheaper, more practical or smaller/bigger, etc.

Products that do not seem to be relevant to customers today (disruptive technologies), might squarely address their needs tomorrow. To improve profitability and continue to be successful, management of the resource allocation process is pointed out as utterly important. Keeping resources focused on innovations and needs that do not appear to be financially attractive today, might be the biggest challenge for managers. Established organizations struggle to face this challenge due to their existing business model. Smaller businesses and start-up are agiler and have a quicker decision-making process, and they have inexpensive forays into the product and market. Companies that have used the strategy to bend/alter disruptive technology to fit their current customers, rather than to find a new market or customer segment for the technology, are according to history almost sure to fail. *"Disruptive technology should be framed as a marketing challenge, not a technological one" (Christensen, 2016 , page 173).*

2.3.2 Disruptive business model innovations

Christensen´s contribution to disruptive innovation theory can be summarized to a fundamental statement for business model innovation; implementation of a disruptive innovation in an established business often causes a conflict with the existing business model, and is not the business model that would make the disruptive innovation flourish (Bower and Christensen, 1995, Christensen, 2016, Christensen and Raynor, 2004, Christensen et al., 2015). Chesbrough (2010) further confirms this statement in the article *Business model innovation: Opportunities and Barriers*

> *"the root of tension [is] the conflict between the business model established for the existing technology, and that required to exploit the emerging, disruptive technology (Chesbrough, 2010, page 358)".*

When facing a disruptive innovation, changing the business model to fit the innovation is likely a more successful solution rather than trying to implement the disruptive innovation in ones existing business model. A new business model sometimes has a more disruptive effect than the innovation itself (Sabatier et al., 2012). In Markides (1997) article *Strategic Innovation*, he states that *"The trick is not to play the game better than the competition but to develop and play an altogether different game (Markides, 1997, page 12)".*

2.3.3 A widening perspective of disruptive innovation theory

Christensen's framework is generally accepted amongst academics, and the term disruptive innovation is widely spread and is extensively used amongst business people and scholars from all over the world. Over the last few decades, other researchers have supplemented theory in the field of disruptive innovation or argued about definitions or research result. In this chapter, we aim to widen the disruptive innovation theory by presenting other contributors within the field.

Adner (2002) did a deeper dive into competitive dynamics and the drivers for disruptive innovation, the study focused on the underlying drivers of technology innovation. He stated that:

> "*By examining how consumers evaluate technology and how this evaluation changes as performance improves, it offers new theoretical insight into the impact of the structure of the demand environment on competitive dynamics" (Adner, 2002, page 667-668).*

Adner's presented a mathematical model that showed a correlation between the technical progression and change in customer demand, in relation to the phenomenon of disruptive technologies. Christensen's work introduces disruptive innovations in low-end and new markets segments. Govindarajan and Kopalle (2006) offer a third possibility; they introduced the term high-end disruption, which has better attributes and a higher price.

Danneels (2004) wrote the article "*Disruptive Technology Reconsidered: A Critique and Research Agenda"* where he challenges some of Christensen's work. Danneels disapproves that Christensen only committed research on successful ex-post examples and made ex-ante predictions, by claiming:

> "*One simple approach of course would be to extrapolate the historical performance trends toward the future. This may be very difficult in the case of very young technologies, or new markets, for which very little historical data exist and for which future evolution is uncertain" (Danneels, 2004, p 251).*

In *The Innovator´s Dilemma* Christensen (2016) discuss the strategic choice to focus on technology that does not seems relevant today, do not fit your customer segment, or is not adaptable to the current business model. Schmidt and Druehl (2008) argue that Christensen's term of disruptive innovation does not always fit

or is accurate enough. Schmidt and Druehl (2008) contributed with a framework to determine the impact of the disruptive innovation on incumbents. The term encroachment was introduced in the disruptive theory, explaining how new products cannibalized existing ones. The framework present three different types encroachment from of low-end encroachment towards high-end, it is divided into three categories; *the fringe-market, detached-market, and immediate scenarios.* Schmidt and Druehl (2008) substantiate that disruptive innovation can, in fact, disrupt the market but does not always displace it.

In summary; a disruptive technology introduces a very different set of attributes from the ones the mainstream customer historically value, and it brings a new and different value proposition to the market. A disruptive technology often gains position in low-end and new market footholds since incumbents often pay less attention to those markets. At its infancy a disruptive technology can be inferior to other established products in the market, but they also bring new customer values, such as being cheaper or faster. Because of this the customer is unwilling to replace a known product with a disruptive one. As the technology develops it gains position in the market and causes disruption. A disruptive innovation can often be in direct conflict with established business models. Changing the business model to fit the innovation is likely a more successful solution than try to implement the disruptive innovation in ones existing business model. A new business model sometimes has a more disruptive effect than the innovation itself.

3 RESEARCH DESIGN AND METHODOLOGY

This chapter describes the research methodology of this study, as well as the background for the choices that have been made in the process. Initially, the research design is will be explained and reasoned. Further, our choice of case study is discussed. Thereafter, we will explain our data collection, and the validity and reliability of the thesis. And lastly, we will present our chosen cases.

3.1 Research design

Initially, we had a plan to do a comparative case study of two international incumbents. Unfortunately, one of the two incumbents had strict none disclosure agreements for their employees, which led us to the conclusion that we would not get enough data material to conduct the devised study. On the contrary to the first incumbent, the second incumbent opened their doors and invited us to do a participant-observation study of a Nordic blockchain initiative they were developing. We welcomed this opportunity and changed our research design. In order to have comparable material for the study we reached out to the biggest blockchain initiatives in the Nordic region, five of them accepted participation in our study. We changed from a comparative study of two incumbents to a multiple case study.

The rationale for a case study is to attain in-depth knowledge of one, or a small number of individuals, organizations or events, generally over time (Easterby-Smith et al., 2015). Yin (2014) explains when research questions are in the form of "how" and "why" the case study approach is the most appropriate methodology to choose. Since both our research question include "how" the form of a case study was suitable.

According to Saunders et al. (2016), it is common to divide research design into three different studies; exploratory, descriptive and explanatory. Since we wanted to clarify our understanding of blockchain and its effect on business model innovation we chose an exploratory research design in this study. Saunders writes "*An exploratory study is a valuable means to ask open questions to discover what is happening and gain insights about a topic of interest.*" (Saunders et al., 2016, page.174). The subject we studied is rather unknown and complex, which leads to an open and flexible approach. Exploratory research was therefore considered to be most appropriate. The exploratory approach allowed us to commence with a broad focus before narrowing down as the research progressed (Saunders et al., 2016). The use of qualitative approach leads to many benefits for both data collection and analysis. For example, a qualitative approach makes it possible to use multiple data sources, such as written records, interviews and observations (Easterby-Smith et al., 2015). For the empiric part we used a triangulating design for the data collection, where our primary data were participant-observation and interviews and our secondary data was document analysis.

3.2 Selection of cases

There are a few common denominators for the cases selected in this study: (1) The blockchain initiative is within an industry incumbent. (2) The blockchain initiative is initiated or have participants from a Nordic country. (3) The blockchain initiative is in a development phase, or less than two years old. This is of utmost importance, due to the study has a retro perspective approach. If we had chosen older initiatives there would be a bigger risk that the informants would have forgotten details or other significant information about the development process.

3.3 Data collection

Table 3 Data collection sources

Data source	Primary data	Secondary data
Interviews	Interviews with key personnel on the blockchain projects	
Participant-observation	Working directly with developing a business model in a blockchain project	
Documents and audio/video media		Public use files: White papers Articles, literature, blogpost, video lectures, academic papers and reports.

Table 3 shows an overview of the data collection in the present thesis. Interviews and participant-observation were used for primary data, and documents and audio/video media for secondary data.

3.3.1 Primary data

In total we conducted five interviews and logged 315 hours of participant-observation studies.

We executed a qualitative data collection in the form of semi-structured interviews. A qualitative interview is a direct conversation about questions and answers within a specific subject (Lofland and Lofland, 2006). Our interview differs from an everyday conversation in the sense that we have a certain number of questions written in an interview guide (Appendice III).

To get a clear picture of the interviewer's perspective on our research problem, we were open to adjusting the questions. In addition, we followed new clues if something new or interesting came up during the interview. Simultaneously, we focused on the original purpose of the study. We used a combination of open and closed questions as well as "laddering up" and "laddering down" techniques during the interview (Yin, 2014).

The purpose of the interview was to get a deeper understanding of how incumbent work with developing business models based on blockchain technology and the effect it has on business model innovation. To get relevant data from the interviews, we built the interview guide based on theory from Osterwalder´s four dimensions of a business model and their associated nine building blocks from the business model canvas (Osterwalder, 2004, Osterwalder et al., 2010). Of the five interviews, two was executed face to face in Oslo and Dublin, the rest was completed over Skype. All interviews were recorded on approval of the interviewee, then transcribed, coded and analyzed.

The informants were selected based on a strategic selection, by focusing on qualifications that suited the problems of the thesis (Thagaard, 2013). The informants all were directly involved with the blockchain cases selected for this thesis, most of the informant had a management role within the blockchain project. The background varied from law and technology to business, but they all had an in-depth knowledge of blockchain technology.

The duration of the interviews was between 30-60 minutes, and both authors were present during all interviews. In the start of each interview, the research problem was explained, and the purpose of the interview was discussed. During the interview one of the authors asked the questions, while the other took notes and observed the interviewee. The interview was divided into three major topics. The first topic was *technology and ecosystem*. The purpose was to analyze how the company works with blockchain technology, architecture, cooperation, incentive and how the environment around them reacted to their work. The second topic was the *business model perspective*, where we tried to get information how the incumbent handled blockchain in relation to their existing business model. In the last topic, we discussed *question related to a specific project* within the incumbent's industry. This part of the interview was based on the nine building blocks from the business model canvas.

3.3.2 Participant-observation study

We were given the opportunity to conduct a participant-observation study[1] by one of the incumbent companies that hired us as business development consultant. Our tasks were to construct a business model canvas for their consortium blockchain initiative. We received limited information regarding the project to be able to contribute with a new perspective on the business model. Our delivery consisted of two business model canvases, one for the service layer of the product and one for the node layer of the product. To be able to perform the assigned tasks we committed interviews with industry specialists, participated in conferences as well as gathered and analyzed documents. We had weekly meetings where we reported our findings and discussed them with the incumbent's "*Head of new solutions"* and altered the progress plan in relation to our findings. Table 4 gives an overview of the work hours performed in the participant observation study in the present thesis.

The advantages of this arrangement were that it allowed us to observe how incumbents work with business model development in present time, it also allowed us to cover the business context. We gained insight on how the incumbent worked and handled blockchain technology. This information is hard to access from an outside perspective, if not subjectively conveyed by an employee.

Table 4 Participant-observation study

Participant-observation studies													
Week	6	7	8	9	10	11	12	13	14	15	16	17	Total
Hours	15	15	15	30	30	30	30	30	30	30	30	30	315

[1] "Participant-observation is a special mode of observation in which you are not merely a passive observer. Instead, you may assume a variety of roles within a fieldwork situation and may actually participate in the actions being studied" YIN, R. K. 2014. *Case study research : design and methods,* Los Angeles, Calif, SAGE..

3.3.3 Secondary data

Blockchain is a relatively new phenomenon, and there are few published academic papers. Thus, the secondary data used in this study consists of white papers, books, reports, video lectures, podcast and blog posts.

3.3.4 Data weaknesses

One of the aspects we had to take into consideration during the participant-observation, was the Hawthorne effect, where the observed objects change their behavior in response to the fact that they are being observed. We do not believe this affected our study, but we cannot be sure.

We based our interview guide on theory from Osterwalder's work with business models, another theory on business models might have changed the interview guide and given other results and contributed with other aspects and elements that we didn't capture.

The secondary data accessible vary in quality, there is limited academic research within the field, and a lot of information is only accessible through self-appointed experts. The technical part has been simplified to be understandable for a non-technical reader. The speed of development in the blockchain community should be considered when reading this thesis since the technical part, and features of blockchain will change as a factor of time.

3.4 Validity and Reliability

During the fall of 2017, the authors of this study and a fellow student conducted a pre-study on blockchain technology called "Digitalizing of real world assets by using the blockchain-technology" (Hoff et al., 2017). An interesting finding from that study was that some parts of the blockchain community hold a resentment for the "financial system". It should be stated that we as scientists do not hold any ideological preferences in this scenario. Our neutrality as scientists might have been affected by of our belief in blockchain technology, and through our employment in Tieto. To prevent this from affecting our study, we continuously had to ask ourselves to be open for alternative findings, and that blockchain might not be the solution for certain issues etc.

Our cases are spread across different industries, and the findings are correlating independent of the industry, which might indicate that the external validity is rather high. But since all the cases are based in the Nordic region, one can argue that the results could be affected by the Nordic business culture, and not be generalizable in an international context. In relation to the internal validity, our cases are some of the biggest blockchain initiatives in the Nordic region. Furthermore, all of our informants have central roles in the developing of these initiatives, which indicate that the internal validity is high.

Blockchain technology addresses problems that affect industries on an overall level, such as increased security and trust. Consequentially, the technology makes us believe that both the external and internal reliability in this thesis is considerably high. On the other hand, the reliability of this thesis is affected by the technological development within the blockchain community. The development rate is incredible, aspects of the technology is constantly changing, and it is hard to keep up with it. The change in technology could possibly affect the business model, and thereby the innovation of business models and the results of this thesis. The reliability of this thesis is a factor of elapsed time, and it will decrease in line with the technological development of blockchain.

3.5 Presentation of cases

In this section we will present the cases in the present study. Each case has a short description of the company and their relevant blockchain cases. We have interviewed one informant from each company. The informants have been anonymized and will be referred to by an informant number according to the case number (e.g. the informant from Case 1, will be referred to as R1 and so on)

<table>
<tr><td colspan="2">Case 1: DNV GL</td><td colspan="2">  </td></tr>
<tr><td colspan="4">Company information</td></tr>
<tr><td colspan="4">DNV GL is a global quality assurance and risk management company. They provide classification, technical assurance, software and independent expert advisory services to the maritime, oil & gas, power and renewables industries. They also provide certification, supply chain and data management services to customers across a wide range of industries. With origins stretching back to 1864 and operations in more than 100 countries (DNV-GL, 2018b).</td></tr>
<tr><td colspan="4">Blockchain initiative: Certificates in the blockchain</td></tr>
<tr><td colspan="4">All management systems, products and supply chain certificates are stored and updated in a secure private blockchain, allowing anyone to obtain instant confirmation that a certificate is valid and up to date. More than 90 000 certificates are uploaded on the blockchain (DNV-GL, 2018a).</td></tr>
<tr><td>Collaborators</td><td>Unknown</td><td>Project status</td><td>Active</td></tr>
<tr><td colspan="4">Blockchain initiative: New Digital Assurance Concept</td></tr>
<tr><td colspan="4">The aim is to use blockchain to improve the transparency of product and supplier information, the goal is to significantly increase the efficiency of supply chains (Vestvik-Lunde, 2018).</td></tr>
<tr><td>Collaborators</td><td>VeChain</td><td>Project status</td><td>Proof of Concept, soon to be launched</td></tr>
</table>

Case 2: DNB	

Company information
DNB is Norway's largest financial services group and one of the largest in the Nordic region in terms of market capitalization. The Group offers a full range of financial services, including loans, savings, advisory services, insurance and pension products for retail and corporate customers. DNB's bank branches in Norway are presented in: in-store postal and banking outlets, Post office counters, Internet banking, mobile services and international offices. DNB is a major operator in a number of industries. (DNB, 2018)

Blockchain initiative: Startblock			
Startblock is an electronic shareholder register platform that make managing the company's cap table easier and more automated by the use of blockchain with open API for development on the platform (Ramvi, 2017).			
Collaborators	Unknown	Project status	Active

Blockchain initiative: R3 Corda			
R3 Corda is a distributed ledger that operates in strict privacy in an open, global network. The Corda platform uses a shared smart contract to encapsulate the business logic of a transaction. Corda only shares data with those with a need to view or validate it; there is no global broadcasting of data across the network (Corda, 2017). R3 Corda is founded and developed by 20 of the largest banks in the world. And has hundreds of cooperating businesses.			
Collaborators	200+ banks, and others	Project status	Active

Blockchain initiative: Marco Polo			
Marco Pole should enable "seamless connection" between trading partners, which eliminates data silos that prevent free flow of information and create inefficiency and deviation. (Hopland, 2018)			
Collaborators	TradelIX, R3 Corda, ++	Project status	Active

Case 3: Tieto	

Company information
Tieto is a Nordic software and services company. Tieto aims to capture the significant opportunities of the data-driven world and turn them into lifelong value for people, business and society. Having a strong role in the ecosystems, they use software and services capabilities to create tools and services that simplify the everyday life of millions of people; help customers renew their businesses by capturing the opportunities of modernization, digitalization and innovation and to foster new opportunities based on openness, co-innovation and ecosystems. Building on a strong Nordic heritage, Tieto combines global capabilities with a local presence. Headquartered in Espoo, Finland, Tieto has over 14,000 experts in close to 20 countries. (Tieto, 2018)
Blockchain initiative: Multiple projects
Tieto established a blockchain department in 2017 that aims to help customers overcome the 'hype' and make use of the real potential of blockchain technology. The department will initially focus on digital identity, personal data, digital ownership and solutions within supply chains, Tieto has a number of projects under development. (Tieto, 2017)

Collaborators	Soverin, Hyperledger Fabric, and Ethereum.	Project status	Depending on project

Case 4: BLOCKCHANGERS	
Company information	
Blockchangers is Norway's leading blockchain company, helping other's both understand and utilize blockchain. Blockchangers do so through advisory, lectures, workshops and developing Proof of Concepts for their clients (Blockchangers, 2018).	
Blockchain initiative: Consultants with a number of different projects	

Case 5: Lantmäteriet	
Company information	
Lantmäteriet is a governmental organization that hosts the Swedish land and property register. They keep information and documentation on Sweden's geography and properties, as well as providing services for subdivisions or changes in land boundaries, handling of applications for registered ownership and ensure that registration of ownership is done in the real-property register (Lantmäteriet, 2018b).	
Blockchain initiative: Digital real estate transfer	
The goal is to commit a completely digital real estate transfer with blockchain. The Real Estate Register becomes a publicly kept logbook of property transactions that always has a "surveillance camera" focused on it, so nobody can access it without it being detected (Lantmäteriet, 2018a).	

Collaborators	Kairos Future, ChromaWay and Telia	Project status	Proof of concept, testing

4 ANALYSIS AND DISCUSSION

This thesis aims to answer two research questions: 1) Is blockchain a disruptive technology, and how is the technology handled by the incumbents? 2) What aspects of the business model are affected by blockchain technology and how will this lead to a new specter of opportunities? The first part of this analysis is a short presentation how the cases in the present thesis work with blockchain technology. Further, we will discuss if blockchain can be viewed upon as a disruptive innovation in light of the presented theory on blockchain and disruptive innovation. Lastly, we will analyze how the incumbents handle blockchain technology in relation to their existing business model. Combined together, these sections will provide an answer to the first research question. Further, based on blockchains attributes, we will discuss the technology's effect on business models in order to answer the second research question. Finally, we will discuss our practical experience from the observational study, using the BMC as a tool for constructing a consortium blockchain business model.

4.1 Research Question 1

Is blockchain a disruptive technology, and how is the technology handled by the incumbents?

Initially in this chapter, we will discuss how incumbents work with blockchain technology based on their choice of blockchain architecture. Thereafter, we will evaluate if blockchain technology in light disruptive innovation theory and conclude if blockchain can be viewed upon as a disruptive technology. Finally, we will present how incumbent companies work with blockchain technology in relation to their existing business model. (Investopedia, 2018)

4.1.1 How do incumbents work with blockchain technology

There are two main areas were blockchain is used; to build a Decentralized Application[2] (dApps), and internally to optimize the infrastructure. Most dApps are built on an existing platform. This means that the incumbent does not have to develop the infrastructure themselves, just the dApp. DApps are built on existing platforms, but since the technology is in its infancy, there has not been established one main platform that has market dominance. However, there are many big corporations that compete to become the preferred platform. Microsoft, IBM & Linux Foundation, Ethereum, and R3 Corda are the most known platforms. They all specialize in different customer segments and industries but compete in some areas. The main difference between the top five platforms is the Ledger type; if it's permissioned or permission-less. The ledger type determines who is allowed to participate in the consensus process. On a permissioned Ledger, only selected entities are allowed to participate in the consensus process, and opposite on a permission-less platform.

[2] Decentralized applications (dApps) are digital applications or programs that exist and run on a blockchain or P2P network of computers instead of a single computer, and are outside the purview and control of a single authority INVESTOPEDIA. 2018. *Decentralized Applications or dApps* [Online]. Available: https://www.investopedia.com/terms/d/decentralized-applications-dapps.asp [Accessed 21.05.2018 2018]..

The use case determines the choice of blockchain architecture; who will have the rights to add information, who is allowed to see the information in the transactions. In some cases, companies want to control these rights, as described in chapter 2.2.5, therefore, a consortium blockchain might be the optimal choice. The R3 Corda project that DNB is a part of is an example of this. R3 only shares data with those with those with a need to view of validate it. All the cases in the present thesis have at least one project with a consortium architecture. The consortium gives companies the opportunity to get the benefits of a distributed network while restricting the consensus process and the possibility to add data. The consortium blockchain can have open access for all users to read and view the information on the blockchain, while restricting the rights to add information to the blockchain. The features of the consortium depend of how you construct it and which rules are set. For certain use cases, the only option is to have a permissioned ledger because they are subject to the law, as in the case of Lantmäteriet.

A private blockchain is the most conservative blockchain architecture. DNV GL´s "Certificates in the blockchain" is an example of a private blockchain. In the blockchain community private blockchains is considered a slow database that doesn't have the security advantages of a public blockchain. This view was shared by our informants:

> *"I don't see the point in private networks. If there's one company running the network, then you might as well have a database" (R3).*

A private blockchain is merely a database that does not bring any new value proposition to its user, or enables any new market opportunities. The informants all agreed that it's hard to benefit from using blockchain as its sole user. The benefits are derived from cooperation. As for the future of blockchain, all informants agreed that a consortium-based model is the preferred solution for companies. By doing so, the company can remain in a position of power, while reaping the benefits that comes from its decentralized nature. One can view this as a centralized business model with a twist.

4.1.2 Is blockchain a disruptive technology?

In the following chapter, we will analyze blockchain technology in light of disruptive innovation theory, and how the incumbents work with the technology.

As presented by Christensen et al. (2015), low-end and new market footholds are where a disruptive technology will take its first foothold, since incumbents often pay less attention to these markets. Blockchains originates from the cryptocurrency Bitcoin, cryptocurrencies such as Bitcoin have established itself in developing countries, where the financial structure is unstable, and parts of the population don't have bank accounts. In other words, Bitcoin has established itself in in low-end markets. One of the main reason blockchain based cryptocurrencies have gain traction in low-end markets, is because blockchain enables the "unbanked" to be banked (BTC, 2018, Haig, 2017). Blockchain gives people a possibility to use, transfer and safely save money without a bank account or any proven identification.

Bower and Christensen (1995) states that in the introduction phase the customer is unwilling to replace a known product with a disruptive product, because the customer doesn't see it as a replacement for the product they use today. This is well represented for Bitcoin, compared to FIAT currencies in the first world. Most of the people who owns Bitcoin use it as an asset class in order to gain profits. Bitcoin does not replace traditional FIAT currencies for these users.

As in the example with cryptocurrencies, the area where blockchain was first used, it took many years before Bitcoin moved from being associated only with a criminal financial underworld to being discussed as a currency or asset class (Tomo Uetake, 2017). Blockchain technology has existed since 2008, and it's not until five years later that incumbent companies stared exploring the technology and its potential usage. We can conclude that there has been an reluctance to replace existing technology with blockchain (Thornton, 2018).

As described in the theory chapter about disruptive innovation, Adner (2002) presented a correlation between technical progression and change in customer demand, in relation to the phenomenon of disruptive technologies. Since the introduction of blockchain in 2008, the technology has come a long way, but it is still in its infancy. This was emphasized by our informants.

> *"We can look at blockchain as we looked at the Internet in the nineties. Even though it was clear in the late nineties that the internet would allow us to deliver services like Netflix, it is not until recently that we have Netflix as a working business model." (R4)*

Based on this statement, it might seem like a long time until the technology become as mainstream as the Internet is today. Nonetheless, as the technology matures new use-cases will become possible, and the use of the technology will increase accordingly. However, there are still many technical aspects that need to be solved in order to make the technology scalable and sustainable for working business models. This is confirmed by one of our informants:

> *"The disadvantage of blockchain is that it's extremely immature. A lot of the technology is undocumented in data version, absolutely unscalable, never been tried on anything other than a proof of concept." (R3)*

As presented in the theory chapter about disruptive innovation, Adner (2002) states that there is a correlation between technical progression and change in customer demand. Because of this immaturity of the blockchain technology, we have yet to see the true blockchain blockbuster businesses. However, we believe that when the technology matures, new businesses that exploit blockchains commercial potential will emerge. Consequently, customer demand will increase, as presented in the theory.

Bower and Christensen (1995) state that a disruptive technology brings a new and different value proposition to the market. Blockchains distributed and decentralized network connects individuals in a Peer-to-Peer manner, which enables the participants on the network to act directly with each other. The network combined with the security that is provided from the asymmetric cryptography enables blockchain to create trust between individuals that have no previous relation. The ability to transact peer-to-peer without the need for an intermediary to establish trust can be viewed as a completely new value proposition. Our informants highlighted direct transactions as an important factor in increasing operational efficiency in value chains. Blockchain´s attributes might lead to radical implications. As stated previously, it may take some time before we start seeing these radical implications. Informant R2 in DNB stated the following:

> *"In the short term, you really have to look to see changes from blockchain technology. You have to be in the industry or know what you are looking for. It must be people that work with it. The regular man and woman in the street won't see it. In the short term, it will not change so much for the banks' role. But again, in the long run, I think we are all going to underestimate the impact of technology. It is really classical for exponential technologies to overestimate the short-term effects and underestimate the long-term." (R2)*

The potential implications of blockchain will be discussed when answering the second research question of the present thesis.

At the initiation, the disruptive technology can be inferior to other established products in the market, but they also bring new customer values, such as being cheaper, more practical or smaller/bigger etc. (Bower and Christensen, 1995). Simply explained, blockchain is a shared database that cannot be cheated or altered, and almost every company in the world uses a database in some form. Amongst other things, blockchain has the ability to remove intermediaries, streamline transactions, increase speed and lower transaction costs. However, since the technology is in its infancy, there are areas where it performs inferior to other technologies. The technology still suffer issues with scalability, handling large datasets, in addition to having issues with vast amounts of energy consumption in relation to the proof-of-work consensus algorithm. Based on discussion above we can conclude that blockchain has this characteristic that Bower and Christensen (1995) describes.

In summary, a private blockchain is simply a database that does not utilize the attributes of blockchain. On contrary, consortium and public blockchains utilize blockchains attributes and can enable both enable new market and low-end market footholds. Blockchain´s ability to enable direct peer-to-peer interactions can be viewed upon as a completely new value proposition. Blockchain can have disruptive implications for many industries, but the technology still has to develop a lot before we will see the effects of this. Being a technology in its infancy, blockchain suffer from issues with scalability, ability to handle large datasets and high energy usage. Based on the discussion in this chapter we can conclude that private blockchain´s are not disruptive innovations. However, consortium and public blockchains should be viewed as disruptive innovations.

4.1.3 Implementation and creation of new business models

In this chapter, we aim to describe how incumbents handle the blockchain technology in relation to their existing business model.

As presented in the theory chapter about disruptive innovation when you are facing a disruptive innovation, changing the business model to fit the innovation is likely a more successful solution than try to implement the disruptive innovation in an existing business model. A new business model sometimes has a more disruptive effect than the innovation itself (Sabatier et al., 2012). Through the interviews in the present thesis it became evident that the construction of a new business model for the blockchain initiative is the most challenging part for companies. Informant R3 in Tieto stated the following:

> *"A business model is one of the most difficult things about this product, because of the way that a distributed network work. It's pointless if one company runs the network. Then you might as well just have a single silo, a single database that one company runs. If that company runs all the nodes on a distributed network, then it's the exact same as if they just ran a single server."*

We believe one of the reasons that it is challenging to create a viable business model for blockchain initiative´s is because of the decentralized nature of the technology. Traditionally business model have had a centralized focus. However, with blockchain you are dependent upon other actors. Accordingly, your business model needs to take the other actors into consideration. When first exploring the blockchain technology, it is not uncommon to build a private blockchain. An example of this is DNV GL's *storage of certificates*. One reason to why incumbents experiment with private blockchains first might be because it doesn't affect the existing business model. It is just a way to implement new technology in the existing business model. On the contrary to a private blockchain, all informants in

this thesis have stated that they either develop a new business model or altering their existing business model for each project that is based on a consortium blockchain.

An aspect that can limit the possibility to create new business models is regulatory and legal aspects. The case of Lantmäteriet is an example of this since they are tied to a lot of regulatory and legal aspects of Swedish law. This will force them to use the technology in certain manners, to remain control over some aspects of their value chain. As stated by informant R5 in Lantmäteriet:

> *"As a government institution we have been given certain frames for our business through laws, regulations and the tasks we have been given. Changing the technology we use does not change this fact." (R5)*

Therefore, the development and usage of blockchain in certain cases may depend on set rules and regulations. In some cases, in order to fully utilize the potential of the technology, laws and regulations may need to be changed. In a sense, governments and law keepers around the world will play a crucial role in the future of blockchain.

All of our informants believe that blockchain technology would affect the markets which they operate in. Nevertheless, the fear of market encroachment and cannibalization of existing business models may also inhibit incumbent companies in exploring blockchain, and developing blockchain business models. Informant R2 in DNB stated the following:

> *"I think established actors might be reluctant to set up such "business-killers." But in a slightly longer term, there is certainly a great potential that blockchain will start cannibalizing their income models or products." (R2)*

On the contrary to this conservative approach, some incumbents take a more proactive approach to exploring blockchain technology and developing blockchain business models. Informant R1 in DNV GL stated that their company view the development of a more digital future as inevitable. Accordingly, they take an active approach in exploring blockchain, which they believe to be an important technology in this future. This is because blockchain can enable digital ownership. Informant R1 states:

> *"The goal is business model transformation. We want to bring the industry from where it's now to a new, I call it secular change, a step-change. The industry tomorrow after this is implemented will have to adapt to the new reality."*

Similarly, DNB´s decision to take part in the blockchain consortium R3 Corda, along with twenty of the largest banks in the world, can be seen as a proactive approach to the future (Corda, 2017). Cryptocurrencies have gained a lot of negative attention from the banking world. By entering the R3 consortium, DNB chose to utilize the blockchain technology rather than criticizing it. Based on the discussion of the presented theory on blockchain technology and disruptive innovation, the authors of the present thesis believe being proactive is the best approach when facing disruptive innovations such as blockchain.

In summary, incumbents find it difficult to construct blockchain business models since the technology has a decentralized focus. Consequently, some businesses chose a "centralized" blockchain architecture, a private blockchain, when first exploring the technology. By doing so, they can create a new business that is not in conflict with existing business models. Legal and regulatory aspects may inhibit the potential benefits of using blockchain technology in some cases. Similarly, market encroachment and cannibalizing business models may inhibit incumbents from developing blockchain business models. However, a lot of incumbent companies take a proactive approach in order to exploit blockchain´s full business potential.

4.2 Summary Research Question 1

Is blockchain a disruptive technology, and how is the technology handled by the incumbents?

A private blockchain is merely a database that does not bring any new value proposition to its user, or enable any new market opportunities. This is because the benefits of blockchain are derived from the network of its users. Companies view a consortium model as the preferable architecture for businesses since it enables them to have certain restricted rights, while reaping the benefits of the decentralized network.

Private blockchains are not viewed as a disruptive innovation. However, consortium and public blockchains has many characteristics of disruptive innovations, and should therefore be viewed as disruptive innovations. This is because they, among many other things, enable new market and low-end market footholds. Blockchain technology has the potential to disrupt several industries. However the technology is still in its infancy and has to develop further in order to overcome its issues related to scalability, handling of large datasets and high energy usage.

Incumbents find it difficult to construct blockchain business models since the technology has a decentralized focus. Consequently, some businesses chose a "centralized" blockchain architecture, a private blockchain, when first exploring the technology. By doing so, they can create a new business that is not in conflict with existing business models. Legal and regulatory aspects may inhibit the potential benefits of using blockchain technology in some cases. Similarly, market encroachment and cannibalizing business models may inhibit incumbents from developing certain blockchain business models. However, a lot of incumbent companies take a proactive approach in order to exploit blockchain´s full business potential. Based on the presented theory, the authors of this study argue that incumbents should take a proactive approach when facing disruptive innovations such as blockchain.

4.3 Research Question 2

What aspects of the business model are affected by blockchain technology and how will this lead to a new specter of opportunities?

In this chapter we will discuss blockchains effect on business models and how it leads to new opportunities, based on the elements presented in the summary of Chapter 0: Trust, Internet of value, and Network.

4.3.1 Trust

Blockchains ability to facilitate trust was an underlying consideration in all of our interviews. It is the ability to facilitate trust that enables peer to peer interactions and remove intermediaries, commonly referred to as disintermediation. Companies that are able to utilize this trait will change their value chain in terms of who they interact with. This trait of the technology can in many cases be seen as a threat to incumbent companies. It may, in fact, enable citizens to be a direct threat to companies since it enables them to interact and transact with other citizens directly. This was acknowledged by informant R4 in Blockchangers who stated that:

> *"Blockchain enables user-driven networks that can compete with companies that deliver services. This is because these networks will make it possible for the users to get the same services from other peers."*

An example of this is how citizens can pay other peers to deliver packages. This way, people can be in direct competition with postal services. Even though many of the interviewees praised blockchains ability to disintermediate, none of them directly stated that they utilized this trait in their projects. It is possible this is because removing intermediaries is in conflict with the company's existing business model and will affect their relationship with partners. Consequently, incumbents and startups have different approaches to solving problems:

"It is useful for us to explore the blockchain sphere outside banking. They have a different approach than us to solving problems. We find it easy to think about streamline processes by using DLT[3] and blockchain. Startup companies think completely different. Their approach is to solve the customer's problem, and how to do it the quickest way possible. If they use blockchain to solve the problem, their value chain is completely different from ours." (R2)

As stated above blockchain can be used for increasing operational efficiency. Informant R4 states the following as a common criteria for where to use blockchain technology *"A good blockchain case has multiple involved parties that struggle to communicate with each other and has a lack of trust"*. When discussing DNB´s project within trade finance, Marco Polo, with informant R2, it became evident that this was the problem that blockchain solved for them:

"In trade finance, the value chains involves a lot of different actors. Let´s say a company in Norway wishes to send goods to China. They are unfamiliar with the Chinese actors who buy these goods so they go to their bank and ask if they can guarantee that they get paid? The bank can guarantee this against a payment. Then their bank contacts their Chinese counterpart and asks if they can guarantee for the payment. Yes, against a payment. Then you already have two banks involved. Additional actors such as logistics companies moth from the sending and the receiving side are involved as well. Because of this the value chains and the processes become long and complex." (R2)

The interview goes on to state that these long and complex value chains involve a lot of processes that are perfect for automating through digitalization. In this example, the transaction costs for guaranteeing trust between the sender and the

[3] Distributed Ledger Technology (DLT) is the collective term for technologies that utilizes distributed databases. Blockchain is a specific type of DLT, but there are other types as well.

receiver become substantial as the value chain grows. The potential benefits of using blockchain to provide trust between the two parties can be of great value when automating the processes. Consequentially, the processes will go faster, and transactional costs will go down. Let us say the Norwegian and Chinese company agree upon the terms for the transaction beforehand, they use these terms to draw up a smart contract[4] on a blockchain infrastructure. The goods are sent from Norway, and when arriving at the receiver, other digital technologies such as GPS tracking can confirm that the package is received. The confirmation is sent to the blockchain and the smart contract automatically transfer the agreed upon amount of money from the Chinese, to the Norwegian company.

When discussing the potential of using blockchains within supply chains, our interviewee in DNV GL, highlighted another aspect where the technology can have an impact. Informant R1 explained that for a long time, supply chains have relied on relationships between the supplier and the buyer for establishing trust. Moving into a more digital world has changed this static picture, making competition more globalized and, consequently, the supply chains more complex. Therefore, the long-lasting relationships that previously guaranteed trust are no longer relevant, you need a new way to establish trust. Blockchain can be the solution for establishing new trust in the supply chain industry:

[4] «Smart contracts are computer protocols that facilitate, verify, or enforce the negotiation or performance of a contract, or that obviate the need for a contractual clause. Smart contracts usually also have a user interface and often emulate the logic of contractual clauses. Proponents of smart contracts claim that many kinds of contractual clauses may thus be made partially or fully self-executing, self-enforcing, or both. Smart contracts aim to provide security superior to traditional contract law and to reduce other transaction costs associated with contracting» (BlockchainHub, n.d.).

"There is a pull from the consumer to have more information and eventually to get more engaged with the supply chain itself. We are already able to give reviews to hotels. Imagine giving reviews to products, also for professional users". (R1)

As stated, actors within a supply chain can rely on the trust that is provided by the network itself and its transparency of information, feedback and ratings. Even though it is not blockchain based, an example of how this can be done is provided by transportation services such as Über. Über has adopted the feedback and rating principles to provide trust for both customers and their drivers. Consequently, taxi businesses have experienced losses.

4.3.1.1 How will blockchains ability to facilitate trust affect business models

From the above, we argue that utilizing disintermediation will mainly effect ´infrastructure management´ by changing the companies required infrastructure to deliver their value offering, and ´customer interface´ by increasing efficiency and/or delivery to the end customer. It will also affect the ´financial´ dimension by removing expenses related to intermediaries. Increasing operational by streamlining existing value chains as described will have an effect on ´infrastructure management´. As with disintermediation it will also affect ´customer interface´ by increasing customer delivery, and ´financial´ by reducing expenses. Changing the role of reputation will influence how businesses communicate and thereby affect ´infrastructure management´. It can also affect ´customer interface´ for companies implementing similar solutions for customers (using customer reviews, as exemplified with Über).

4.3.2 Internet of value

The ability to transfer value in an incorruptible way has implications beyond transferring currency from one bank account to another. Our interviewee at Norway´s largest private bank, described one of blockchains main traits in the following way:

> *"Internet is an information system, a system that disseminates information which can be copied and reused. For this reason, Internet has a value problem because anyone can copy your work and sell it to others and claim it is their work. With blockchain, you don´t have this value problem, because you can always verify and control who owns what. This is the reason that the completely absurd thing called CryptoKitties in a way makes sense: because you can always verify who owned this and that CryptoKitty, you cannot falsify that information. Blockchain transfers value the same way the internet transfers information. In the long run, I believe the implications of this to be enormous." (R2).*

The interviewee is referring to CryptoKitties, a blockchain based game released in 2017 that allows the players to collect, trade and breed digitally unique kittens. In other words, the kittens in the game is a form of *digital collectibles*. This may seem like a ridiculous example of digital ownership, but may prove to have great value since the world is moving towards a more digital reality, something that was highlighted by informant R1 at DNV GL:

> *"Digital will be more and more predominant in our lives. I believe that in ten-fifteen years perspective you will see technologies like augmented reality, virtual reality, neuro-tech, taking on and becoming more and more mainstream. Essentially, digital will be a place for us just as the physical world. Blockchain gives you that layer that was missing for making digital a place where you can have ownership, where you can have transaction of value. It allows you to manage digital ownership, and access information and identities in a secure way. "*

The transfer of ownership is not limited to only digital assets, it may also be applied to assets from the physical world. This is commonly referred to as tokenization: when the physical asset is represented in the digital world by a unique identification (Hoff et al., 2017). This is exemplified by Lantmäteriets blockchain initiative where they aim to be able to transfer ownership of property on a blockchain. Blockchain may very well be the solution for ownership of physical assets since all participants of the network are able to tell the true ownership of the asset. There is, however, one major difference between digital and physical assets on the blockchain: the bridge between the digital world is not something that the blockchain technology can solve by itself. Thereby, the ownership of physical assets is only as secure as the information that is being uploaded to it. Another aspect of digital ownership is the ability to prove authenticity of assets. This was the original motivation for DNV GL to exploring the blockchain technology:

> *"We started working with blockchain to generate proof of authenticity, but the idea is that we are moving into the concept of digital identities, which is an essential theme in blockchain in general, not just for DNV GL." (R1)*

A good example of a company that is already able to prove both authenticity and digital ownership by using blockchain technology is Everledger, a company that verifies diamond. Everledger has tailored their services to fit already existing practices for identifications of diamonds. Each diamond is given a digital identity. Information about the diamond throughout its whole value chain is connected to its digital identity on the blockchain. This creates transparency about the diamonds provenance to ensure that it is not unethically mined, or have been smuggled across borders to avoid taxes (Gutierrez and Khizhniak, 2017). The diamonds digital identity also allows it private owners to have digital ownership of the diamonds. Third parties, such as banks and insurance companies, can use the information from the blockchain. Blockchain has the possibility to allow information about the asset to be available for every participant in the

network, including banks and insurance companies. The diamonds digital identity also allows it private owners to have digital ownership of the diamonds. Third parties, such as banks and insurance companies, can use the information on the blockchain. Picture a scenario when the asset is stolen, information about this will be uploaded to the blockchain. Insurance companies are with this technology, able to verify ownership and compensate the owner for his loss (Gutierrez and Khizhniak, 2017). Ideally, if the thief tries to sell the asset, the seller needs to verify the ownership on the blockchain. The buyer will then get a notice that the asset has been reported stolen. In other words, the thief has to sell the asset on the black market, which will reduce its value.

There is a number of national electronic identification (eID) programs all over the world, Estonia has already tested blockchain in relation to their e-residency program (Gemalto, 2017). Blockchain in combination with electronic identities could potentially be a powerful tool that could disrupt a number of industries. One could imagine the possibility if an "identity-less" individual in a developing country received an eID that is connected to the biometric of that person. This makes it possible for that individual to create a financial history, which could later be used as a credit check when applying for mortgages or a loan.

4.3.2.1 How will the Internet of value affect business models

We can substantiate the introduction of digital identities will bring a new dimension to the ´Product´ dimension in business models since it will make it possible to have ownership in the digital world. It will also make it possible to have digital ownership of physical assets. This might change the retail market, and empower the end customers to do peer-to-peer trading in a more secure manner and thereby affect ´Customer Interface´ through disintermediating. On the other hand, new business opportunities will arise from providing a "proof of authenticity" and digitalization of real-world assets. The proof of authenticity will affect the ´Product´ dimension since it will verify authenticity of products and value chains, and thereby help diversify products.

4.3.3 Network

Since blockchain is a decentralized technology, the best use cases for this technology is when you have multiple actors involved. Traditional business models are mainly centralized. For this reason, the blockchain community has criticized large corporations for trying to centralize and commercialize blockchain technology. However, the companies we interviewed all realized that the strength of the technology lies in the ecosystem that comes with its users. When asked why and how incumbents work to commercialize blockchain, informant R4 response was:

> *"Many of the projects that we take on are for the companies to learn about the technology. Very few of them have gone to production. However, if they would go to production, a lot of them talk about gathering multiple actors to realize the full potential of the technology. After all, it´s not easy to do blockchain by yourself."*

The actors involved and the information in circulation, form an ecosystem that can open up for new opportunities. This was mentioned as one of the additional benefits of DNB´s Startblock project. Startblock is a share register for small and medium-sized companies on a blockchain. Companies are imposed by law to keep a register of their stock owners, which is a challenge for smaller companies. The original purpose of Startblock was to solve this challenge. However, our informant in DNB believed Startblock would form new opportunities for the network of users. Using the blockchain infrastructure to create additional value on top of the network was a theme in all of our interviews.

Many of today´s world-leading IT companies follow a platform model where the company owns data, such as Google, Facebook, and Amazon. Blockchain enables the users to control ownership of their own data. Our interviewee in Tieto stated that this goes hand in hand with their view of the future of healthcare:

> *"We don't see the future of healthcare in silos of journal information. Regardless of blockchain, we see the future of healthcare, and I´m talking 10-15 years from now, is when you [as a citizen] own your own journal (…) So the IT that we deliver has separated data from functionality. We deliver the functionality, and then they connect it to your data." (R3)*

The informant clarifies that it is also possible to buy a system which has both functionality and data, though they are loosely coupled so you can swap one out and keep the other. However, the interesting part about this quote is how well blockchain technology fits with Tieto´s view of the future of healthcare. This is because blockchain enables companies to be curators of networks, without having access to the information of its users without their approval. In light of the Cambridge Analytica scandal, where millions of Facebook users had their data harvested and misused, topics related to ownership of data have gained much attention (Solon and Laughland, 2018). In addition, governments impose pressure on companies to be more careful of how user data is handled, as with the General

Data Protection Regulation (Voigt and Bussche, 2017). Blockchain may be a solution for increasing data security, since it decentralizes the information, and give the users control of their own data.

The ability to empower the users by giving them back ownership of their data was also supported by our interviewee in Blockchangers. In R4 opinion, the power structures will be moved more towards the users instead of where they traditionally have been, in the hands of the product makers and service providers. It will have democratizing effects. As a consequence of this:

> *"New business models will emerge. New business models that you cannot compete against in the same way you have competed previously. This way of thinking open source and open innovation, where you activate the users and the users become a part of the product in a completely different way.(…) I believe you need to think of blockchain in the same way as sharing economy. It's about restructuring how you deliver services and who delivers them. The users and the service providers will become more mixed." (R4)*

As stated in the chapter "Trust", changing the role of trust can affect business to business interactions. It will also allow users to collectively compete with established business models. Today, many companies rely on large quantities to make their businesses financially profitable: the bigger the quantities, the lower the price. Described by our interviewee in Blockchangers, blockchain technology may in some cases open up for new financial models:

> *"Blockchain, smart contracts and automation of processes makes it possible to realize extremely small deals with a great number of customers. A typical example of this is to rent out data storage on your private hard drive. Making a decentralized system of hard drive rental that can compete with Dropbox. People can rent out 1 MB of their hard drive and receive an extremely small payment. This is possible because you can automate deals with customers with a click and make value transfers without involving banks. Think of it as sharing economy 2.0" (R4)*

In essence, this means that blockchain in combination with other automation technologies will open up a whole new market of micro-economy. New business opportunities that previously was not financially possible will emerge as a direct consequence of automation. By utilizing the peer-to-peer network in such a way as described above, blockchain technology enables the users to become competitors to established companies. Established companies will face difficulties if they compete with these new user-driven business models with their old ones.

An area of finance that already has been greatly influenced by the democratizing effects of blockchain is the area of venture capital. The traditional way of acquiring capital through venture capitalists or banks is often a difficult and regulated process. A lot of companies that base their technology on blockchain has instead developed a new way of acquiring capital, called an initial coin offering (ICO). ICO´s do not involve the same regulatory aggravation. An initial coin offering is when a company creates a cryptocurrency people can buy from them. In most cases, the company that wishes to acquire the capital has written a plan, or a white paper, that is publicly available to the public and can be used to help them decide if they believe in the company and its technology, or not. If people believe in their project, they can buy their cryptocurrency in exchange for fiat currency, or other digital currencies. An ICO is essentially a new way of crowdfunding. Companies that conduct ICO´s are often either companies that do software for some sort of payment system (like Bitcoin), or a company building a technology where their currency could be used for some purpose. Our interviewee in DNB view ICO´s as a positive change in venture capital:

> *«I believe in the basic functions of ICO´s. The fact that companies no longer have to go "cap in hand" to the bank and ask for funding, but as long as people or investors believe in what you are offering, you will get funding. I don't think the finance industry has realized how much money is already being channeled into this. They are mostly occupied with discussing the regulatory aspects of it.» (R2)*

To put this statement in a context, in 2017 ICOs raised 5.6 billion USD in crowdfunding (Williams-Grut, 2018).

Further, our informant in Blockchangers had a similar opinion. He stated that one of blockchains biggest impacts until now had been its ability to raise capital through ICO crowdfunding. Despite the fact that ICO´s has led to funding of a lot of new and exciting start-ups, it has also lead to some scams. This is acknowledged by both the informants in Blockchangers and DNB. The cryptocurrency sphere has by many been described as a bubble in the same way as the dot-com bubble. The prices on various cryptocurrencies have been exponentially increasing since Bitcoin was first introduced in 2009. This has lead a lot of people with little knowledge and understanding of blockchain and cryptocurrencies to invest in ICO´s, in hopes of making a fortune in a short timeframe. This uncritical way of investing has been taken advantage of by criminals who have scammed people through ICO´s. Informant R4 in Blockchangers states that another downside of ICO´s is the fact that only start-ups that understand how to use blockchain are able to conduct ICO´s. As of today, non-blockchain based start-ups are not able to utilize ICO´s to get funding.

4.3.3.1 How will blockchain networks affect business models

We argue that blockchain can empower its users increasingly involving them in the value production that comes from the network and its ecosystem. We also argue that blockchain empower their users by giving them ownership of their data, and thereby giving them control over who has access to it and for what purposes. We believe that empowering the users will greatly affect ´Customer interface´. However, it will also have a great effect on ´Infrastructure Management´ and ´Product´ since the customers can become increasingly involved in the value production.

Blockchain can assist new financial models that previously were non-profitable through micro-economics which will affect the ´Financial´ dimension. These micro-economics business models can also involve customers and thereby affect both ´Customer Interface´ and ´Infrastructure Management. Through ICOs, blockchain enables crowdfunding of companies. For the same reason as with micro-economics, crowdfunding will affect ´Financial´, ´Customer Interface´ and ´Infrastructure Management´.

4.4 Summary Research Question 2

As presented in the discussion above, the different traits of the blockchain technology have multidimensional effect on business models. In Table 5 we have summarized the above discussion in a table for visual presentation. The table shows that the areas of a business model that has been the most affected is ´customer interface´ and ´infrastructure management´. Seemingly, all of the discussed traits benefit the users: the value delivery becomes faster, more information becomes available, the user gets more power, and the ability to contribute in crowdfunding and crowdsourcing business initiatives. Businesses can benefit from faster and more profitable processes, new business opportunities, and higher transparency of products, companies and users. However, they will also face a new reality where the customer pays a more important role in their value production, and where they potentially can be challenged by crowdsourcing-businesses models. We believe the reason for this these findings is the fact that blockchain is a technology developed by users for users, which explains blockchains democratizing effects. Therefore, we argue that blockchains main effect on business models will be the increased merging of users, the value production and the companies that produce the value.

Table 5 Visual summary of blockchains effect on business models

	Product	Customer Interface	Infrastructure Management	Financial
Disintermediation		X	X	X
Increased operational efficiency		X	X	X
Changing the role of reputation		X	X	
User empowerment	X	X	X	
Micro-economics		X	X	X
Crowdfunding		X	X	X
Authentication through the use of digital identities	X	X		

4.5 Observational study

In this chapter the practical implications of using Business Model Canvas as a framework for developing consortium blockchain business models will be presented.

During our observational study, we used Osterwalder's Business Model Canvases to create a business model for a consortium blockchain project. To capture all information, we developed two business model canvases, one for the service layer of the product and one for the node layer. The BMC for the service layer was a business model for the services provided by the blockchain initiative. The BMC for the node layer had a primary goal to find what incentivizing factors the nodes would need to participate in the network and to contribute as a node. The consortium blockchain project we worked on had many participators, meaning many different business models, different value creation and company goals. It was not possible to capture all the various companies initiatives in one BMC. The BMC focus on one single company´s business model, but it does not take into account other company initiatives. For this reason, it was insufficient as a tool for describing multiple company incentives for participating in a network, and what value comes from participating in that network. The value creation and incentives for each node are of utmost importance: if nobody wants to participate, there are no nodes to run the network, hence there is no network and the blockchain does not provide any value. Consequently, a blockchain business model needs to focus on the network and its participators as a whole. It needs to be able to capture the incentives and values of the participants to succeed.

Something that was highlighted in all of our interviews is the network effects provided by being part of a blockchain network. These new opportunities could potentially change business models. Therefore, we also believe it will be important for the participants to be able to analyze the blockchain network so that they could identify how to best exploit the network effects.

In summary, we do not recommend using BMC when working on a blockchain project. A business model tool that captures the value creation and incentive for the entire network would be preferable. We believe that the BMC is not an expedient tool for constructing consortium blockchain business models. The main reason is that it is not capable of taking into account the value and incentives of the different users in the network. Another tool is needed for this. Also, we believe companies participating in a blockchain consortium need such a tool to be able to fully exploit the network effects.

5 CONCLUSION

The first research question in this thesis was: Is blockchain a disruptive technology, and how is the technology handled by incumbents? This study has found private blockchain not to be a disruptive innovation. On the contrary, consortium and public blockchains both have many characteristics of disruptive innovations and should accordingly be viewed as disruptive innovations. Among many other things, they enable new market and low end market footholds. Furthermore, the study shows that consortium networks are viewed as the preferred blockchain architecture for enterprises since it enables them to remain in control of certain, restricted rights, while reaping the benefits of the decentralized network. Further, incumbents are developing new business models for this technology in most of the cases. However, they find this challenging. The authors believe this is because the technology has a decentralized focus, whilst traditional business models are more centralized.

The second research question was: What aspects of the business model are affected by blockchain technology and how will this lead to a new specter of opportunities? Our findings show that all four dimensions of business models will be affected by blockchain technology, and that most of blockchain traits will have multidimensional impact. Blockchain enables possibilities such as increased operational efficiency, removal of intermediaries in transactions, micro-economics, crowdfunding, digital ownership and authentication of assets. Further, we would like to highlight blockchains democratizing effects that can empower the users and create a shift in power structures between providers and users. We believe the effects of this is that users will be increasingly engaged in both value creation and the infrastructure needed for value delivery. In addition, blockchain can change the role of trust. As a consequence, businesses need to have a higher focus on customer relationships.

Furthermore, practical work conducted in this study has showed that the business model canvas is not an expedient tool for constructing consortium blockchain business models. We believe this to be caused by the business model canvas being focused internally on centralized business models, whereas blockchain businesses require an ecosystem focused business model.

6 WEAKNESSES, FURTHER RESEARCH AND POSITION IN LITERATURE

Weaknesses will in some degree characterize any research project, and it is important to be open about these for the task's credibility. Some of the informants in this thesis have been partly limited in their ability to share information because of non-disclosure agreements.

Further, the development within the blockchain sphere is at a such a high pace that the preconditions of the present thesis could have changed during the period it was written. Lastly, the study could have had several more interview objects to get an even higher validity. However, we believe the findings in this study can be generalized.

Osterwalder´s four dimensions of a business model do not include strategy as part of a business model. Therefore, we suggest for further research to evaluate blockchains effect on strategy. The field of blockchain is developing at a high pace. Conducting a study with similar research questions to this thesis could potentially generate other results in the future. Another suggestion is to conduct a similar study with informants from different industries to evaluate if it generates similar results. Lastly, when the technology has developed, and blockchain technology has become common for business use, we believe it would be in researchers interest to explore how it has affected company business models after joining the consortium.

The present study contributes with a more technical explanation to why blockchain is a disruptive technology, by focusing on the technology aspect of blockchain analyzed through disruptive innovation theory. Further the study implies what parts of the business model that will be affected and implications for the innovation of business models. This study is among the first to criticize Osterwalder's Business Model Canvas tool in light of developing business models based on blockchain technology. Our research contributes to what aspects of the business

models that will be most affected. This information can be used to develop, or choose a more suited tool for developing business models based on blockchain technology.

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8 APPENDICES

8.1 Appendices I: Gartner's Hype Curve

Gartner's Hype Curve

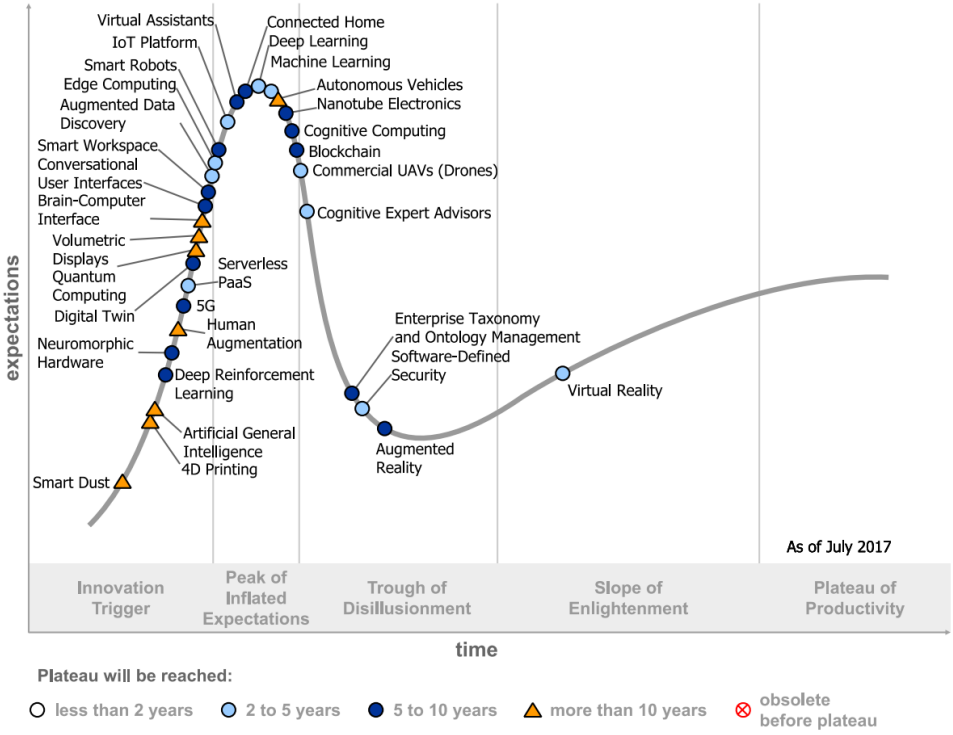

Figure 8 Hype Cycle for Emerging Technologies, 2017 (Walker, 2017)

"Digital Platforms: Emerging technologies require revolutionizing the enabling foundations that provide the volume of data needed, advanced compute power, and ubiquity-enabling ecosystems. The shift from compartmentalized technical infrastructure to ecosystem-enabling platforms is laying the foundations for entirely new business models that are forming the bridge between humans and technology. Within these dynamic ecosystems, organizations must proactively understand and redefine their strategy to create platform-based business models, and to exploit internal and external algorithms in order to generate value." (Walker, 2017).

Description of how the hype curve works:

https://www.gartner.com/technology/research/methodologies/hype-cycle.jsp

Previous research on the field and gaps in the literature

To ensure that our research would contribute to literature we conducted a thorough search of previous work on the field. We used "Business", "Model" and "Blockchain" as keywords for our search. We evaluated the results in order to identify if previous publications would conflict with our intended study. Table 6 summarizes the results of this process.

Table 6 Overview of previous research

Database	Search criteria's	Placement in text	Date	Number of hits	Link
Engineering Village	Business Model and Blockchain	Abstract, Title, Keyword	15.02.2018	52 0 relevant	(EngineeringVillage, 2018)
Science Direct	Business Model and Blockchain	Abstract, Title, Keyword	15.02.2018	9 results 0 relevant	(SienceDirect, 2018)
Google Scholar	Business Model and Blockchain	Title[5]	15.02.2018	9 results 4 relevant	(GoogleScholar, 2018)
Oria	Business Model and Blockchain	Title[1]	15.02.2018	3 results 0 relevant	(Oria, 2018)

The four relevant hits from Google Scholar all involved business model innovation in some form; three were based on the financial market, and the fourth was based around e-health. None of these articles interfered with our intended research question.

[5] Due to the irrelevant hits that were generated from "Abstract" and "Keyword", we had to filter the search to title only.

In addition to the list above we have done thorough research online, and followed up on tips from informants and our network. Following are articles that include business model innovation in relation to blockchain:

Seppälä (2016) study *"The role of trust in understanding the effects of blockchain on business models"* study is an interview-based case study that undertakes the financial and energy sector. For further studies the author recommended to include businesses from other industries to do a comparison study.

"The business blockchain" provides a good introduction to understand blockchain and its potential use-cases. However, the book didn't provide us with any new insight, in our opinion it is more suited for readers that are new to the subject. (Mougayar and Buterin, 2016)

In the article *"How Can Blockchain Technology Disrupt the Existing Business Models?"* the authors methodology was based on a "literature review" and "desk re-search". As a recommendation for further research the authors suggested researching the same subject but using a different design (Nowiński and Kozma, 2017).

In the beginning of May 2018, we discovered an master thesis that was published 28.02.2018 with the title *"The impact of blockchain on business models: a study on how the attributes of blockchain affect the elements of business model"*. The thesis is based on a Delphi study, and have based blockchains attributes on *"The business blockchain"* (Mougayar and Buterin, 2016). We have not had the time to do a thorough analysis of the study, but we can see some similarities and also differences in the conclusion compared to what we have observed in our thesis *(Kamal et al., 2017).*

8.3 Appendices III Interview guide

Interview guide

Section 1: General information and introduction

Short presentation of the students behind the study

Short introduction of the thesis and the purpose of the interview

Inform about our expectations of the interview

Start the conversation by informing that we wish to record the interview

Anonymization of informants

Tell the informant that he has the right to refrain from answering unpleasant/sensitive questions

Sign the declaration of consent

Would you please tell us about yourself? (Education, your role within the company, how long you have been working there etc.)

Section 2: Technology and ecosystem

Can you tell us about your blockchain-project(s)?

Have you established new partnerships for this project?

→ Consortium, private, public network

Do you cooperate with actors from different industries to realize this product?

How have your competitors responded to your product?

Is the product a result of a something the marked has been requesting, or is it something that your company thought the market needed? (technology push, market pull)

What were the incentives for you as a company to start this project?

Section 3: Business perspective

Have you developed a new business model for this project, or have you implemented the project in an existing business model?
If YES: what is your strategy for developing a new business model? E.g. do you use a lean start-up approach
If NO: why did you choose to implement it in an existing business model?
Does your blockchain project(s) cannibalize on existing business models?

Section 4: Project specific questions (if relevant)

1) What problem does this technology solve for you?

   What problem does this technology solve for your users?

2) Why did you choose blockchain technology to solve this problem? What is unique about this solution.

3) What is the target group for your product/service?

   Is this a new customer segment, or an existing one?

   How do you reach your customers?

4) How have you implemented your product to market?

5) How do you make profit on this product?

6) Are there any new costs this product

7) How is this project superior to other alternatives on the market today?

Section 5: Personal opinions

Technology: what are the upsides and downsides of this technology?

Section 6

Can we contact you if we have any additional questions?

8.4 Appendices IV Consent form

Description of master thesis and consent form

Description of master thesis
We, Olle Nyberg and Even Lokøy, are students at the master's program Innovation and Entrepreneurship at the Western Norway University of Applied Sciences (HVL) and University of Oslo. The supervisor is Ole Jakob Bergfjord (ojb@hvl.no).

The thesis' research question concerns *Blockchain technology's effect on business model innovation in established industries.*
Our purpose is to study the processes behind the creation and establishment of blockchain based technologies and how it effects business models in light of disruptive innovation theory and other business model tools.

As part of the project we want to carry out interviews with key personnel who either are part of your blockchain project, or have been involved in its formation. The interview data will assist us in answering our research questions.

Under the interview we would like to ask questions concerning your role in the formation of the blockchain project and its function today, as well as strategic choices made in the past and those for the future.

Voluntarily participation
Your participation is entirely voluntary, and even if you agree, you may withdraw at any time without any negative effect, including during the interview itself. We will ask you to sign this consent form at the bottom, which is a standard document that both interviewer and interviewee must sign in order for the Library to legally place the interview in its publicly accessible collections. (Note: Only the content published in the master thesis will be available in the library. The interview as a whole will not be available.)
We will also provide you with a draft copy of the transcript of the interview so that you may review its content and add any clarifications and corrections that you feel necessary. For the transcription to be as accurate as possible we would like to record the interview.

Anonymity
If desired, your identity and any other information that might lead to your identification will be anonymized in the final thesis.

I have read this document and I understand what is requested of me as a participant in the Master thesis project, I freely consent to participate.

Name of Interviewee (Printed)

Name of Interviewee (Signed)

Name of Interviewer 1, (Printed)

Name of Interviewer 1, (Signed)

Name of Interviewer 2, (Printed)

Name of Interviewer 2, (Signed)