UiA University of Agder

Master

Blockchain Mediated Control: A Case Study of Implementation Strategies in Permissioned and Permissionless Blockchain Projects

A Case study of Norwegian Companies, using the Theoretical Lens of Technology-Mediated Control to understand inter-organizational adoption intention

KAJSA ROSNES BOGEN & HENNING VAN TA

SUPERVISORS
Jaziar Radianti
Paolo Spagnoletti

University of Agder, 2022
Faculty of Social Sciences
Department of Information Systems

Obligatorisk gruppeerklæring

Den enkelte student er selv ansvarlig for å sette seg inn i hva som er lovlige hjelpemidler, retningslinjer for bruk av disse og regler om kildebruk. Erklæringen skal bevisstgjøre studentene på deres ansvar og hvilke konsekvenser fusk kan medføre. Manglende erklæring fritar ikke studentene fra sitt ansvar.

1.	Vi erklærer herved at vår besvarelse er vårt eget arbeid, og at vi ikke har brukt andre kilder eller har mottatt annen hjelp enn det som er nevnt i besvarelsen.	Ja
2.	**Vi erklærer videre at denne besvarelsen:** • Ikke har vært brukt til annen eksamen ved annen avdeling/universitet/høgskole innenlands eller utenlands. • Ikke refererer til andres arbeid uten at det er oppgitt. • Ikke refererer til eget tidligere arbeid uten at det er oppgitt. • Har alle referansene oppgitt i litteraturlisten. • Ikke er en kopi, duplikat eller avskrift av andres arbeid eller besvarelse.	Ja
3.	Vi er kjent med at brudd på ovennevnte er å betrakte som fusk og kan medføre annullering av eksamen og utestengelse fra universiteter og høgskoler i Norge, jf. Universitets- og høgskoleloven §§4-7 og 4-8 og Forskrift om eksamen §§ 31.	Ja
4.	Vi er kjent med at alle innleverte oppgaver kan bli plagiatkontrollert.	Ja
5.	Vi er kjent med at Universitetet i Agder vil behandle alle saker hvor det forligger mistanke om fusk etter høgskolens retningslinjer for behandling av saker om fusk.	Ja
6.	Vi har satt oss inn i regler og retningslinjer i bruk av kilder og referanser på biblioteket sine nettsider.	Ja
7.	Vi har i flertall blitt enige om at innsatsen innad i gruppen er merkbart forskjellig og ønsker dermed å vurderes individuelt. Ordinært vurderes alle deltakere i prosjektet samlet.	Ja

Publiseringsavtale

Fullmakt til elektronisk publisering av oppgaven Forfatter(ne) har opphavsrett til oppgaven. Det betyr blant annet enerett til å gjøre verket tilgjengelig for allmennheten (Åndsverkloven. §2). Oppgaver som er unntatt offentlighet eller taushetsbelagt/konfidensiell vil ikke bli publisert.

Vi gir herved Universitetet i Agder en vederlagsfri rett til å gjøre oppgaven tilgjengelig for elektronisk publisering:	Ja
Er oppgaven båndlagt (konfidensiell)?	Nei
Er oppgaven unntatt offentlighet?	Ja

Preface

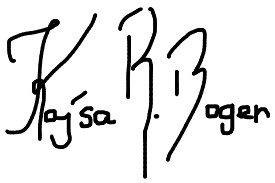
This master thesis has been written in connection with the master course cybersecurity from the Faculty of Social Sciences at University of Agder. It was conducted in the time period between January 2022 and June 2022.

The purpose of the thesis was to study Blockchain implementation in different organizations, and learn more about the prospects of blockchain technology.

First and foremost we would like to extend our thanks to our supervisors Jaziar Radianti and Paolo Spagnoletti from the institute of Information system at the University of Agder. Their guidance, expertise, and patience have been extremely beneficial. Their support and feedback have been a tremendous help in completing this thesis; both have been easily accessible and available at all times, which has been very motivating and contributed to the advancement of the research.

In addition, we would like to express our gratitude to the interviewees who contributed to this thesis, and shared their knowledge and insight with us. The information gathered from the interviews was of the utmost importance, and we greatly appreciated the respondents' positive attitude toward us as researchers. Finally, we would like to thank our families and friends for their support during this time.

Kristiansand, 3rd of June, Kajsa Rosnes Bogen & Henning Van Ta



Abstract

Blockchain could improve existing business processes by enabling networks of users, businesses, partners, and others to execute transactions trusted through cryptography, decentralization, and consensus. The financial technology (fintech) industry has been the first adopter of blockchain technology, which has set an example for other industries to translate blockchain's unique attributes to other use cases. However, blockchain could disrupt existing organizational governance and decision-making. Lacking knowledge of the complex landscape in which blockchain operates, concerns arise, driving organizations and researchers alike to investigate technological- and organizational outcomes. In this dissertation, we investigate how Blockchain can function as a Technology-Mediated Control technology and how this can affect network participants. To evaluate various adoption intentions, we employ a case study in conjunction with a literature review. Interviews with project managers from various Norwegian organizations utilizing either permissioned or permissionless blockchains provided us with their perspective on the processes and potential structural changes. Legacy systems in processes outside the jurisdiction of the respective organizations was a common concern, according to both research papers and interviews. Consequently, the maturity of technological factors is a significant barrier for organizations to implement blockchain, necessitating a new standard of cooperation between organizations. According to the research, the most significant contribution is the theory of blockchain-mediated control, whereas blockchain functions as the technology that mediates control. In addition, we identified a potential risk propagation within the theory that eludes current solutions: the oracle problem in smart contracts.

Contents

List of Figures

List of Tables

Chapter 1

Introduction

According to Harvard Business Review, organizations integrated the web into the fabric of their businesses during the internet boom a few decades ago (Tapscott and Vargas, 2021), and these companies went on to become the world's leading organizations. Despite the difficulty of altering how organizations conduct their core business, transformation is essential for organizations seeking to excel and prosper in the era of digital disruption (Tapscott and Vargas, 2021). History has demonstrated its ability to produce seismic shifts that force people, organizations, governments, and international cooperation to alter their habits in an instant (Sangha et al., 2022). The COVID pandemic and the current Russian war in Ukraine have generated waves that are transforming the world. These factors have exerted considerable pressure on organizations to improve their adoption of new technological solutions to combat this volatility; shortages and lockdown impacts driving inflation; currency fluctuations; and strain on global supply chains (Sangha et al., 2022). All of these uncertainties have created an incentive for government and private organizations to design and validate blockchain-based cooperative solutions as an emerging technology for fostering trust among digital ecosystem participants.

1.1 Background

There has been an exponential increase in the number of organizations investigating blockchain technology for security and efficiency enhancements. According to a forecast published by the Statista Research department, global spending on blockchain solutions is expected to increase by 216 percent between 2021 and 2024 (Statista, 2022). According to "Gartner's 2021 Hype Cycles: Innovating Delivery Through Trust, Growth, and Change," organizations must build trust in order to sustain growth and anticipate that change will continue to disrupt (Dawson, 2021). Gartner's Hype Cycles is an international journal that publishes "a graphical description of a common pattern that emerges with each new technology or other innovation" Figure 1.1 demonstrates that the majority of

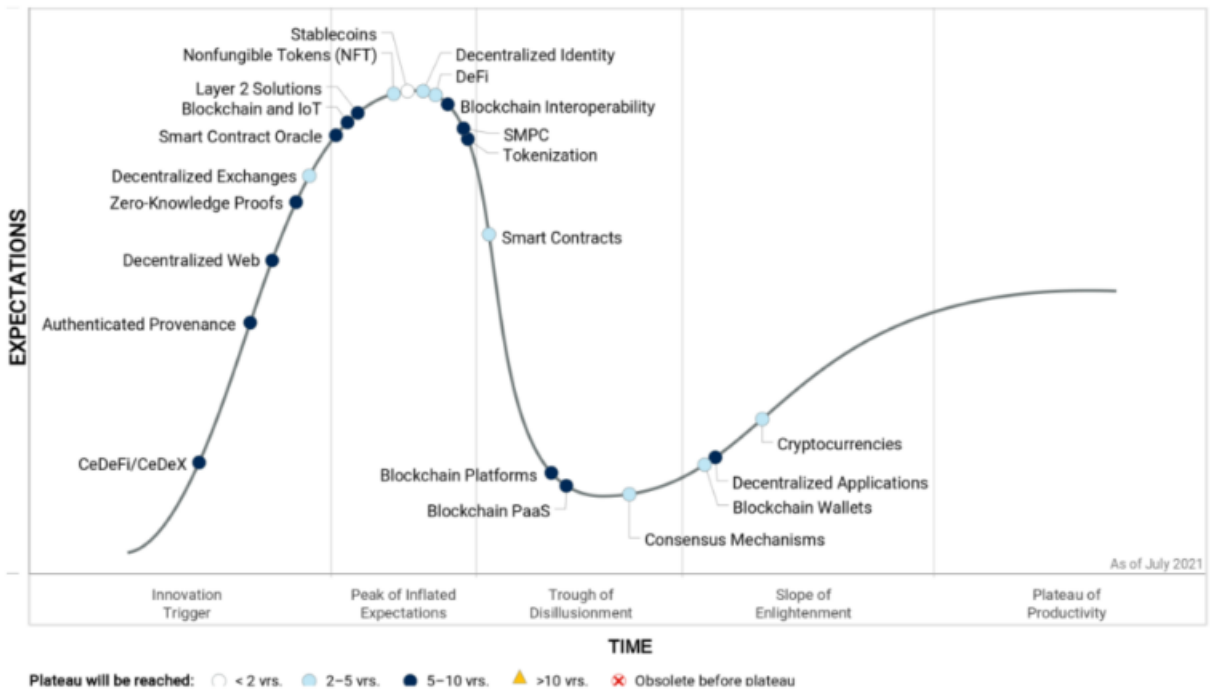


Figure 1.1: Hype Cycle for Blockchain 2021 (Litan, 2021)

blockchain use-cases are in the innovation trigger, whereas cryptocurrencies, decentralized applications, blockchain wallets, consensus mechanisms, Blockchain PaaS, and Blockchain platforms are transitioning through the "Trough of Disillusionment" and onto the "Slope of Enlightenment." This indicates that the projects contain a growing number of examples of how blockchain technology can benefit the organization.

According to a literature review conducted by Tiron-Tudor, Deliu, Farcane, and Dontu, implementing blockchain technology within an organization necessitates organizational changes (Tiron-Tudor et al., 2021). Implementing blockchain technology within an organization will increase its autonomy (101Blockchains, 2020). The implementation of blockchain technology necessitates a shift from a hierarchical organizational structure to a decentralized autonomous organization (DAO)(Morrison et al., 2020). As blockchain has the potential to transform organizations and alter their structures and business models, an increasing number of scholars from various fields are collaborating to comprehend its future effects. The reason that scholars from the information systems disciplines find blockchain as interesting as a research area, as in the accounting disciplines, is that blockchain technologies are emerging as an important organizational phenomenon, especially between the boundaries of firms, organizations and sectors (Kostić and Sedej, 2020).

As aforementioned, blockchain are gaining traction among academics, businesses, government agencies, etc. The exponential growth of blockchain-based projects across all industries motivates us to conduct this investigation. To com-

prehend how Blockchain technology can affect the management, governance, and control of organizations, we begin by describing its defining characteristics.

1.2 Blockchain Features

In "Tech Trends for 2022," Deloitte compares the current state of blockchain to the Internet in 1997: clunky, with an inadequate user interface, but full of enterprise application potential (Henry and Pawczuk, 2021). As the internet did, blockchain enables businesses to streamline business processes and operations to increase value through the development of new digital business models (Henry and Pawczuk, 2021). The ability of blockchain to establish trust outside of its organizational boundaries, without the need for traditional intermediaries, is radically altering how value is created and delivered. "Tech Trends for 2022" by Deloitte warns that if change within a single organization is already considered to be extremely difficult, then change between multiple organizations and industries will likely present orders of magnitude more difficulty.

1.2.1 History

In 2008, an anonymous developer (or group) with the pseudonym Satoshi Nakamoto, released a whitepaper on blockchain (Nakamoto, 2008). This popularized the technology that Stuart Haber and W. Scott Stornetta had described in the 1990s as a cryptographically secured chain of blocks (Haber and Stornetta, 1990). In the years following the introduction of Bitcoin, the use of blockchain has exploded in numerous areas, including:

- Cryptocurrencies, which is an encrypted data string that denotes a unit of currency. Blockchain being the technology that monitors and organizes the platform for its use.
- Decentralized finance (DeFi), an emerging financial technology based on secure distributed ledgers. Removes the control banks and institutions have on money.
- Non-fungible tokens (NFTs), an unique and non-replaceable data device that is stored on the blockchain. NFTs can ble linked to easily reproducible elements such as images, videos, audio, or other digital files, and use blockchain to provide the NFT with public proof of ownership.

1.2.2 Key Elements

The primary advantage of blockchain is that it permits the recording and distribution of immutable, non-editable digital information. It serves as the basis

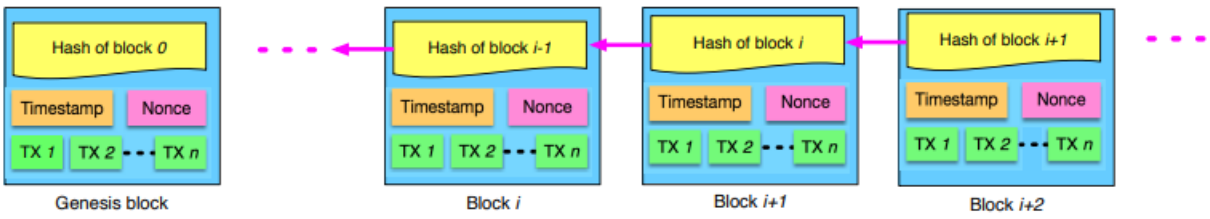


Figure 1.2: Example of blockchain(Zheng et al., 2018, p.355)

for unchangeable ledgers. Distributed ledger technology (DLT) is another name for blockchain technology (Ølnes et al., 2017). It is compiled as a list of records stored in a massive database that spans multiple versions. Every entry in the blockchain is referred to as a "block," and when blocks are arranged sequentially, the blockchain is created (Zheng et al., 2018, p.355). The block contains messages and transactions that are cryptographically linked and timestamped (Nakamoto, 2008, p.2) To be approved and added to the blockchain, all blocks require consensus from the other participants. Figure 1.2 illustrates an example of a blockchain from Zheng et al. (2018). The initial block in a blockchain is referred to as the genesis block, and it has no parent block. Parent blocks are blocks that point to the previous block through a reference that is a hash value of the previous block (Zheng et al., 2018, p.355).
With the incorporation of multiple functions into blockchain technology, the blockchain system has become an integration of multiple infrastructure fields. The key elements that elevates and defines the use of blockchain (Siddiqui et al., 2020, Mosakheil, 2018):

- Decentralization is a major characteristic of the blockchain network. Recording, storing or even updating data distributively between peers, lowering server cost.

- Transparency of the data recorded in the blockchain system. Blockchain systems are mostly public, thus allowing anyone to access the transaction information in the system.

- Autonomy of the data within the blockchain. The data is interconnected allowing every node to update the information without any hindrance.

- Immutablility in the records of the transaction data. The data recorded by the blockchain stores the data permanently, modifications on the records will not be easy unless there is someone that owns 51% of the controllable nodes.

- Anonymity can be a factor for how users will have to use generated addresses to transfer data. The would require no authentication to the user

if the blockchain is public. This improves the privacy for the transactions in the blockchain, even though the transactions are public.

- Auditability of the transactions in the blockchain as the transfers are validated by a timestamp. Records can easily be verified and traced by users accessing any node in the blockchain network.

Data Structure & Data Structure

Typically, blockchain is used for data storage. Data such as transaction details are recorded in blocks and replicated throughout the distributed system (Mosakheil, 2018). To address the need for digital storage, Nakamoto (2008) proposed in his paper "Bitcoin: A Peer-to-Peer Electronic Cash System" the use of Merkle Trees in blockchain transactions. Through the Merkle Tree, the blockchain could facilitate the discarding of spent transactions in order to conserve space without compromising a block's hash. Figure 1.3 illustrates how old blocks can be compacted by removing merkle tree branches (Nakamoto, 2008, p.4).

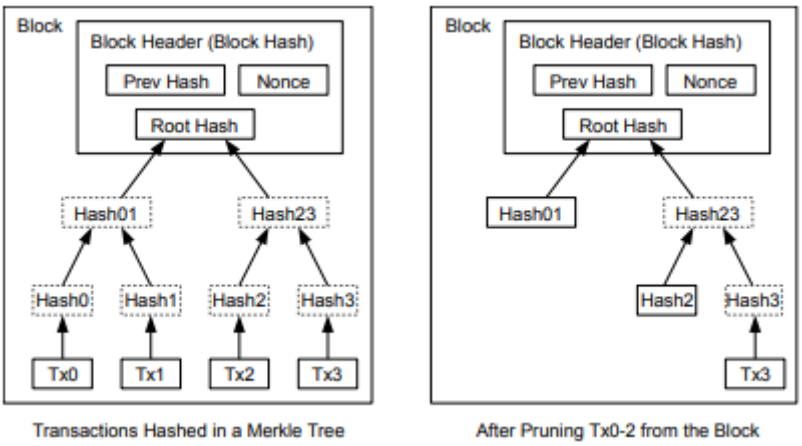


Figure 1.3: Merkle Tree (Nakamoto, 2008, p.4)

The functions of cryptography, algorithms, economic models, and mathematics are required for blockchain technology (Siddiqui et al., 2020). Combining peer-to-peer networks and blockchain would solve the database synchronization issue through the use of consensus algorithms (Er-Rajy et al., 2017).

1.2.3 Types of Blockchain

Blockchain can be categorized into public, private (or managed), consortium, and hybrid blockchain structures (Wegrzyn and Wang, 2021). This depends on how network participants reach consensus, validate transactions, and choose a platform. The blockchain structure has both advantages and disadvantages.

The Venn diagram in figure 1.4 illustrates how the various permissionless and permissioned types intersect.

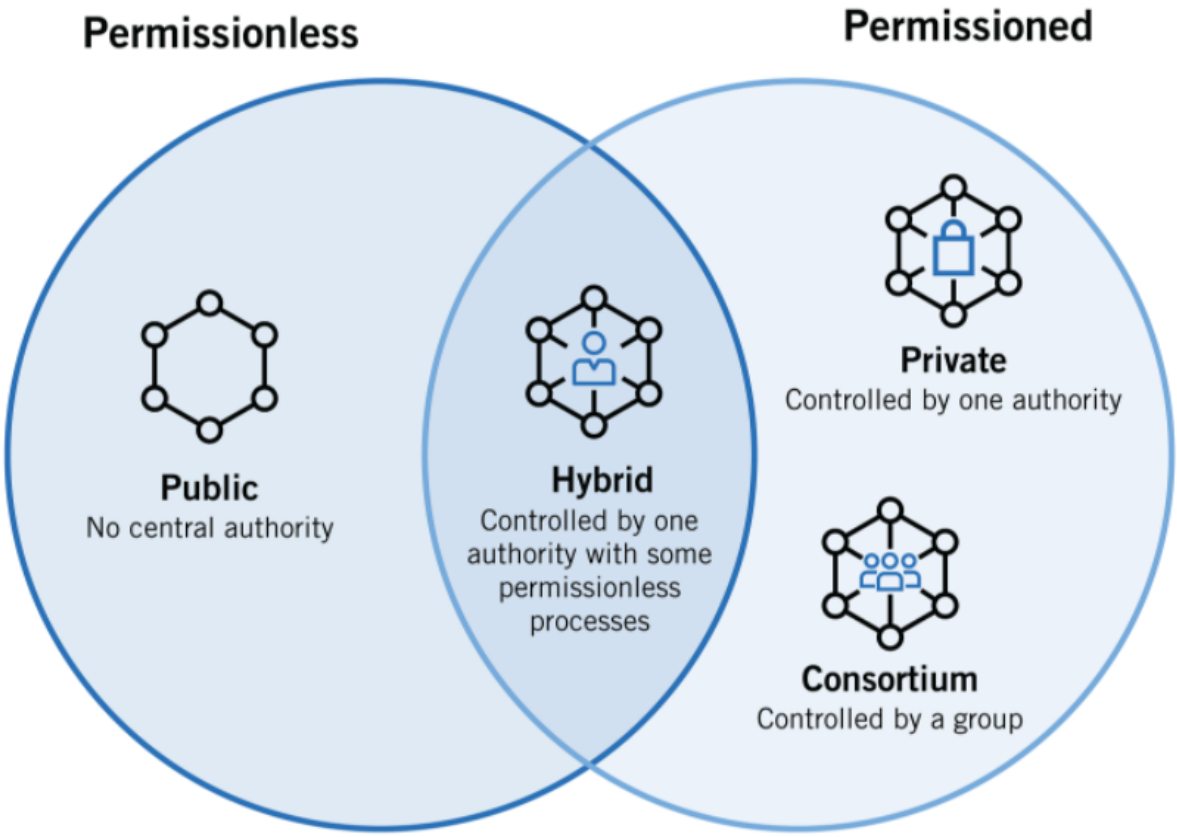


Figure 1.4: Venn diagram of how blockchain types intersect (Wegrzyn and Wang, 2021)

Public Blockchain

The most prevalent network structure is the public blockchain, as it is used for cryptocurrency transactions (Bitcoin, Ethereum, etc.). Public blockchains are permissionless, permitting anyone to join, and are entirely decentralized. To reach consensus, it frequently employs Proof-of-Work mechanisms, also known as mining (Tang et al., 2019, Siddiqui et al., 2020, Mosakheil, 2018). The structure is based on the premise that smart contracts inspire confidence in the underlying technology, not in the people. This resolves the trust issue between two parties in a transaction and compels both parties to adhere to the structure. Effectively eliminating or outsourcing the role of trust in a transaction to technology. Use cases of public blockchain:

- Cryptocurrency, NFT, etc.
- Voting for increased transparency and trust
- Fundraising for increased transparency and trust

Private Blockchain

Private or permissioned blockchains are the direct result of industries attempting to drive the development of new blockchain platforms designed for private settings in which participants are authenticated (Dinh et al., 2017, Siddiqui et al., 2020, Mosakheil, 2018). This type of blockchain structure is centralized, as the majority of blockchain consensus power is determined by a single entity. Some use cases of a private blockchain:

- Supply chain management within the organization
- Asset ownership and tracking
- Internal voting for own organization

Consortium Blockchain

Similar to private blockchains are consortium or federated blockchains. It is a permissioned blockchain administered by a consortium of organizations as opposed to a single entity. Thus providing a method for decentralizing the private blockchain, which results in enhanced security (Wegrzyn and Wang, 2021, 101Blockchains, 2021b). There are challenges associated with this model, as establishing the consortium can be a collaborative effort involving multiple organizations. Consortium blockchains are an effective remedy for numerous supply chain transparency problems. However, the setup costs may be prohibitive, and a large number of processes must be digitized for all members to connect to the blockchain. There are multiple use cases some of them being:

- Supply chain management across several organizations
- Banking and payments between banks and organizations
- Sharing research data and results
- Tracking food; inventory management, product traceability, etc.

Hybrid Blockchain

Hybrid blockchains is a unique blockchain that amalgamates components of both public and private blockchain, or tries to use the best parts of both types (101Blockchains, 2021a, Siddiqui et al., 2020). Typically, it is controlled by a single organization, whereas the oversight will be provided by a public blockchain, which is required to validate certain transactions (Wegrzyn and Wang, 2021). Some of the best use cases of the hybrid blockchain are:

- Real estate purposes

- In retail to streamline processes
- Regulate financial markets

1.2.4 Consensus algorithms

A consensus algorithm is required to verify and validate blockchain transactions and determine which blocks should be added to the chain. Confusions can arise when every node in a distributed network attempts to broadcast its newly discovered block. The consensus algorithm is intended to resolve this issue (Nguyen and Kim, 2018). Numerous variants of consensus mechanisms have been proposed, with proof-of-work (PoW) being the most popular (Nakamoto, 2008). In Proof-of-Work, nodes are only permitted to broadcast their blocks if they have expended a significant amount of computing power validating transactions and mining new tokens. Proof-of-Stake (PoS) is an alternative to Proof-of-Work (PoW) that allows staking in each node and a random factor to determine block appending (Nguyen and Kim, 2018). In recent years, PoW and PoS have been the most widely used consensus mechanisms in both research and applications. The table 1.1 displays the benefits and drawbacks of both of the prevalent consensus mechanisms.

Consensus mechanism	Advantages	Disadvantages
Proof of Work	(1) No need for trust. (2) Everyone can join. (3) Random.	(1) Slow. (2) High power consumption. (3) Incentives required. (4) Low scalability
Proof of Stake	(1) Proportional to ownership. (2) More secure.	(1) Risk for no incentive. (2) Incentives required.

Table 1.1: Advantages and disadvantages of blockchain consensus

1.2.5 Smart contracts

S. Haber and W. S. Stornetta proposed the "hard-to-tamper system to timestamp digital documents" in a 1991 journal article (Haber and Stornetta, 1990). Their paper demonstrates a system that can be used to establish a link to prove a document's creation date. All digital documents in the system are issued a certificate indicating their creation date, as well as information regarding previously issued certificates for other digital documents (Haber and Stornetta, 1990). In 2008, just a few years later, Satoshi Nakamoto's (2008) white paper was published. The creator of the white paper refers to the system as "Bitcoin" (Nakamoto, 2008), which consists of a distributed ledger containing blocks that contain a set of transactions, a nonce, a timestamp, and a hash to the preceding block, which is very similar to the method proposed by Haber

& Stornetta (Kemmoe et al., 2020). With Bitcoin's rising popularity, organizations and individuals have become interested in developing decentralized solutions in industries other than financial technology. The original Bitcoin architecture only supports programs to validate and verify currency transactions, which is insufficient to apply the technology to other fields (Kemmoe et al., 2020).
Vitalik Buterin created the Ethereum chain in 2014, which is a blockchain-based decentralized payment system with an integrated Turing-complete programming language (Buterin, 2014). Encoding arbitrary state transition functions, this built-in programming language enables the creation of an extensive variety of "contracts." Then, users of the Ethereum blockchain can use these functions to replicate existing systems or create new ones (Buterin, 2014).
Because of smart contracts, blockchain has become one of the most promising technologies for the next generation of internet interaction. Smart contracts are capable of being digitally signed, are programmable, and are self-executing agreements that participants must agree to in order to be allowed in the network (Du et al., 2019). On the blockchain, they will automatically validate and execute the terms of an agreement (Du et al., 2019). They are scripts that can run efficiently on the blockchain, and if properly configured, their accuracy eliminates risk and increases the blockchain's credibility.

Functionality

In figure 1.5, Kemmoe et al. (2020) describe a smart contract by dividing the smart contract process into five stages. **Step 1** is where the developer writes the logic for the contract following the programming language supported by the intended blockchain. This code has to be compiled in the correct programming language supported by the blockchain, after the source code is compiled they obtain a byte code (Kemmoe et al., 2020, p.117785). **Step 2** is after obtaining the byte code from the compiler, it will be published to the blockchain platform. At this stage a lot is dependent on the blockchain selected, the smart contract will be a read-only or possible to modify. If the smart contract is read-only, the developers have to publish a new version and redirect the intended users to it (Kemmoe et al., 2020). **Step 3** will also depend on the selected blockchain, but access to a published smart contract program will be available. Again, depending on the blockchain the platform will return an address, which will be used to interact with the smart contract. Users of the network have to obtain this address to be able to send transactions. Every transaction revolving the smart contract has to contain the function of the smart contract that they wish to use and the desired functions arguments (Kemmoe et al., 2020). All transactions are stored in the platforms pool of transactions, while they wait to be executed and validated. **Step 4** is the second to last step of the smart

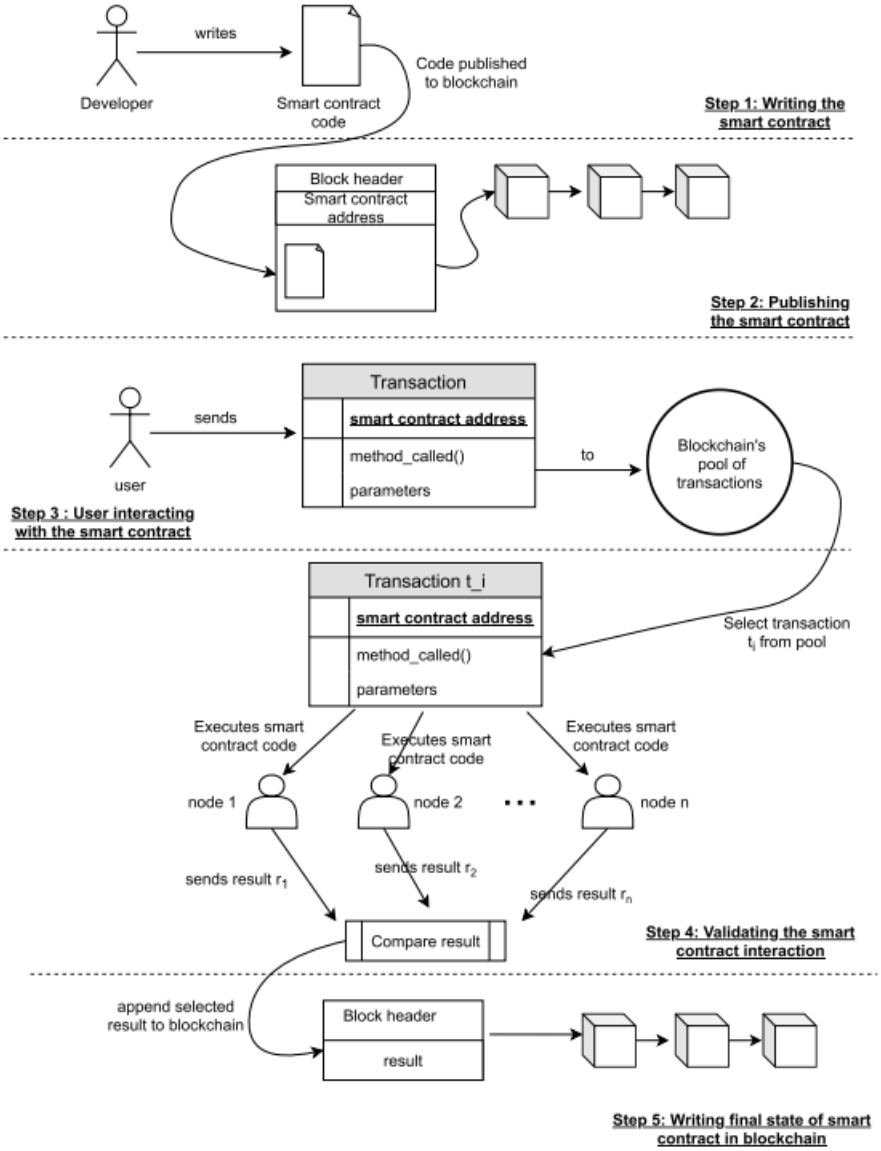


Figure 1.5: Overview of how Smart Contracts works, appended from: (Kemmoe et al., 2020, p.117785)

contract process, the blockchain platform will select a set of transactions to be executed and validated from the pool of transactions (Kemmoe et al., 2020, p.117786). The first phase is the execution phase, here the selected functions of the smart contract will be executed by a set of nodes, the nodes that executed the functions will compare their results and select the one to hold according to the consensus mechanisms on the blockchain (Kemmoe et al., 2020). Here the selected consensus mechanism will play a crucial role. In a Byzantine Fault Tolerant (BFT) consensus where a group of nodes agrees on the final answer, and in proof-based consensus each node has to provide evidence that it has executed the operation - the first node to present the valid proof is elected leader and are then allowed to attach its results to the blockchain (Kemmoe et al., 2020). And lastly **Step 5**, once the valid result has been selected based on consensus mechanism, the information will be inserted in a block that consequently will be appended to the blockchain. It is important to mention that the initial state of each smart contract will be updated if there is a validated transaction which altered the internal variables of a smart contract, consequently those new values will be considered the initial values by the network and all future transactions (Kemmoe et al., 2020).

Multi-Attribute Smart Contract

As previously mentioned, blockchain's increasing number of use-cases is creating an environment in which a large number of organizations must be involved for the use-case to function as intended. In accordance with this trend, there is a growing need to comprehend the implications of governance and control in systems enabled by smart contract technology. Cruz et al. (2018) propose a Role-Based Access Control (RBAC) in this context; the authors identified three actors: the role-issuer, the service-provider, and the users (Cruz et al., 2018). The role-issuers are entities capable of creating roles and rules in the system, the service-providers are entities outside of the role-domain issuer's that use those roles to grant specific rights, and the users are all those to whom a role has been assigned (Kemmoe et al., 2020, p.117793). The role-issuer is the individual who creates the smart contract that manages the users' roles. Cruz et al. (2018) is just one of many possible Multi-Attribute Smart Contract systems, Lee et al. (2019) proposes an RBAC that can support users' anonymity and authentication (Lee and Lee, 2019), and Rahman et al. (2020) proposes a second RBAC system to improve its security by utilizing users' location data to determine access rights (Rahman et al., 2020).

Smart Contract Oracle

Smart contracts have tremendous potential for real-world applications, but they rely heavily on "Oracles," a trusted third party. Oracles link the physical world to the blockchain, thereby creating a gateway. The oracles are trusted to feed the blockchain with accurate information, allowing people to interact without trust (Alexander, 2017, p.2); however, this introduces a single point of failure back into the chain. Oracles can jeopardize the blockchain's intended security functions, which leads to these two repercussions of implementing smart contracts using real-world data.

1.2.6 Security risk of blockchain

Even though the blockchain systems are reliable to use, there are security risks that one has to consider in the implementation process. Configuration of the blockchain has to include security mechanisms to ensure the safety in blockchain usage. Blockchain being still in its infancy, having huge opportunities it suffers from challenges and limitations. Issues mentioned in numerous of research lists scalability, security, privacy, compliance and governance issues have yet to be explored and addressed (Mosakheil, 2018). The main security risks and challenges that organizations should be aware of when implementing blockchain can be seen in table 1.2. The different security risks have been selected out from the literature, and evaluated through the theoretical lens of blockchain implementation, as part of risks that needs to be made aware of.

Security risk	Description
Consensus-related risk	(1) The PoS blockchain system is vulnerable when a single miner owns 50% and more coins on the blockchain. The attacker can then manipulate and interfere with the consensus and blockchain data. (2) Selfish mining and block-discarding where the miners try to gain advantage over the system.
Private Key Security	Private key is generated and held by participants of the blockchain. The system is vulnerable when it is being generated, as there is no assurance of the randomness of signatures. The attackers can recover private key thus tampering with data in the blockchain.
Faulty Smart Contracts	Smart contract deployed to soon during its development can result in the operation being faulty and run an additional time, resulting in added costs on the users.
Network Threats	There exists a range of network threats that can impose on the blockchain implementation. Transaction malleability and timejacking attacks occurs due to flaws in the protocol. Denial-of-service attacks can occur if not enough resources are available for the blockchain operations.

Table 1.2: Overview of security risks

1.3 Organizational Studies on Blockchain Implementation

Blockchain are intended to provide foundations for the development of peer-to-peer platforms for the exchange of information, assets and digitalized goods without the need of human intermediaries (Aste et al., 2017). Current information systems rely on databases where information is kept in silos, where large corporations keep expanding their data-farms to millions of square feet (Choudhury, 2021). Trades and negotiations are influenced by asymmetric information between economic agents, which give origin to problems like moral hazard and adverse selection. The current society is centralised and institutional hierarchies exist to govern the activities of the socio-economic communities. Aste et al. (2017) mentions three solutions that blockchain will have over services, businesses and regulations.

- Operational efficiency through immutable and distributed record-keeping
- Information symmetry through transparent record-keeping
- Decentralised Corporations and Governance

1.3.1 Blockchain Body of Knowledge

Blockchain has in the recent years been used as a strategic innovation technology, and because of its complex nature it is important to accumulate theoretical findings in a structured way, as such to be used by practitioners to deploy blockchain solutions. Ineffective implementation of Blockchain, because of blockchains technological immaturity could cost organizations more than it benefits them. There are promising use cases for blockchain, but there has yet to be a widespread adoption of it in business strategies. Therefore, to facilitate a common body of knowledge this research will build upon six fundamental elements proposed by Rajiv Kohli & Ting-Peng Liang (Kohli and Liang, 2021). The framework for blockchain research performed by Kohli & Liang (2021) are extracted from 65 submissions that was received for this purpose. They wrote a special section on "Strategic integration of blockchain technology in Organization" and analyzes the building blocks through exemplars that show blockchains strategic integration into organizations.The proposed elements are "research themes, application domains, key constructs, outcomes, underlying theories, and research methods" (Kohli and Liang, 2021), and can be seen in figure 1.6.
For this theses, the framework will help in identifying similarities and differences between previous research related to the appropriate research area.

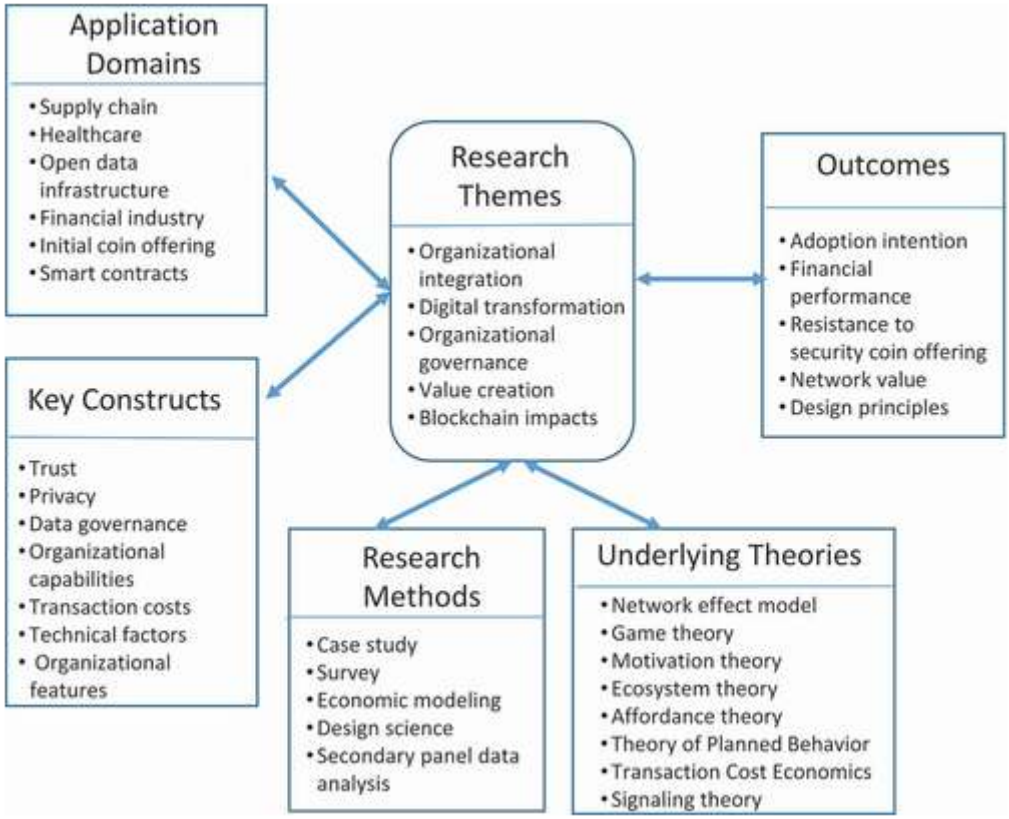


Figure 1.6: Research framework by Kohli & Liang (2021)

1.4 Research Area

The motivation for this thesis is that all high scale Blockchain projects require heavy coordination between the company implementing Blockchain and all of their partners (e.g. government ministries, business associations, banks). Therefore this thesis aims to explore the role of Blockchain as a control technology to build trust in inter-organizational relations. Because Blockchain was originally introduced as a trust-less technology, scholars need to understand the control aspect in a domain that originally was designed to embed and consequently transfer the control to the technological media that are supporting the data exchange and coordination between the involved parties. There is a lack of research surrounding the governance of relation between organizations using blockchain, and how external factors affect these relations. This is why, the desired goal is to analyse how Blockchain can function as a Technology-Mediated Control technology, and how that can impact the participants in the network. To achieve this goal, the following research questions was formed after many iterations:

> *What possibilities exist for blockchain technology to mediate control?* and *What are the plans for blockchain adoption in implementation projects?*

1.4.1 Research Approach

To analyse this, the research will be based on a case study of two real-world blockchain implementation projects in Norway. One using permissioned blockchain in a use-case to handle estate registries, and the other is a permissionless blockchain for national cap tables. A Systematic Literature Review (SLR) will be followed by the analysis of interviews and secondary data collected on the two cases for our empirical investigation.

1.4.2 Thesis Structure

Chapter 2 the Systematic Literature Review of the current literature related to our problem here literature is organized after the framework of strategic integration and technology-mediated control. Chapter 3 explains the selected method for acquiring qualitative data through interviews and describes all acquired information that contextualize the case profile, it also illustrates and explains the process of SLR. In chapter 4 findings from the qualitative study and findings from our conceptual frameworks related to the SLR are presented. Second to last, we have chapter 5, here findings from both interviews and literature reviews will be discussed while rooting the findings in the current literature. Chapter 6 will conclude this thesis.

Chapter 2

Previous Work & Theoretical Frameworks

The following chapter presents the relevant theories corresponding with the framework for "strategic blockchain integration" presented in chapter 1, the research approach of Systematic Literature Review (SLR) is described in further detail in chapter 3. The theories chosen based on the SLR is relevant to create a foundation on which we identifies the research gap in current literature. Through looking for similarities and differences, we are able to categorized the literature to find gaps and trends within the research available. Focusing on application area, outcomes, and the research theme as presented in figure 1.6. Table 2.1 shows how we evaluated the different articles up against the framework mentioned.
As mentioned in chapter 1 this thesis will build upon the increasing demand for control in the blockchain domain, and contextualize our problem even further by using the framework for Technology-Mediated Control as our "Underlying Theory" to expand on the knowledge in an appropriate manner.
For organizational integration the main focus found during SLR where the management and leadership abilities of the organization. Readiness are a key factor to successfull implementation.

2.1 Organizational Integration

As managers are often the gatekeeper of new information technologies (Liang et al., 2021), they also have viable information on what influences them to choose to adopt or not to adopt new technologies such as blockchain technology. The management characteristic in a blockchain implementation project, are theorized to play an important role in the whole process of adopting blockchain technology on an organizational level (Vu et al., 2021). According to the research paper published by Irannezhad et al. (2021), their results showed that the factor with most influence in the implementation of blockchain is acquiring top management support for the technology. Further, they establish that orga-

Author(s)	Research theme	Application domain	Key constructs	Outcome	Underlying theory
Du et al., 2019	Digital transformation	Fintech/smart contracts	Affordance theory	Financial performance & adoption intention	Affordance theory
Huang et al., 2022	Organizational integration	Supply chain	Organizational capabilities	Design principle/-efficiency in implementation	Contingency theory
Ziolkowski et al., 2020	Organizational governance	Cryptocurrencies, intellectual property rights, supply chain, land registries	Technical factors	Governance	N/a
Irannezhad et al., 2021	Organizational integration	Supply chain	Organizational capabilities	Adoption requirements	N/a
Cho et al., 2021	Value creation	Supply chain	Data governance	Adoption intention	Game theory
Garg et al., 2021	Blockchain impacts	Fintech	Organizational features	Financial performance/adoption intention	N/a
Liang et al., 2021	Organizational integration	Healthcare/ Fintech	Technical factors	Adoption intention	Unified theory of acceptance and use of technology
Beck et al., 2018	Organizational governance	Smart contract	Data governance	Design principles in governance	Theoretical perspective of IT governance
Biswas and Gupta, 2019	Organizational integration	All application domains	Technical factors	Adoption intention	N/a
Zhang et al., 2020	Digital transformation	Supply chain	Data governance	Design principles	N/a
Gonczol et al., 2020	Blockchain impacts	Supply chain	Technical factors	Network value	N/a
Vu et al., 2021	Organizational integration	Supply chain	Organizational capabilities	Adoption intention	Innovation adoption theory
Kouhizadeh et al., 2021	Blockchain impacts	Supply chain	Technical factors	Adoption intention	Force field theories
Siddiqui et al., 2020	blockchain impacts	All application domains	Security	Organizational features	N/a

Table 2.1: Summary over strategic integration in literature review

nizational integration of blockchain projects has to meet the strategic requirements, business models and structures must match the organizational objectives (Irannezhad et al., 2021). Management can also be tasked with motivating additional stakeholders to be more willing to accept the change, through managements persistent commitment to the technology. The research paper published by Huang et al. (2022) evaluates the critical success factors for implementing blockchain projects in the circular supply chain management (CSCM), their research concludes with stressing the importance of the function of leadership (Huang et al., 2022). The report states that "Leadership promotes partner membership within the supply chain and helps firms seek support from outside technology and resources" meaning that leadership during a blockchain project are closely associated with collaboration. To succeed with collaboration, leaders need to align their goals, build partnership trust, and make stakeholders participate in the project (Huang et al., 2022).

2.1.1 Readiness

Research on assessing and managing the readiness for blockchain incorporation, states that the strategic readiness for a blockchain project should precede the business modeling and technology designs (Irannezhad et al., 2021). The strategic work related to each business environment, should align the corresponding environment to the technological strategy, e.g. entry points for blockchain has to comply with government regulations. Meaning that prior to any implementation of blockchain, leaders need to pay attention to change in processes, structures, and entire business models (Irannezhad et al., 2021). Blockchain technology are unique from other technology because the implementation of the technology is conditioned by blockchains application use-cases which determines its value, and its technological constraints. Meaning that, before evaluating the feasibility of the blockchain implementation, the technical limitations and challenges needs to be understood by all involved stakeholders (Vu et al., 2021, p.13)

2.1.2 Technical Knowledge

The findings presented by Huang et al. (2022), highlights the critical role of technology and knowledge-related factors in implementing blockchain in CSCM (Huang et al., 2022, p.459). Evidence does also point to the view of technological maturity, technological feasibility, and technical capability being essential during the implementation of blockchain projects. Acquired technical knowledge of blockchain implementation can help with both the implementation process and the post-implementation process (Irannezhad et al., 2021, p.8). Blockchain technology is a technology that can have impacts on core business, meaning that business models might need some changing. For this reason, it is important that organizations ensures competence of employees, as compatibility must be ensured between old and new business models.

2.2 Organizational Governance

There are still many big challenges to implementation of blockchain solutions, some of them are closely related to the overall governance of an organization. For blockchain to work as intended, uncertainties related to its environment needs to be solved. Participants of the intended use-case may be in different regions making regulations and restrictions differ. As such, laws might not apply to all participant in the network (Vu et al., 2021). Taxation is one of the issues that needs resolutions as it has to be differentiated based on the transaction provided (e.g. consumer products, public utilities, services) (Biswas and

Gupta, 2019, p.230). Blockchain technology has no centralized authority, making following standards such as PCI/DSS non-compulsory for trading entities in the network. This also includes the Distributed Ledger Technology (DLT) supported firms to comply with privacy laws (e.g. HIPAA, SOX, FISMA, GDPR). Additionally, according to Biswas and Gupta (2019), because of the autonomous structure of the blockchain economy, the necessary areas of IT governance as decision rights, accountability, and incentives are indeed challenged.
Blockchain does still carry some weight because of its early history, the initial adopters of blockchain technology, or bitcoin, where businesses and traders monetizing of illicit/controversial goods that are prohibited by law (Biswas and Gupta, 2019). As such, industry and academic experts have pointed out that usage in this area could jeopardize the intended large-scale adoption in core industries and services (Biswas and Gupta, 2019).

2.2.1 Inter-Organizational Governance

Barriers or drivers for blockchain technology implementation in the inter- organizational domain revolves mostly around the lack of capability or fear of loosing privacy, this is considered an organizational characteristic (Vu et al., 2021, p.13). When utilizing blockchain technology organizations and executives need to be aware of the bilateral transaction that will occur with two or more groups or businesses, sometimes even between industry sectors (Liang et al., 2021). According to the research paper published by Irannestad et. al., supply chains (SC) are increasingly dependent on having a number of multi-international organizations, making cooperation in inter-organizational areas of high importance (Irannezhad et al., 2021, p.7). This constitute that stakeholders needs to align their objectives and collaborate across industries, but not only that, Irannezhad et al. (2021) argues that there is an increasing need to define industry standards, its governance model and if there is any network orchestration determined for its implementation process. Additionally, when cooperating between industries, sectors and businesses, competition may arise in the network. Therefore, it is of high importance that the blockchain implementation is highly adaptable to all its environmental factors and that we are able to assess that the blockchain implementation is viewed as fair by all involved participants (Irannezhad et al., 2021, p.8).
Organizational Capabilities Organizational characteristics are defined by Vu et al. (2021), as a certain attribute that the adopter can use to influence the adoption process (Vu et al., 2021, p.13). Huang et al. (2022) defines organizational capability as the technical resources and competencies the organization has in order to execute the operational activities necessarily to implement blockchain technology (Huang et al., 2022, p.460).

One of the most important capabilities of the organization is technological maturity, readiness, and feasibility, this will promote partnership trust, stakeholder buy-in, and risk management. According to the results presented by the research from Huang et al. (2022), and the research from Irannezhad et al. (2021), both shows that the technology-related success factors where those who played the biggest role in implementation of blockchain technology. Included by technological maturity/readiness/feasibility are assessment for the required technical infrastructure, and software architecture (Irannezhad et al., 2021). The technical factors of blockchain, such as consensus mechanisms, interoperability and integration features are all part of the organizations own assessments of its technological maturity.
The organizations looking to implement blockchain also has to be aware of their "data readiness" (Irannezhad et al., 2021), this is because the blockchain technology is inherently a database, making the quality of input data an extreme necessity to the overall quality of the blockchain.
When implementing blockchain in a big scale, organizational capabilities are not isolated to the physical walls of said organization. Today's organizations, are highly interrelated and interdependent on everything from government bodies to banking systems to be able to execute its core business. Therefore, elements such as environmental, social and economic capabilities needs to be considered. Blockchain is still a very complex technology, which requires all stakeholders to understand blockchains ramifications and intricacies (Huang et al., 2022).

2.3 Adoption Intention

The research paper published by Irannezhad et al. (2021), tackling blockchain implementation in the supply chain, concludes their research with a framework for a readiness assessment model. This model enables decision makers to identify relevant activities related to the blockchain implementation, and how those activities work affects or are dependent on relationships among them. Irannezhad et al. (2021) stresses the importance of the strategic planning and identification of relevant activities will contribute to the overall adoption intention (Irannezhad et al., 2021).
A paper by Cho et al. (2021) where they discusses blockchain and auditing, shows that a retailer are more likely to consider the costs of blockchain adoption *if* the blockchain adoption costs are relatively low or if policymakers expect blockchain adoption to contribute to gains in social welfare (Cho et al., 2021). If costs are low the retailer might choose to adopt the technology while at the same time offering incentives to vendors to encourage them joining the blockchain network. Also if policymakers see blockchain implementation as possible gains in social welfare, it is likely that they may seek to subsidize the

cost (Cho et al., 2021).

2.3.1 Technical Adoption Enforcers

The blockchain technology when implemented correctly and to the right application domain, can be highly cost effective and assist industries in complying to regulatory requirements (Garg et al., 2021, p.12). Again, it will promote trust, reduce firm costs, and enhance security. When implementing blockchain for business processes, it will help streamline the entire transaction, also making it seamless for all involved stakeholders by reducing unnecessary friction (Garg et al., 2021, p.13). The research performed by Garg et al. (2021), recommends that executives look into adopting the technology because of its ability to clearly state and define business rules, which could improve regulatory compliance.

2.3.2 Managers Adoption Intention

Related to managers intention to adopt the technology, a research paper by Liang et al. (2021) reflects that managers are influenced if blockchain technology implementation is viewed as reputation enhancing for internal stakeholders (Liang et al., 2021). Viability is the ability to work successfully, and in blockchain adoption intention the viability is considered an important strengthening factor for adoption intention from a managers perspective. Viability of a blockchain project is measured by financial resources, IT infrastructure, and top management support (Liang et al., 2021). If blockchain are implemented as a technology that enhances the businesses competitive advantage, other businesses are forced to implement the technology to keep being competitive. Managers intention to adopt blockchain are also influenced a lot by blockchain technology providers, research shows that the functional benefits of blockchain are positively related to the intention to adopt the technology. Blockchain technology providers should emphasize the transparency, security, traceability, efficiency, and speed (Liang et al., 2021). Additionally, managers seem to be highly influenced by the symbolic meaning of blockchain, a meaning that enhances reputation of being industry-leading and known for adopting advanced technologies.

2.3.3 Innovation

According to research done in relation to innovation and blockchain, there are three major forces affecting blockchain adoption which is the technological, organizational, and environmental forces. The organizational element refers to the organizational structure, resources, and stakeholders. The technological context is the availability of the technological innovation, and lastly the

environmental context presents the characteristics of markets, industries, and policymakers (Kouhizadeh et al., 2021). For example the conducted research pointed out significant adoption intention related to each of these individually, whereas the technological immaturity of blockchain technology affects managers as it concerns them and make them question their long term commitment and support. This in turn is relying on a broader technological issue, which is affecting a specific organizational concern, which again have an impact on the overall inter-organizational acceptance.

2.3.4 Inter-Organizational Adoption

Organizational managers drive inter-organizational adoption by supporting the blockchain technology and by cooperating and coordination across industries, sectors and markets (Kouhizadeh et al., 2021, p.13). On the other hand, as firms continue to work with more interdependent relationships, the said competitive advantages shifts from a organizational level to an inter-organizational level, which stipulates that the organizations competitive advantage will be interlinked to the competitive capabilities of the network of relationships (Kouhizadeh et al., 2021, p.14).

When implementing blockchain projects in scale, there are a need for a multitude of involved entities. According to research done in the circular supply chain management (CSCM) domain, it clearly states that a lack of industry involvement can impact the success of the blockchain project. In CSCM for sustainability standards or blockchain standards a considerate amount of parties need to be in agreement (Kouhizadeh et al., 2021, p.15). A number of industries have formed consortia to link those companies seeking blockchain adoption together with other companies seeking the same. The consortia are also tasked with developing models, standards, and reliable governance structures (Kouhizadeh et al., 2021). Additionally, because of lacking governmental involvement and external stakeholders involvement, industries are unwilling to adopt the technology. Which means that, for industries to be involved on a bigger scale, government and external stakeholders needs to get involved in the standardization of blockchain technology (Kouhizadeh et al., 2021).

Results from Kouhizadeh et al. (2021) points to the importance of management involvement in recruiting partners in the work of adopting blockchain, through incentivizing and finding ways to encourage partners, the results might be the making of consortia or co-operative. The effort to support blockchain adoption trough blockchain learning and partner development should always be a priority (Kouhizadeh et al., 2021). To align interest in this manner require a good amount of work prior to adopting blockchain, organizations looking to implement blockchain has to build internal technical expertise before adoption. Given

the fact that blockchain is still an immature technology organizations should allocate time to gather necessary information related to the possible security effects on the organization (Kouhizadeh et al., 2021). Additionally, finding the right partners to build the most effective governance structure is an necessity. According to Kouhizadeh et al. (2021) they states that blockchain standards should be cooperatively developed between the industry and governments to further advance blockchain (Kouhizadeh et al., 2021).

2.4 Technology-Mediated control

The researchers W. Alec Cram & Martin Wiener have performed an extensive study on the emerging topic of Technology-Mediated Control (TMC), bringing the rich history of research on information systems control and on ubiquitous technology to light trough TMC. They state that the literature in organizational and information systems research has typically viewed controller as dyadic in the sense that it involved a controller and a controllee (a group of controllees) (Cram and Wiener, 2020, p. 72) . They summarize their findings related to organizational control in a key concept table, the table 2.2 defines the five concepts and their subconcept.
The research paper have drawn upon two main concept for TMC, which is "Organizational and Information Systems (IS) Control" and "Ubiquitous Technology", they define ubiquitous technology environments as organizations that collects data from an increasing variety and quantity, sources can be wearables, mobiles, and sensors (Cram and Wiener, 2020, p. 74) . In the perspective of TMC, two types of data is particularly relevant and it is the behavioural and emotional/physiological data. With behavioral data means externally observable data that relates to what people do, and with emotional/physiological data means everything that refers to an individuals internal biological characteristics (Cram and Wiener, 2020).
They define Technology-Mediated Control as "managers using ubiquitous technologies as a means to influence workers to behave in a way that concurs with organizational expectations", see figure 2.1.
Further, according to the researcher this model 2.1 illustrates the two basic TMC use-cases, which is to support or automate the managerial control processes. If the technology is supporting the managerial control process it's highly likely that it operates as an monitoring tool that provides information to aid the controller. Secondly, technology can be used to automate managerial control processes by acting as a proxy for human controllers (Cram and Wiener, 2020).
The research had an aim to analyse very different cases that had implemented technology to be a technology-mediated control varying in different degrees

Concept	Subconcept	Definition / Description	References
Control relationship (*who*)	Controller	The source of control activities—often a direct supervisor of the controllee (e.g., a line manager)	Kirsch (1996, 1997)
	Controllee	The target of control activities—often a subordinate of the controller (e.g., a project manager)	
Control process (*when*)	Specification	Information about desired controllee behavior (e.g., a manager establishing formalized performance targets for employee tasks)	Eisenhardt (1985), Kirsch (2004)
	Monitoring	Observation/measurement of controllee behavior (e.g., a manager observing the execution of daily tasks by employees)	
	Evaluation	Assessment of controllee behavior (e.g., a manager comparing actual employee performance against expected employee performance)	
	Reward/Sanction	Pay, bonuses, promotion, or demotion that result from a controllee's compliance/violation (e.g., an employee receiving a bonus payment for meeting productivity targets)	
Control purpose (*why*)	Value appropriation	Controls implemented with the intention of monitoring controllee behavior in order to reduce agency risks (e.g., using controls to minimize the opportunity for controllees to act opportunistically, such as taking too many breaks while on the job)	Wiener et al. (2019), Dekker (2004), Gulati & Singh (1998)
	Value creation	Controls implemented with the intention of coordinating worker activities in order to enhance their application of knowledge and skills (e.g., controls to facilitate controllee interactions, such as regular meetings to share best practices)	
Control modes (*what*)	Formal input, behavior, and outcome control	Explicit activities that a controller conducts to regulate the activities of controllees (e.g., a written sequence of steps to be followed by controllees)	Choudhury & Sabherwal (2003), Kirsch (1997), Ouchi (1979)
	Informal clan and self-control	Implicit determinants that a controller promotes to encourage goal-directed controllee behavior (e.g., shared norms and values to facilitate teamwork)	
Control style (*how*)	Coercive (or authoritative)	The design of control processes/technologies in a way that coerces controllee effort and compliance during task execution (e.g., enforcing corporate rules in a unilateral manner)	Adler & Borys (1996), Heumann et al. (2015), Wiener et al. (2016)
	Enabling	The design of control processes/technologies in a way that enables controllees to better master their tasks (e.g., providing controllees with transparency on the rationale behind control processes)	

Table 2.2: Key Control Concepts (Cram and Wiener, 2020)

of support and automation. They implemented the use of the "CIMO-logic", CIMO-logic is a method for researchers to establish a design principle. This research paper will follow this specific way of looking at the CIMO-logic: In context (C), use intervention (I) to invoke generative mechanisms (M) that produces outcome (O).

2.4.1 TMC in blockchain literature

For our thesis, to define the controller and the controllee we look to the technology. Depending on the case, the controller and the controllee will act different, this is because the technology governing this relationship are able to vary a lot

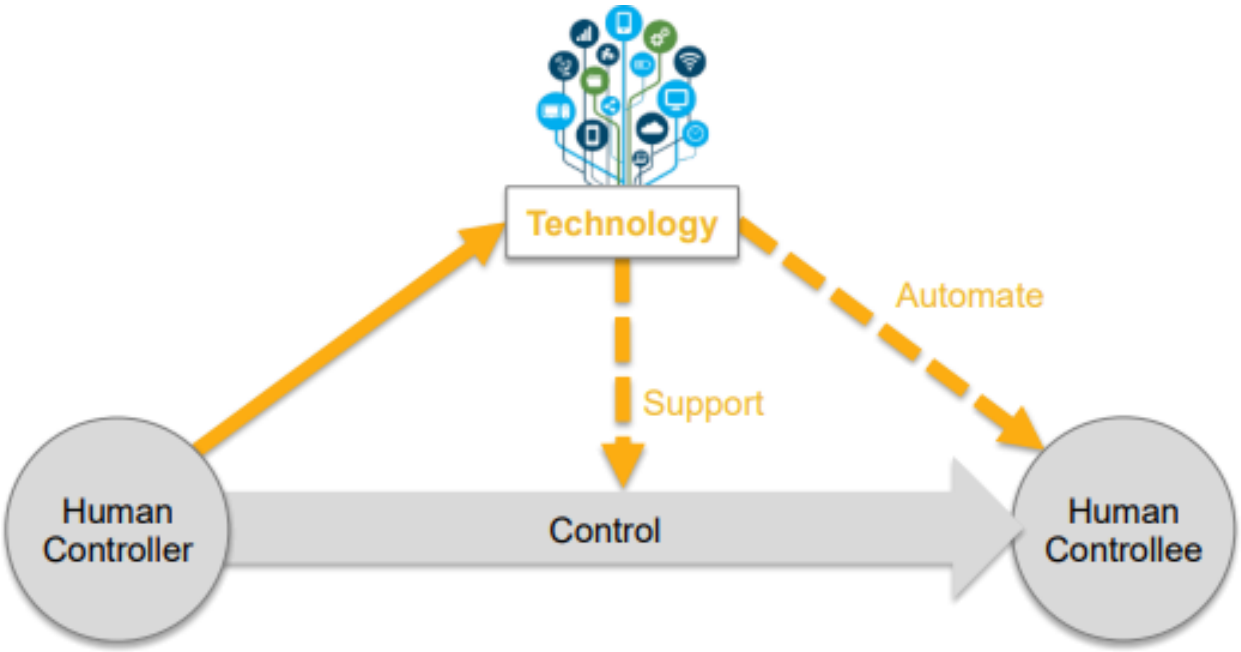


Figure 2.1: Basic TMC Types (Support vs. Automate) (Cram and Wiener, 2020)

Dimension	Description
Context (C)	Internal and external *context* factors that can influence behavioral change (e.g., organizational setting and control purpose, controller-controllee relationship, data volume, variety and velocity).
Interventions (I)	Technological and managerial *interventions* that controllers have at their disposal to influence controllee behavior (e.g., control systems and processes, performance management, control modes and style).
Mechanisms (M)	The generative *mechanisms* that the interventions trigger in a certain context and that fuel behavioral change at an individual level (e.g., awareness, competition, feedback).
Outcomes (O)	An interventions business-oriented *outcomes* at an organizational level (e.g., improved performance, lower error rate, reduced cost).

Table 2.3: CIMO Framework (Cram and Wiener, 2020)

as it is very dependent on application domain. The context (C) in CIMO-logic will most often be the blockchain as a technology-specific approach to the TMC context. This means that multiple organizations can adopt the approach suggested, as long as the appropriate conditions for a blockchain solution are available. So when we use the TMC as a theoretical lens in the literature review, we contextualize the control to that it is implicitly described for blockchain technology. In the literature we are able to identify three areas where the TMC is able to exerts its control in some form or another: TMC in smart contracts, TMC in supply chain and TMC in open data infrastructure.

Blockchain Mediated Control (BMC)

The instance of TMC in smart contracts arrives from the autonomy that smart contracts generates inside the blockchain systems. From the figure 2.1 describing basic TMC types, the smart contracts would automate the control output from the human controller and exert it over the controllee. The different CIMO-

aspects can be found in the table 2.4. The (C) context with smart contracts is that it acts like the technology-specific approach asserting control over participants, stakeholders and regulations. The (I) intervention is that it alleviates and eliminates processes inside an organizational setting and also decrease the data volume participants interact with. Du et al. (2019) explains that transactions could take days or even weeks to process, because it involves the clearance of many paper-based records(Du et al., 2019). Second intervention found in the literature is or smart contracts to automatically enforce violations done by stakeholders to uphold performance (Irannezhad et al., 2021). The third intervention found is for smart contracts to perform regulatory control(Garg et al., 2021). The (M) mechanisms underlying the smart contract makes it so that it enables secure information sharing between parties that do not trust each other, ensures when a violation has been reached and can automatically perform regulatory compliance through the consensus in the blockchain. The smart contract will automate all aspects of the contract clause, including all tedious and time-consuming processes. The (O) outcomes in this instance will be effective means to automate predefined agreements, increase efficiency(Du et al., 2019), have better resolutions in supply chains (Irannezhad et al., 2021) and require fewer regulatory controls (Garg et al., 2021).

Nr	Context	Intervention	Mechanism	Outcomes
1	Participants	Eliminate and alleviate processes inside organizational setting	Enables secure sharing between parties that do not trust each other	Increases efficiency
2	Stakeholders	Automatically enforce violations done by stakeholders	Ensures when a violation has been reached	Better resolutions can be achieved
3	Regulation	Perform regulatory control	Automatically performs regulatory compliance through consensus	Fewer regulatory controls needed

Table 2.4: TMC in blockchain literature through CIMO

In the instance of TMC in supply chain, it provides a supporting role in control following the figure 2.1. There are different contexts in supply chain management, and as mentioned earlier depends on the case for defining controllers and controllees. In circular supply chain management (CSCM) it transfers the control from managers to customers (Huang et al., 2022), in such a case the controllers can incentivize the controllee (I) where they can only realize benefits through biometric authentication (M). This case would allow the circular supply chain to become more efficient and allow controllers be more aware of product life-cycle (Huang et al., 2022). Another context in supply chain is to allow the blockchain to provide disintermediation, eliminating and providing dispute resolution (I) by enforcing violations done by stakeholders through

smart contracts. It will help in efficiency in organization through its capabilities. However the control it exerts is different and following figure 2.1 it would be a supporting control measure and not a fully automated one. The (C) context for this is relied upon the defining features of blockchain itself. The immutability and transparency it allows for would control how supply is traced in a supply chain. The (I) intervention will be that the immutable records will explain where a deviation of products happen to go, explaining to management where resources are missing and providing ample information and control over the supply(Vu et al., 2021). The (M) mechanisms underlying the supply chain is the possibility for the records to trace and comprehend the structure of the supply flow. The (O) outcome is less opportunity for corruption to occur within organization and more control over supply management(Kouhizadeh et al., 2021).

2.5 Concluding Remarks in literature review

Several themes and concepts are deduced throughout the literature review. We search for discrepancies in order to identify the research gap and to enhance and investigate new instances of relevant research themes. The SLR provided a wealth of information regarding its inter-organizational uncertainties (such as the underground economy, legal/regulatory compliance, etc.). In addition, there is a lack of consideration of TMC for blockchain purposes. Consequently, the purpose of this thesis is to investigate the uncertainties in inter-organizational environments using Blockchain Mediated Control as the context.

Chapter 3

Research Methodology

The previous chapter described theory that this research will make use of, this chapter will explain how the research process, design and data collection have been performed to acquire the findings in chapter 4. the chapter of research methodology explains how both a qualitative case study and a literature review has been conducted to acquire a deeper understanding of our selected research area.

3.1 Research Process & Design

Research projects often have more than one process happening simultaneously, which means there where continuous iterations moving from literature review to refining of the interview strategy. Figure 3.1 illustrates the process of how

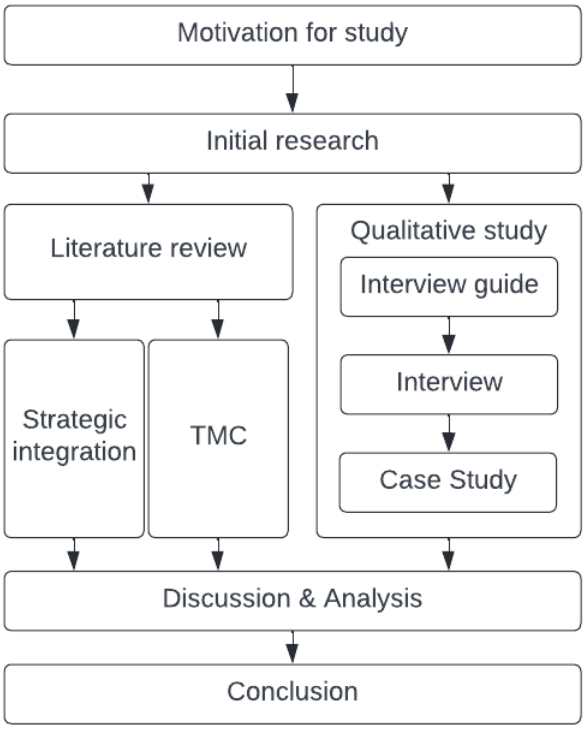


Figure 3.1: Research design of the thesis

the study was performed. Starting with the motivation for the study, both researcher find the field of blockchain very interesting and aims to become experts in the field. Then, we conducted preliminary research on blockchain and its potential applications, about which we could write our thesis. To streamline the research, the literature review and qualitative study were conducted concurrently following an iterative process of initial research. The qualitative study involves creating an interview guide, contacting organizations for interviews, conducting the interviews, and compiling the data into cases. While the qualitative study is in progress, the literature review, in which researchers examine previous studies by reading texts and locating pertinent information, is continuously conducted. The data is then amalgamated into the discussion & analysis where it will help in concluding the thesis.

3.2 Method for Literature Review

The literature review is composed of many stages, Okoli (2015) present different stages to a literature review to which we have summarized: finding the purpose for the review, creating a scope for the review, performing the search in various databases, screening the searches and evaluating which to include, extracting data from the literature chosen, appraisal of the quality of each paper, summarizing the content and writing the actual review(Okoli, 2015).
Figure 3.2 displays the different stages of the literature review. The process has mainly been inspired by the model Okoli (2015) had made. The figure beside it figure 3.3 shows how the literature review was performed, with considerations to the cycles within the thesis.
Literature Cycles To further gain understanding and comprehension of the blockchain research area. The literature review collected 14 studies and reflected upon them up towards the collected theories. The literature found is mainly centered around the application domains: supply chain management, financial industry, and smart contracts. The literature review was performed, and through consideration from each iteration/cycle of doing them a new iteration/cycle was performed to enhance the results and further define the problem area and questions. Although the cycles were not intended to be performed in the first place, the research had benefited from the cycles, more so than at first glance.

First cycle Through the first cycle, initial findings helped in discovering the scope of the blockchain implementation. This resulted in finding about management of blockchain, where we further looked into blockchain development, cybersecurity of blockchain and changes to organizational structures, also often mentioned in documents and papers issued by well known organizations. These

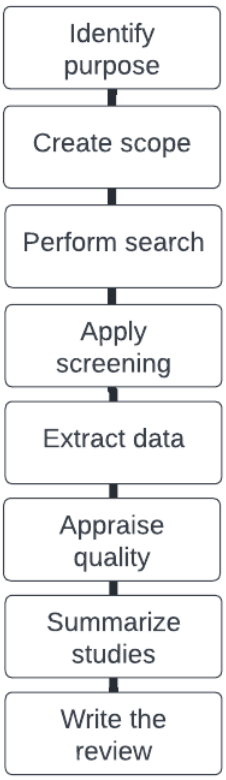


Figure 3.2: Systematic guide to literature review

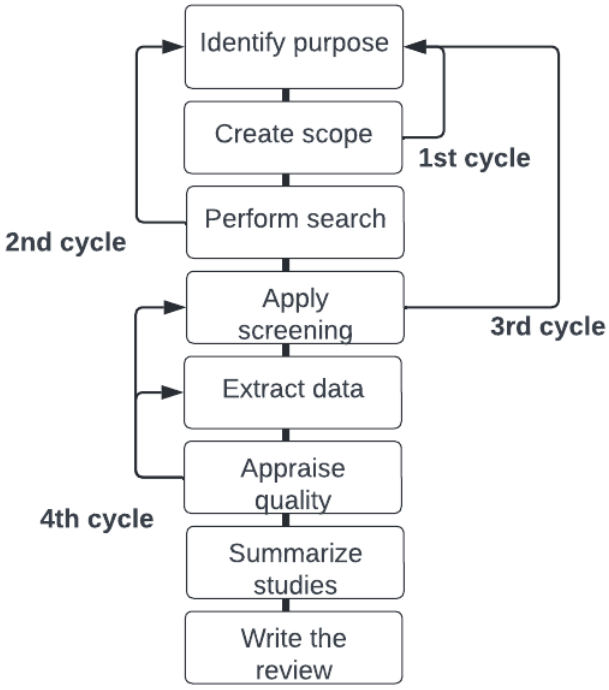


Figure 3.3: How the literature review were done through cycles

concepts and themes were also later used to create many of the questions asked in the interviews.

Second cycle After refining keywords for searches within the management perspective, the second cycle revealed more qualities within blockchain implementation, challenges and benefits with the implementations, frameworks and strategies. This resulted in the structuring of the different blockchain domains within the literature review. Such as application domain, key constructs, underlying theories, etc. These were used as classification for articles in the full literature review.

Third cycle After conducting the first interview, the first discovery of requirement for control had come to light. This resulted in possibility of evaluating the technology mediated control concept, which had earlier been just a tool to help us frame our research. We considered it to be of great importance, when reviewing the blockchain implementation literature.

Fourth cycle The fourth cycle was after the second interview was performed, and a discovery of the oracle problem had been included. This was validated

by the first interview and led to a new cycle within the literature review, to include the concept for further exploration.

3.2.1 Literature review - process

The process of the literature review was following the systematic literature review mentioned by Okoli (2015).

Purpose Literature review is a central part of many scientific papers. It is performed to gather an understanding for what current and existing research are already done by other researchers. The purpose of the literature review in this paper is to help the researchers identify key aspects of what blockchain changes and produces in an organizations security arsenal, as well as other aspects that could be missed during preliminary scoping. It will also summarize findings from previous studies on the research topic (Ridley, 2012).

Scope The scope of the literature review was done by evaluating the importance of blockchain implementation and looking for how researchers evaluated the process of blockchain implementation with focus on frameworks, challenges, benefits and strategy. Due the large volume of articles written on the blockchain topic it would not be feasible to analyze every article found on the topic. There were a inclusion and exclusion criteria made to reduce and narrow the prospect to a more precise and relevant scope.

- Exclude studies with a publication date prior to 2017
- Exclude studies written in another language than English
- Exclude studies without at least a few citations unless they are newly published
- Include studies that are within the main topics
- Include journal articles and conference papers

Search The theses used the academic research database Scopus and committed a thorough separate search in Senior scholars basket of eight. Several suggestions for search terms were put forth and revealed to be quite a challenge. The excessive number or lack of articles available when conducting different searches were the primary issue when conducting the searches. An excessive number would require a heavy time sink into evaluating criteria and quality. Since Scopus revealed several more articles than Senior scholars basket of eight, it was necessary to establish keywords-searches in Scopus while within Senior

scholars basket of eight journals included all fields. The search statement in Senior scholars basket of eight was as follows:

> Blockchain implementation AND (challenges OR benefits OR framework OR strategy) AND (cybersecurity OR security OR risk)

The statement used in Scopus:

> (KEY (blockchain AND implementation) AND TITLE-ABS-KEY ((challenges OR benefits OR framework OR strategy)) AND ALL ((cybersecurity OR security OR risk)))

The search in Scopus resulted in a total of 191 different articles, and the search in the basket of eight resulted in finding an additional 73 different articles spread between the different journals. The total studies found in the search being 264.

Screening When the search was done it had revealed a large amount of articles and conference papers that were within the topic. Thus the first screening was performed to reduce the amount of required analyzing of texts. The screening had already decided on a criteria of judgement on which it would be based upon. The screening would be performed in iterations following the criteria as:

- Exclude duplicates
- Include based on relevant title
- Include based on relevant abstract
- Include based on relevancy of content

First iteration was to exclude duplicates from the result, however there were no duplicates found, leaving the total still 264. Second iteration was to include based on relevant title, here 175 articles was excluded leaving a total of 89 studies left. The third iteration of inclusion based of relevant abstract, excluded 45 studies leaving a total of 44 studies to read. The fourth iteration and the most time consuming one based of the relevancy of the content of each articles, excluded 20 articles, leaving 24 to be quality appraised. During the iterations some studies were found to be outside the scope of the literature review, thus promptly removed in the iteration it was evaluated so.

Extract Data Extracting data is a crucial step in the literature review procedure, and is a step where reviewers take information from each paper to serve as the raw material for the synthesis step (Okoli, 2015, p.18). The data extracted will be listed under section 2. Only articles appraised to be within the quality mentioned in paragraph beneath is included in the section. Figure 3.4 shows

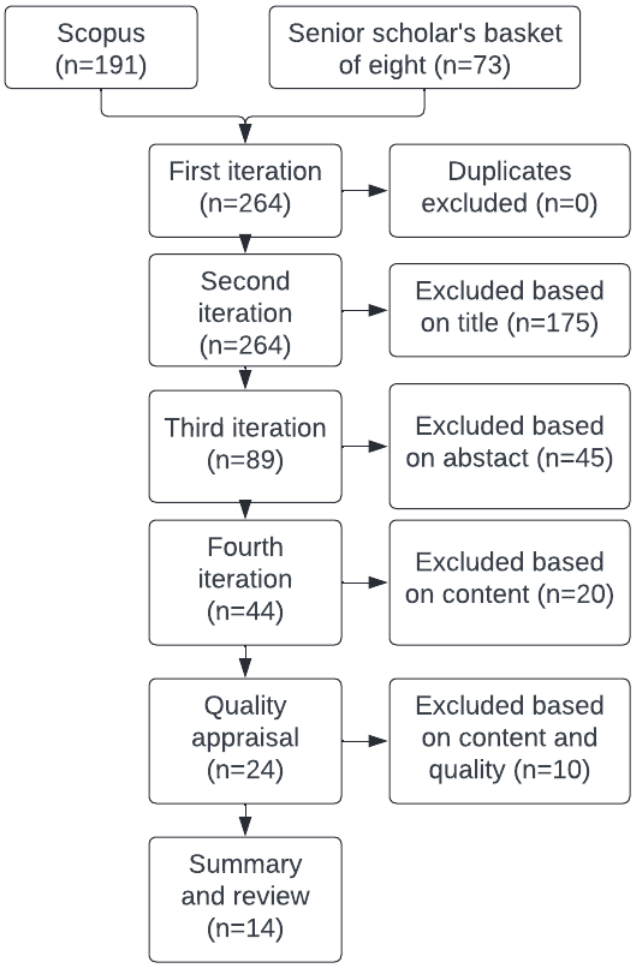


Figure 3.4: Prisma chart for the literature review

a prisma chart, used to depict the flow of information through the different phases of a systematic review (PRISMA, n.d.). The figure will help researchers understand the process of how the literature review has proceeded.

Appraise Quality The previous screening excludes papers from the review without considering their quality to ensure that only relevant papers are considered in the review (Okoli, 2015, p.19). In this step the quality of the paper, its methodology, is being evaluated to see if it stands up to the minimal methodological standards.

Summarize studies A total of 14 texts were considered to be within relevance and quality in the end of the literature review. The texts were summarized in contexts to the concepts that were found to have relevance to this thesis.

Review The last step in the systematic literature review is writing the review itself. When considering articles, the researchers needs to carefully chose and present relevant and important data from the literature. The literature is supposed to support and help back up the existing theory and contribute to further research (Okoli, 2015).

3.3 Qualitative Study

A case study is a research that focuses on the "thing" that is to be investigated (Oates, 2006, p.141), this case study focuses on the implementation of a blockchain system in an organization. This case study explores two Norwegian companies operating in the public sector but in different industries, which have or are in the process of, implementing blockchain on a big scale.

3.3.1 Selection of cases

The scope of which organizations we wanted to target, were organizations with experience with blockchain implementation. Since there are several use-cases for blockchain implementation and different application domains, we tried to find organizations that are similar in size with different implementation goals. Ultimately the study categorized the cases into two; public and private blockchain. The idea was to discern if there are any connection to the control exerted over a private blockchain, and if it was different compared to a public one. We based the categorization on documents with leading results that there are differences in control goals and applications in this field. In order to find the organizations that were within the scope of the study, different searches were performed on the internet. The reason for mapping the cases to different parameters, is because it might become easier to find dissimilarities in control aspects between them, and enrich the study through this aspect.
When contacting the different organizations, the research team made efforts in contacting them through phone-calls to get a swift response and in touch with the right people from the different organizations. We reached out to several organizations in different services in effort to gather interview subjects, and even though a large number were interested in the topic, many were unable to be interviewed due to not having ownership of the project of which they were involved in. The study ended up with two interviews with two different organizations, which is lacking in quantity, but is made up by gathered data.

Case 1: PrivateBlock

PrivateBlock is a innovative organization with the model that is a "Cooperative" and is an organizational model for economic activity. A Cooperative is

defined as "an autonomous association of persons united voluntarily to meet their common economic, social, and cultural needs and aspirations through a jointly-owned and democratically-controlled enterprise" (Alliance, 2018). Their principle is that those who run the production or make use of it, also should lead it - that way any surplus does not fall to outside capital owners.
At the time of the interviews the organization is considered as a large organization, with more than 500 employees, and operates in the private sector. They are stationed in Norway, and have ongoing operations mainly in Norway. Ownership of land or housing mainly happens through sale transaction, which is done through registrations of deeds. Through the blockchain project they were trying to be one of the few pioneers in piloting a project, that encompassed the large market of property management. The main functions of the blockchain was to help with the buying and selling of share housing, helping the process by utilizing blockchain on a web-based solution to trade.
Blockchain has been documented (Spahiu et al., 2022, Sobolewski and Allessie, 2021) to be a great asset in property management, resulting in protecting property registration decisions from unauthorized malicious activities and guaranteeing transparent, reliable and more competitive property market transactions, boosting economic growth and further sustainable development(Goderdzishvili et al., 2018).There are known registration difficulties in the property register, making the process take up to 3 days. Through the solutions that blockchain can provide it can be done within seconds(Thakur et al., 2020).
Land registry faces several issues that needs to be addressed. Some of the major issues are: Multiple agencies for land registers, legacy systems, not enough IT usage, methods not applicable for innovative thinking, and fraud and corruption(Thakur et al., 2020).

Case 2: PublicBlock

PublicBlock described in this case is a is a public institute providing registers as a service for National deployment. At the time of the interviews the organization is considered to be a large organization with over 400 employees, and operates in the public sector. They are an organization that is stationed and operates in Norway. The agency have control and manage computerised collections of information that is used nationally. They do this to simplify the daily life for the citizen of Norway through their efforts and projects. They also have projects that cooperates with foreign governments, organizations and businesses at various levels.
The solution the organization is targeting is centered around a capitalisation table. Capitalisation table has been previously mentioned in other research and is a plausible and potential solution in blockchain (Dhillon et al., 2017, Crosby et al., 2016). The main benefits that develops from this implementation is used

to register, issue and transfer securities so that the capitalisation tables of a registered organizations are always accurate and up-to-date(Natarajan et al., 2017).

3.3.2 Data Collection

To gather qualitative data, interview is selected as a method to investigate the research problem, and the data sources are two organizations that are in the process of - or have run a blockchain implementation project in the past. The overall goal of applying interviews as a method, is to gather data that is immeasurable by mathematical formulas. As the research area of blockchain implementation is fairly new, and have many and complex variables that might affect the overall adoption intention. Interviews is a suitable method because it will aid the researcher in obtaining detailed information about a certain context. It will also be useful when asking complex questions or open-ended, that require the researcher to change the logic and order of the questions to match to their specific situation (Oates, 2006, p.187). The interview will therefore focus on the depth of data rather than the breadth, the interviewer will try to gather as much detail about the specific instance that is under investigation.

Before conducting the interview, an interview guide is developed to best suit the research problem for data analysis. The guide is based on the research in section 2 and other prior sources. The interview guide contains questions related to themes such as blockchain technology development, cybersecurity management and organizational structure. The interviews purpose is to generate an understanding within organizational implementation to firmly recognize arguments for adoption of blockchain technology.

The interviews are conducted digitally because of the availability of our participants, and are carried out semi-structured. Meaning that the researcher have a list of relevant themes to be covered, but will try to follow the flow of the conversation and investigate further any issues or harmonies that the respondents presents themselves (Oates, 2006, p.188) . The situation for our interview where not done in the interviewees "natural setting", but as researchers it is our task when conducting a case study that we try to not disturb the instance. So to make up for a lack of "natural settings" in the digital meeting, all participants had both audio and video turned on. The researchers gave the respondents some extra seconds after each sentence, just to make sure that they actually where done talking and it was not a lag.

When utilizing interviews that are semi-structured, the data collected looses some of its ability to be generalized to the rest of the affiliated parties because the results from the interviews are often different. In trying to understand the context In-depth case study are also more comprehensive and time consuming.

3.3.3 Data Analysis & Coding

When conducting a case study one big challenge is the complexity of the gathered data, the first process is to transform the data from audio and video format into words on paper. In the process of converting the raw data into textual data, the researchers are clear in their choice to add or take away some words to add to the overall flow of the interview. Written data are also sent to the respondents to check with them if they are agreeing to what we written down before the analysis starts. The recording from the interviews had a lot of the classic "Uhm, well, no, but, yes, but, etc" which the researchers saw as irrelevant to the analysis. After the data has been transformed from a recording to a text document, the text is clear to the researcher. The researchers wants to amplify that the raw events are much more detailed than what our respondents are able to communicate in an interview like this, making our data condensed and simplified considerably.
According to Miles et al. (2018) coding is analysis, they believe that "coding is deep reflection about and, thus, deep analysis and interpretation of the data's meaning" (Miles et al., 2018, p.79). An important aspect when conducting the analysis of the raw data, is the ability to overcome overload. The goal is to be able to condense and order the information, analyse it and write up the material (Miles et al., 2018). This is a time consuming process, Miles et al. (2018) suggests that the best known strategy for this is to use research questions and conceptual frameworks to help the researcher in the selective process of information analysis. When coding is implemented the researchers are undertaking a *data condensation* task , it enables the researcher to collect the most meaningful material

Preliminary analysis The information collected during the interviews are in unstructured format, the researchers did not want to lead the respondent if they did not go "off-theme". Respondents where eager to tell about their projects, meaning they often covered more than one question at a time. This was exactly as the researchers had planned as they wanted the respondent to tell their own side, and inform about what they saw to be the most problematic or beneficial area with blockchain implementation. As a result of this unstructured exploratory method during the interviews, the holistic coding method are used to establish more defined data chunks. This research has used holistic coding as a preparatory approach to a unit of data before the more detailed process of coding (Miles et al., 2018, p.82-83). When developing a display of the qualitative data, the holistic coding is displayed in table 3.1. Data are at this point general and are only meant to guide the researcher in the continuing effort to establish a more complex interplay between data chunks. The table

Data Chunk nr	Case 1	Case 2
1	Knowledge Sharing	Innovation
2	Control	Disruptive Technology
3	Challenges in Control	Costs VS Benefits
4	Innovation	Control
5	Organizational Change	Benefits and Challenges
6	Change Management	Challenges with regulation
7	Trust	Technological Benefits
8	Innovation	Change Management
9	Knowledge Sharing	Risk
10	Innovation	Privacy Challenge
11	Successful Partnership	Change Management
12	Cooperation	Trust
13		Control
14		Data-Driven Future
15		Control

Table 3.1: Overview of the holistic codes derived from interview

highlight effectively how the respondents are perceiving the overall picture of the situation, and through abstraction we see the main defining terms that the respondents are talking about.

3.3.4 Reliability & Validity

To enhance validity, the method triangulation is used to corroborate findings. The study uses two or more data generations methods; interviews and literature review (Oates, 2006, p.37). The triangulation will give us multiple angles of which to attack the research question(s). As with all research, the researcher and its readers needs to be conscious about the underlying philosophical paradigm for the research. When selecting a data collection method like interviews, that is a particular kind of conversation between people (Oates, 2006, p.186). The data collection is subjected to bias because the interview has been planned, and usually there is an agenda for the interviewer to steer the discussion onto their topic of interest.

3.4 Ethical issues

When planning and designing the study, it was also necessary to send a NSD application. NSD also known as the Norwegian center for research data, is responsible for managing all research projects and also offers an archive for research data. NSD has to approve the application sent to them for the researchers to collect and process potentially private information. Before any data was collected and stored for the thesis, we made sure to get approval from

NSD. To abide these rules, this study has been approved by NSD with reference number 989853.
Complications arrived when asking different organization for interviews. Some organizations were not willing to disclose any information regarding their projects. Most of the organizations we have tried to interview had been participating within a blockchain implementation project, however some have not the required security clearance and are not allowed to speak on the topic even though it will remain anonymous. This is an implication that is completely understandable as some organizations does not want to reveal their business processes. Overall we were pleased with the quality of the interview that was conducted.

Chapter 4

Findings

The cases used in this case study have been explained in the previous chapter 3, and the method and reasoning behind the method was explained in chapter 3. Here the results from both interviews and public available information are presented. The criteria of this study for selecting interview subjects was that the interviewed were representing an organization in blockchain implementation. General assumptions was made regarding the benefits and challenges of blockchain implementation; Since they are large organizations with lots of resources available they are likely to have more knowledge and capabilities compared to small to medium sized organization who do not have the technology, knowledge or capabilities for an implementation of blockchain. The chosen interviewees were implementing the blockchain in different type, therefore the research context is divided into the different types: private (permissioned) and public (permissionless). The blockchain type is determined from the collected data from the literature, news and interview. The data extracted from the organizations has been anonymous as agreed upon with NSD and the informants. With the anonymity in mind, minimal information regarding the organization is provided in this section. All the interviews were conducted through Microsoft Teams - with users supplied by University of Agder. The organizations interviewed are real and the case study data that has been given pseudonyms was gathered through public documents and interviews. This chapter will describe the parameters used in the case studies represented in two organizations of different sectors who partook in the interviews. Summary of findings are represented in table 4.1.

There were two respondents from two different organizations, that participated in the interviews, one public and one private. The goal of the interviews was to ask the different organizations about their blockchain implementation, so that it was possible to get valuable data regarding what aspects was considered important.

Company	Blockchain type	Implementation strategy	Risk evaluation	Organizational structure
PrivateBlock	Permissioned	Innovative project	No changes, or routines required	Ready for change
PublicBlock	Permissionless	Innovative intent	Risk analysis and impact assessment performed	No changes the next 5 years

Table 4.1: Summary of findings

4.1 Implementation strategy

The first area that the interviews focused on was finding out what the organizations were doing for their implementation strategy, how they were proceeding with this and what came out of it. Implementation strategy is a broad term were we focus on finding the most relevant data.

PrivateBlock specified that this was an innovative project, a strategic decision to involve newer technology and explore the potential of a solution in blockchain technology. It was a strategic decision because PrivateBlock have innovation as their main strategic objective, so they will explore anything that corresponds with PrivateBlocks purpose as a Cooperative but also - more importantly, they want to be industry leading. PrivateBlock partnered with an organization that had expert knowledge in the field of Blockchain implementation. Following the innovation process of "Design Thinking", they gathered relevant employees from their company to attend a three day workshop that where facilitated by their partner organization. During the workshop both companies exchanged their expert knowledge from their respective industries, PrivateBlock shared their competence related to their internal organizational systems and processes, while the partner organization shared their knowledge on the technology and how the technology might affect the organization.

> "We were very open about what this could be for our organization, we came up with several current ideas and thoughts on how the technology could be utilized in accordance to the real estate process."

The process was determined by going back and forward between ideas, because the more PrivateBlock learned and understood about the technology, the more they where able to understand if the solution was appropriate for the organizational purpose. However when the project had finished, it had ultimately been established that the solution was not ready for the current market. The solution where not successful in the sense that it could not be implemented as

a real world use-case of blockchain. On the other side, the project was considered a success, because the overall goal of the organization where to learn and understand how they could use the technology. PrivateBlock's CEO and every departments where satisfied with the project, even though they ended up with something they where not really looking for, they had accomplished what they set out to do which where to prove that they are an innovative organization.

> "Even though we do housing construction and housing management - which is something safe and good - we believe that the world is changing and that we must keep up and be ahead if we are to have the opportunity to continue to be a significant and large player in the market."

PublicBlock was informed about the possibilities of Blockchain technology in 2015-17 where another company suggested PublicBlock to look into Blockchain because it fitted their organizational structure. They quickly launched a public offer, and outsourced most of the project to a startup. Their project had innovative intent, they were not necessarily looking for blockchain solution, rather it was this other organization that provided them the knowledge about the blockchain systems. They were however interested in it because around the same time other organizations that were involved in PublicBlock operations, called for an openness around shareholders. Meaning that they had external incentives to explore the technology, because those benefits presented by the technology was exactly what the policymakers for the organization where calling for. They got involved in a student program where they quickly discovered their use case through cooperating and sharing relevant information between the parties.Through experimentation, PublicBlock found it necessarily to enter into a "R&D" (Research and Development Agreement) contract, where they could then start to look at MainNet and use the main chain for Ethereum. The choice of technology is not done conscious, as they emphasise that they are not in production, they do not have to take a definite stand on it. The Blockchain implementation project started of as an innovative project and now, 5-7 year later, the system are going to go live with partners hoping to establish an exchange for unlisted companies across the Nordic region in the long run.

> "This solution would be a huge efficiency mechanism for the public sector, because it is moving towards us becoming more and more data-driven."

PublicBlock has long term strategic plans for the Blockchain technology meaning that they see themselves using less resources on creating services, their role is how to ensure trust in the Blockchain. So their role would be to make sure that the information used are of quality, than actually creating the service itself.

4.2 Risk evaluation

Risk evaluation is a important aspect of implementation considerations. Being able to consider all aspects of the blockchain solution initiated, will help in discovering if the solution is adequate.

PrivateBlock mentioned that they had not done a risk evaluation of the Blockchain project. The project was an innovation project. Which meant that they were not considering using it for a real business application yet, and developed the solution to learn from it. PrivateBlock acquired knowledge about security risks, threats and vulnerabilities during the workshops that the partner organization facilitated. The security aspects of this solution had a lot to say in how it was evaluated to be implemented, as it was exactly the security features of Blockchain technology they where originally sold on and why they started the project. They expressed that they had their own routines within the organization and it explicitly would not concern the innovation project they were developing, this because they are subject to the "Financial Supervisory Authority" and would have gone through multiple dimensions of regulation before the project would have gotten approved. When asked about safety of the technology they said:

> "Today, there are settlement offices with real estate agents, who have client accounts where they receive money, and ensure that no one can control the money before the takeover or contract is fulfilled. Here we could get a greater safety in the technology, and we were very confident of that."

PublicBlock was convinced to explore possible blockchain solutions because of the security and efficiency that blockchain provides, but their biggest challenge is that PublicBlock is heavily dependent on legacy systems. For this reason, they expressed that they had performed several analysis and evaluations. They had carried out a risk and vulnerability analysis, a data protection impact assessment, and used the best in Norway to audit. Going to great lengths to ensure that the blockchain system is a viable solution to the problem they had found. They had also used the network in Ethereum to further explore how to use the decentralized blockchain. One of their early activities was to implement a "force transfer" mechanic, where one can revert and make changes in the chain. Many risks were considered as very hypothetical, e.g. 51% attacks have never occurred on well-known blockchain solutions. They expressed that they had not done a code review, or security consulting as they were not there yet with the solution.

4.3 Organizational Structure

One of the core elements asked about in the interview was how organizational structure would change depending on the solution present in the different cases. Blockchain is described as a disruptive technology and tends to affect structures and processes that are involved, to that note, the blockchain solution is entirely dependent on the purpose of the use-case. Therefore, the organizational structure and the organizational purpose will determine the most appropriate application.

PrivateBlock landed on building a blockchain that could assist in the owner registration and the sale process of apartments and homes that are specifically organized as housing stock companies. This type of real estate can be compared to co-owners or a housing association, and PrivateBlock have the responsibility for the housing limited companies in Norway. Commonly, apartments and houses are registered to the public registry of property in the "National Mapping Authority". Since PrivateBlock has the responsibility and manage these specific real estates, they saw a potential in how the organization could benefit them in their strategic objectives as a cooperative. Smart contracts was chosen as the view for handling the trade between seller and buyer, while the property itself was a token. PrivateBlock ended up testing their Blockchain application in an actual buyer situation, but there where nothing happening in the background. They never transferred the property registry to the blockchain, they only programmed the functionality for the smart contract and without connecting it to any real data.
The importance of information sharing, and elevating the internal competence in preparation for a full-scale Blockchain implementation in the organization. This is because their function as caseworkers would not be needed anymore, which means their role would be to monitor the technology and make sure that the information is correct. PrivateBlock job would be to make sure that the processes are happening as intended and that the solution are programmed correctly. If they wanted to continue with the solution, they would either agree to further the partnership with the Blockchain provider or acquired the competence in-house.
PrivateBlock emphasizes inter-organizational governance challenges, as Blockchain is still an immature technology and there were no suitable cryptocurrencies to facilitate the trading of housing stocks on the blockchain. Which meant that in order to launch their solution to the general public, they had to create an organizational currency or a digital Norwegian krone. How were they going to implement this, and should they expect the general public to carry crypto wallets? They attempted to determine how this problem could be solved

with intermediaries, where users create client accounts that are linked to banking organizations, but this would contradict the entire premise of blockchain implementation. PrivateBlock was informed by the partner organization or blockchain provider of their professional knowledge regarding other companies interested in Blockchain technology. They had information on what people, public ministries, and the regulatory unit believed about the solution, which demonstrated that large and influential actors believe this has a future purpose and are eager to investigate it.
For the general public to be comfortable with trusting Blockchain technology, they theorize that a safe-player or an organization with a well-known brand represents the technology could answer to this problem. Norway is a country where we trust each other to do what is said to be done, other countries might find the abilities of Blockchain more alluring because of a bigger need of transparency.

PublicBlock Capitalization tables (cap table) for unlisted companies exemplified a situation in which the difficulty matched the available technology. Each of the 350.000 companies in Norway owns its own cap table and is responsible for ensuring that it is always up-to-date. The current issue with cap tables is that their functions depend on being updated, but the system is so poorly coordinated as to render the function nearly useless. Initially, they considered a permissioned-based infrastructure for their blockchain, but it did not provide any additional value and would have required additional IT costs for knowledge building and additional miscellaneous expenses. So they shifted to an Ethereum-based solution. The capitalization table solution would facilitate the simplification of information for stakeholder statements, making life easier for all parties involved, and expanding PublicBlock's organizational features and capabilities.
Blockchain technology is a good fit for PublicBlock due to its all-or-nothing nature; if a transaction fails, the entire transaction is rolled back. Whatever happens, it will roll back. Exactly for this reason, makes Blockchain technology a great fit for PublicBlock, as it can solve multiple problems at once; our role is to simply add the legal requirements to the smart contracts. For instance, if they had four to five functions that govern the Company Act, which is the heart of a company's establishment and which is our responsibility, we would be responsible for them. PublicBlock could immediately begin writing these smart contract-based governance and control template documents. Using a smart contract, legislation can be programmed down to the transaction level, granting the company a completely different level of granularity. With smart contracts, all parties to a transaction are able to complete their tasks concurrently and divide up the workload. Implementing the cap table would mean

that PublicBlock would only provide the infrastructure to create the cap table, but the companies themselves would be responsible for adding the information. Investors, public sector agencies, journalists, and others will have easier access to information as a result of this.
To engage the entire organization, they had to hold numerous "general meetings" and engage in extensive internal communication. So they distributed articles, developer courses, and information blocks throughout the project. There was a great deal of interest in the innovation project, but there was no communication plan for it, so it only occurred ad hoc. The interest was also evident at the executive level, as the technology was of great interest to the entire organization, given that the systems of today does not resemble those of 15 years ago. PublicBlock had many concerns regarding the inter-organizational environment and external stakeholders, despite doing their due diligence in preparing their organization for the implementation. They were constantly confronted with the question of cryptocurrencies and digital IDs. It is difficult to justify why government funds are invested in a system rumored to be used for money laundering due to cryptocurrencies. PublicBlock emphasizes that the implementation of blockchain on a large scale is comprised of numerous components, and that they are increasingly dependent on external partners. They identify the EU Digital Program and the Swedish Public Agency, which are both engaged in separate projects but will be interconnected. This demonstrates that large-scale Blockchain implementation must be part of a larger network, such as the European Union's European Blockchain Service Infrastructure (EPSI).
They are expecting a hybrid solution for when the big changes with decentralized technology arrived, it can not be either or, we have to continuously improve and adapt to the changes. They are also expecting that there would be no major changes in the next 5 years, and that blockchain would be tied to the new technologies such as machine learning, IoT and big data. PublicBlock are sure that we are moving towards a data-driven future, where the trading of data chunks will be much more improved using Blockchain technology because of it granularity, that will maybe create different business models since we get exactly the right data at the right time. This is why, because of the massive amount of possible data. PublicBlock does not think the Blockchain solution itself will be able to handle the amount of real data that e.g. what unit registers contains. This is why PublicBlock thinks it is important to establish control mechanisms at the national level, and PublicBlock are going to continue researching this area of large-scale Blockchain implementation.

Chapter 5

Analysis & Discussions

The chapter of analysis & discussions will present our findings as related to our research questions, case and literature review. The chapter is meant to review the findings from the cases in chapter 4 and compare them to the findings from the literature review. The findings are discussed and analyzed in order to help provide evidenceevidence to the research. Our contribution will also help organizations with intent to implement blockchain solutions and give clear overview of the potential the technology presents. The chapter is split into two sections, where the first section will present a detailed analysis of the implementation strategy in use and how to proceed with blockchain. The first section will also try to summarize best practice in blockchain implementation. The second section will look to blockchain as a technology in mediated control as a concept for organizations to adopt when evaluating blockchain implementation.

5.1 Blockchain implementation implications

When evaluating the strategic blockchain implementation aspect, several features within the organizations came to light. Organizational governance, capability, features, adoption intention, transaction costs - many which were recognized by the literature review, through the framework for strategic integration. We recognize that there might be aspects and features that are outside the evaluated research such as TMC. These functions are important to evaluate when looking into how strategic blockchain implementation occurs.

5.1.1 Organizational Capability

The implementation of blockchain's primary features necessitates and compels modifications to technical resources and skills, which is referred to as organizational capability. As "capability" is a broad topic, there would be many more facets to cover if organizational capability were emphasized more. Prior to the implementation of blockchain, it is essential that the organizations in question be technologically mature or prepared. Therefore, organizations must have

up-to-date legacy systems, enhanced IT system and governance, and methods applicable to innovative processes.
Throughout the project phase, PublicBlock emphasized the significance of keeping legacy systems current, and the organization questioned their capabilities for this. They were conducting an impact analysis and attempting to keep their employees invested in the potential of blockchain technology, maintaining its capability and doing their best to enhance it. PrivateBlock was aware that they needed to increase their competency to continue maintaining the blockchain solution internally. They did consider outsourcing the maintenance to their partner organization, but because the project was not launched, no organizational changes were necessary. PrivateBlock utilized the project experience in lieu of acquiring new knowledge and skills to increase their capability.

5.1.2 Organizational Integration

Not to be confused with capability, integration focuses on the necessary organizational support for integrating technology into the organization. Support from the organization's upper management is one of the most crucial aspects of blockchain integration. If the project is acknowledged by management, then the strategic requirements, business models, and structures are aligned with the organization's goals. Literature emphasizes the significance of leadership, stating that it motivates stakeholders to embrace change and fosters inter-organizational cooperation.
Both PrivateBlock and PublicBlock initiated their blockchain projects with the intention of being innovative or as innovative projects. Therefore, both organizations are at a stage in which they seek to innovate their processes, having realized that staying updated with relevant technology is a sustainable strategy. However, there are differences between the organizations, as PrivateBlock, despite being pleased with the solution, determined that the market was not technologically mature enough, and therefore "shelved" the project. There are distinct strategic requirements, business models, structures, and challenges within PrivateBlocks's line of business that correspond with the documented technology. The company stated that it was prepared for the solution. However, there are currently too many limiting factors for them to implement the blockchain solution at this time.
PublicBlock had the backing of upper management for their innovation project, and they continued to involve the organization by sending out blockchain-related articles, news, and data blocks. Involving themselves more in the development and establishing a solid foundation for their solution through academic research and multiple processes to determine the solution's potential. They were persuaded that a blockchain solution had enormous potential in their

problem domain.

5.1.3 Organizational Governance

Aspects of inter-organizational behavior and multidimensional processes comprise organizational governance within the strategic implementation of blockchain. When evaluating implementations, it is acknowledged as a valuable construct. Inter-organizational cooperation in blockchain could introduce competition within the employed network, so there must be similar mission goals and objectives, which severely restricts blockchain's application domain. As a result of the pressure exerted by their respective markets on numerous organizations, decentralization can become an issue in and of itself, making consensus crucial.
PrivateBlock acknowledges problems with organizational governance. In Norway, they are piloting the blockchain project within their industry, but no other companies have adopted the technology as of yet. Creating a blockchain platform for their own data is equivalent to creating a traditional database, necessitating that similar organizations has to adopt this mentality and create a blockchain-based market for sustainability in this solution.

5.1.4 Security considerations

The security benefits of Blockchain are readily apparent; it improves system traceability, anonymity, and immutability, and provides transparency. It is common knowledge that blockchain technology secures system processes, but there are also security risks involved. If blockchain technology permits control over an organization's processes, it also creates a potential vulnerability. Controlling blockchain processes could have grave consequences. The oracle problem is central to this issue, acting as a single point of failure; this necessitates careful deliberation prior to implementation.
Regarding security concerns, both cases were dismissive. Arguably, because the case informants were not security specialists and had limited experience with cybersecurity and lacked security expertise. Publicblock demonstrated a greater concern for risk and potential impact, as they mentioned conducting risk analysis and personal data assessment. However, they mentioned that some of the processes they had engaged in were a waste of money, as the participation of third-party experts in certain fields was unnecessary.

5.2 Blockchain mediated control

In section 2.4.1 the case of blockchain as a technology in mediated control is explored. Replacing procedures within organizations for better streamlined processes and control. Permitting Blockchain to utilize its strengths where they

are most advantageous, a decentralized node system, where it can self-regulate or support human controllers.

Because of the disruptive nature of the technology, this research views blockchain as a potential for mediating control. It infiltrates processes within organizations and modifies the structure to accommodate its viability. Technology distinguishes TMC from one another; the manner in which a TMC performs its control or processes is dependent on the technology. In the case of blockchain technology, the control can be multilayered, allowing for the automation of the control of multiple roles. As a TMC, the automating role that blockchain plays is a crucial factor to evaluate. The automation enables human controllers to specify which rules the blockchain must adhere to; these parameters will essentially serve as the framework for how the blockchain can exert its control.

There are also considerations to be made, as the research demonstrates that blockchain-mediated control (BMC) is not risk-free. Oracles are described in section 1.2.5 as a trusted third party that serves as a gateway between the physical world and the blockchain. The gateway introduces a single point of failure, exposing the possibility of losing control.

5.2.1 CIMO in cases

When evaluating the contexts and aspects of the CIMO-logic described in section 2.4 in relation to blockchain, we attempt to identify all applicable control areas. Both cases have different blockchain implementation requirements and are implementing them in different industries, so the expected level of control would also vary.

PrivateBlock as mentioned earlier was using blockchain to complement its transaction system of share housing. The context (C) of this instance is to automate the sale process, thereby giving the blockchain control over the sale process. The documents must adhere to the procedures that have been determined by consensus. Releasing caseworkers' control over the process within the organizations. The interventions (I) enable the blockchain to eliminate and simplify time-consuming processes within the organization and redirect the workforce to other tasks. Supporting human controllers who would monitor and keep the blockchain in check, as well as secure sharing between nodes within the blockchain, would be the mechanisms (M) that enable the blockchain to achieve this capability. Using blockchain to mediate control leads to a reduction in the number of caseworkers and an increase in the sale process's efficiency, which is the outcome (O) of the automated record system.

PublicBlock considers implementing blockchain technology for their cap table. The context (C) here is to automate the regulation of cap tables, which initially takes a significant amount of time to go live and, once live, quickly becomes obsolete as values may have already been modified. Through the provided solution, stakeholders or those who will benefit most from the cap tables will assume control. Blockchain will facilitate the transfer of control to other parties, which is the intervention (I). PublicBlock would retain control of the gateway, in regards to oracle, but the parties involved in posting a cap table would be responsible for shareholder reporting and their own new capital issuance marketing. Consensus-based blockchains and smart contracts will be the mechanisms (M) that enable the processes, regulating the tables so that they are always up-to-date. In this instance, the outcomes (O) will be a more efficient release of cap tables to assist private companies in calculating their market value, as well as fewer regulatory controls overall.

Chapter 6

Conclusions

This thesis set out to explore how blockchain can operate as a Technology-Mediated Control technology, which were explored through a case study and conceptualized using the state-of-art research in the cybersecurity discipline. To achieve this objective, research question were formulated to methodologically collect relevant data. This chapter will conclude the thesis by discussing the significance and contribution of the key research findings in relation to the research objectives and questions. In addition, it will assess the study's limitations and suggest avenues for future research.

Blockchain can provide numerous benefits to organizations. It requires intensive coordination between the implementing organization and its partnered organizations. The mindset of rapid innovation that many organizations use to explore new and exciting technologies aids in identifying the potential of blockchain technology. Through the cases, the informants acknowledged the difficulty in implementing blockchain technology. There are various adoption intentions within the field. The larger organizations are utilizing their resources to innovate their blockchain exploration.

To guide the research objective, research questions were formulated to collect evidence and data pertinent to this topic; *What possibilities exist for blockchain technology to mediate control?* and *What are the plans for blockchain adoption in implementation projects?* The research questions and literature review allowed us to assess blockchain's viability as a control mechanism. As no other text mentions the control-exercising capability of blockchains, it became difficult to differentiate the various context in which the blockchain transfers or inherits control. Nonetheless, based on the concept as a starting point, it is true that blockchain can serve as a control intermediary. Qualitative interviews were conducted to discover new and pertinent research regarding the reasons why organizations adopt blockchain technology. The organizations discussed the complexities involved in implementing or developing blockchain solutions during the interviews. Together, the research question, literature review, interviews, and case study formed the key contribution of this thesis, blockchain

mediated control.
Despite the fact that it is difficult to draw conclusions without more research subjects and data, this study yielded a number of findings. In both permissioned and permissionless blockchain solutions, cybersecurity risk is of little concern to managers. Blockchain is viewed primarily in terms of its advantages, with little consideration given to its disadvantages. Permissioned is viewed as having higher costs, whereas permissionless is viewed as having less control over the solution. The primary distinction between public and private solutions was their market maturity. The private permissioned solution required that the market be sufficiently mature for inter-organizational cooperation to proceed with the solution. While the public permissionless solution did not face this issue, despite the fact that PublicBlock was not in production and legacy systems were a problem, the market maturity had a lesser impact on implementation.

Suggestion for Future Research In regards to risk assessment in the field, the real problem identified in the BMC is the Oracle problem, it can propagate the amount of risk a organization face in regards to control. In allowing the control to exist in the blockchain, gateways can become a single point of failure within the solution. Therefore, it is essential that future research efforts continue to concentrate on the Oracle Problem in relation to blockchain-based smart contract solutions. Regarding the specific case studied for the purpose of this research, it was later confirmed that the blockchain solution for "PrivateBlock" was continued by "PublicBlock" and will be released this year (2022). It is necessary to conduct additional research on the inter-organizational capabilities of blockchain in order to comprehend how this technology can benefit the entire society.

Contribution to Practice Companies seeking to implement blockchain technology for their security controls should conduct an assessment to facilitate the alignment of their business and technological strategies. Respondents to this study had initiated an innovative project to determine how this could benefit the organization; the blockchain use-case that most closely aligned with the business control purpose was chosen for further investigation. Therefore, the importance of cooperative relationships between businesses is emphasized to facilitate in-depth knowledge of blockchain and the intended control purpose that blockchain can provide.

Bibliography

101Blockchains. (2020). How blockchain will change organizations. https://101blockchains.com/how-blockchain-will-change-organizations/

101Blockchains. (2021a). Hybrid blockchain: The best of both worlds. https://101blockchains.com/hybrid-blockchain/

101Blockchains. (2021b). What are the different types of blockchain technology? https://101blockchains.com/types-of-blockchain/

Alexander, E. (2017). The oracle problem-an analysis of how blockchain oracles undermine the advantages of decentralized ledger systems.

Alliance, I. C. (2018). *Cooperative identity, values & principles*. https://www.ica.coop/en/cooperatives/cooperative-identity 02.05.22

Aste, T., Tasca, P., & Di Matteo, T. (2017). Blockchain technologies: The foreseeable impact on society and industry. *computer*, *50*(9), 18–28.

Beck, R., Müller-Bloch, C., & King, J. L. (2018). Governance in the blockchain economy: A framework and research agenda. *Journal of the Association for Information Systems*, *19*(10), 1.

Biswas, B., & Gupta, R. (2019). Analysis of barriers to implement blockchain in industry and service sectors. *Computers & Industrial Engineering*, *136*, 225–241.

Buterin, V. (2014). A next-generation smart contract and decentralized application platform. white paper. https://ethereum.org/en/whitepaper/

Cho, S., Lee, K., Cheong, A., No, W. G., & Vasarhelyi, M. A. (2021). Chain of values: Examining the economic impacts of blockchain on the value-added tax system. *Journal of Management Information Systems*, *38*(2), 288–313.

Choudhury, A. (2021). 10 largest data centres in the world. https://analyticsindiamag.com/10-largest-data-centres-in-the-world/

Cram, W. A., & Wiener, M. (2020). Technology-mediated control: Case examples and research directions for the future of organizational control. *Communications of the Association for Information Systems*, *46*(1), 4.

Crosby, M., Pattanayak, P., Verma, S., Kalyanaraman, V., et al. (2016). Blockchain technology: Beyond bitcoin. *Applied Innovation*, *2*(6-10), 71.

Cruz, J. P., Kaji, Y., & Yanai, N. (2018). Rbac-sc: Role-based access control using smart contract. *Ieee Access*, *6*, 12240–12251.

Dawson, P. (2021). 2021 hype cycles: Innovating delivery through trust, growth and change. https://emtemp.gcom.cloud/ngw/globalassets/en/doc/documents/2021_hype_cycles_innovating_delivery_through_trust_growth_and_change.pdf

Dhillon, V., Metcalf, D., & Hooper, M. (2017). Decentralized organizations. *Blockchain enabled applications* (pp. 47–66). Springer.

Dinh, T. T. A., Wang, J., Chen, G., Liu, R., Ooi, B. C., & Tan, K.-L. (2017). Blockbench: A framework for analyzing private blockchains. *Proceedings of the 2017 ACM international conference on management of data*, 1085–1100.

Du, W. D., Pan, S. L., Leidner, D. E., & Ying, W. (2019). Affordances, experimentation and actualization of fintech: A blockchain implementation study. *The Journal of Strategic Information Systems*, *28*(1), 50–65.

Er-Rajy, L., El Kiram My, A., El Ghazouani, M., & Achbarou, O. (2017). Blockchain: Bitcoin wallet cryptography security, challenges and countermeasures. *Journal of Internet Banking and Commerce*, *22*(3), 1–29.

Garg, P., Gupta, B., Chauhan, A. K., Sivarajah, U., Gupta, S., & Modgil, S. (2021). Measuring the perceived benefits of implementing blockchain technology in the banking sector. *Technological Forecasting and Social Change*, *163*, 120407.

Goderdzishvili, N., Gordadze, E., & Gagnidze, N. (2018). Georgia's blockchain-powered property registration: Never blocked, always secured: Ownership data kept best! *Proceedings of the 11th International Conference on Theory and Practice of Electronic Governance*, 673–675.

Gonczol, P., Katsikouli, P., Herskind, L., & Dragoni, N. (2020). Blockchain implementations and use cases for supply chains-a survey. *Ieee Access*, *8*, 11856–11871.

Haber, S., & Stornetta, W. S. (1990). How to time-stamp a digital document. *Conference on the Theory and Application of Cryptography*, 437–455.

Henry, W., & Pawczuk, L. (2021). Blockchain: Ready for business. https://www2.deloitte.com/uk/en/insights/focus/tech-trends/2022/blockchain-trends.html

Huang, L., Zhen, L., Wang, J., & Zhang, X. (2022). Blockchain implementation for circular supply chain management: Evaluating critical success factors. *Industrial Marketing Management*, *102*, 451–464.

Irannezhad, M., Shokouhyar, S., Ahmadi, S., & Papageorgiou, E. I. (2021). An integrated fcm-fbwm approach to assess and manage the readiness for blockchain incorporation in the supply chain. *Applied Soft Computing*, *112*, 107832.

Kemmoe, V. Y., Stone, W., Kim, J., Kim, D., & J., S. (2020). Recent advances in smart contracts: A technical overview and state of the art. *IEE Access*, *8*, 117782–117801.

Kohli, R., & Liang, T.-P. (2021). Strategic integration of blockchain technology into organizations. *Journal of Management Information Systems*, *38*(2), 282–287.

Kostić, N., & Sedej, T. (2020). Blockchain technology, inter-organizational relationships and management accounting: A synthesis and research agenda. *Inter-Organizational Relationships and Management Accounting: A Synthesis and Research Agenda (May 16, 2020)*.

Kouhizadeh, M., Saberi, S., & Sarkis, J. (2021). Blockchain technology and the sustainable supply chain: Theoretically exploring adoption barriers. *International Journal of Production Economics*, *231*, 107831.

Lee, Y., & Lee, K. M. (2019). Blockchain-based rbac for user authentication with anonymity. *Proceedings of the Conference on Research in Adaptive and Convergent Systems*, 289–294.

Liang, T.-P., Kohli, R., Huang, H.-C., & Li, Z.-L. (2021). What drives the adoption of the blockchain technology? a fit-viability perspective. *Journal of Management Information Systems*, *38*(2), 314–337.

Litan, A. (2021). Hype cycle for blockchain 2021; more action than hype. https://blogs.gartner.com/avivah-litan/2021/07/14/hype-cycle-for-blockchain-2021-more-action-than-hype/

Miles, M. B., Huberman, A. M., & Saldaña, J. (2018). *Qualitative data analysis: A methods sourcebook*. Sage publications.

Morrison, R., Mazey, N. C., & Wingreen, S. C. (2020). The dao controversy: The case for a new species of corporate governance? *Frontiers in Blockchain*, *3*, 25.

Mosakheil, J. H. (2018). Security threats classification in blockchains. *Culminating Projects in Information Assurance*.

Nakamoto, S. (2008). Bitcoin: A peer-to-peer electronic cash system. *Decentralized Business Review*, 21260.

Natarajan, H., Krause, S., & Gradstein, H. (2017). Distributed ledger technology and blockchain.

Nguyen, G.-T., & Kim, K. (2018). A survey about consensus algorithms used in blockchain. *Journal of Information processing systems*, *14*(1), 101–128.

Oates, B. J. (2006). *Researching Information Systems and Computing*. Sage.

Okoli, C. (2015). A guide to conducting a standalone systematic literature review. *Communications of the Association for Information Systems*, *37*(1), 43.

Ølnes, S., Ubacht, J., & Janssen, M. (2017). Blockchain in government: Benefits and implications of distributed ledger technology for information sharing.

PRISMA. (n.d.). *Prisma flow diagram*. http://prisma-statement.org/prismastatement/flowdiagram.aspx

Rahman, M. U., Guidi, B., Baiardi, F., & Ricci, L. (2020). Context-aware and dynamic role-based access control using blockchain. *International Conference on Advanced Information Networking and Applications*, 1449–1460.

Ridley, D. (2012). *The literature review: A step-by-step guide for students*. Sage.

Sangha, P., Rugg, R., Brumfield, A., & Mustata, C. (2022). Crypto and blockchain acceleration in uncertain times. https://www.ibm.com/blogs/blockchain/2022/05/crypto-and-blockchain-acceleration-in-uncertain-times/

Siddiqui, S. T., Ahmad, R., Shuaib, M., & Alam, S. (2020). Blockchain security threats, attacks and countermeasures. *Ambient communications and computer systems* (pp. 51–62). Springer.

Sobolewski, M., & Allessie, D. (2021). Blockchain applications in the public sector: Investigating seven real-life blockchain deployments and their benefits. *Blockchain and the public sector* (pp. 97–126). Springer.

Spahiu, E., Spagnoletti, P., & Federici, T. (2022). Beyond scattered applications: A taxonomy of blockchain outcomes in the public domain. *Blockchain technology applications in businesses and organizations* (pp. 239–264). IGI Global.

Statista, R. D. (2022). Global blockchain solutions spending 2017-2024. https://www.statista.com/statistics/800426/worldwide-blockchain-solutions-spending/

Tang, H., Shi, Y., & Dong, P. (2019). Public blockchain evaluation using entropy and topsis. *Expert Systems with Applications*, *117*, 204–210.

Tapscott, D., & Vargas, R. V. (2021). Blockchain is changing how companies can engage with customers. https://hbr.org/2021/01/blockchain-is-changing-how-companies-can-engage-with-customers

Thakur, V., Doja, M., Dwivedi, Y. K., Ahmad, T., & Khadanga, G. (2020). Land records on blockchain for implementation of land titling in india. *International Journal of Information Management*, *52*, 101940.

Tiron-Tudor, A., Deliu, D., Farcane, N., & Dontu, A. (2021). Managing change with and through blockchain in accountancy organizations: A systematic literature review. *Journal of Organizational Change Management*.

Vu, N., Ghadge, A., & Bourlakis, M. (2021). Blockchain adoption in food supply chains: A review and implementation framework. *Production Planning & Control*, 1–18.

Wegrzyn, K. E., & Wang, E. (2021). Types of blockchain: Public, private, or something in between. https://www.foley.com/en/insights/publications/2021/08/types-of-blockchain-public-private-between

Zhang, A., Zhong, R. Y., Farooque, M., Kang, K., & Venkatesh, V. G. (2020). Blockchain-based life cycle assessment: An implementation framework and system architecture. *Resources, Conservation and Recycling*, *152*, 104512.

Zheng, Z., Xie, S., Dai, H.-N., Chen, X., & Wang, H. (2018). Blockchain challenges and opportunities: A survey. *International Journal of Web and Grid Services*, *14*(4), 352–375.

Ziolkowski, R., Miscione, G., & Schwabe, G. (2020). Decision problems in blockchain governance: Old wine in new bottles or walking in someone else's shoes? *Journal of Management Information Systems*, *37*(2), 316–348.

Appendix A

Interview Guide

Interview Guide for "Blockchain technology effect on cybersecurity management"

The questions under each theme are meant as a guiding question for the interviewer, they may not be asked exactly as it is written here, but the interviewer will fit the question to the tone and environment for the interview. This is in accordance with the method for data gathering related to our research questions.

Theme 1: Blockchain Technology Development

- Purpose: Gathering of responders' experiences with the process of developing blockchain in-house or outsourced technologies.

  High level questions:

  1. What was your technical experience when developing and implementing blockchain into your organization?
     i. The process
     ii. The development
        1. Permissioned / permissionless
        2. Private / Public
  2. What is your opinion on the technical processes that are now changed?
     i. Any challenges
     ii. New tasks
     iii. Tasks that are not relevant anymore
  3. What organizational changes and new skillsets are required to work with blockchain technology? Are required personnel available in the organization or do you implement other strategies (e.g. training, recruiting new staff, hiring temporary experts)?
  4. What strategies have been taken to "internalize" this new technology in your organization, and especially to those who have limited knowledge on the meaning of the adoption of this new technology?
  5. How has the blockchain affected your business and customers?

Theme 2: Cybersecurity Management

- Purpose: Gather responders' perceptions on the management of cybersecurity risk, threats and vulnerabilities before/during/after implemented blockchain

  High Level Questions:

  1. What is your experience with risk management of blockchain technology?
     i. Framework
     ii. Expert Experience/Advice
     iii. Threats, vulnerabilities and risks isolated to blockchain

2. Are you able to inform us about how you evaluated the necessary security measures needed for implementation of blockchain from development till the finished system?
    1. "Blockchain is a comprehensive technology, replacing many protocols and procedures. It also introduces new risks, e.g. 51% attacks"

Theme 3: Organizational Structure

- Purpose: Gather responders view on changes made to the organizational structures, but only in relations to the implemented technology.

  High Level Questions:

  1. What are your impressions on the changes made to the organizational structure?
     i. Significant changes (Small, but important, changes)
     ii. Communication – self efficacy
     iii. Efficiency / Tardiness
     iv. Autonomy / Complexity
  2. Is the organization (or the board?) pleased with the implementation of blockchain?
     i. Why?
  3. Are new rules, regulation and policies introduced to the organization? Can you give examples?

Appendix B

Consent Form

Vil du delta i forskningsprosjektet

"Blockchain-teknologiens effekt på cybersikkerhetsstyring"?

Dette er et spørsmål til deg om å delta i et forskningsprosjekt hvor formålet er å undersøke implementasjon av blockchain teknologier effekt på risk håndtering.. I dette skrivet gir vi deg informasjon om målene for prosjektet og hva deltakelse vil innebære for deg.

Formål
I denne masteroppgaven vil vi undersøke kvalitative beslutninger som tas under implementasjonen av blockchain teknologi. Vi vil undersøke prosesser som blockchain rører ved, spesielt i lyset av sikker ledelse av prosjekter.
Vi har ønsker å analysere dette temaet fra tre vinkler:

1. Dine erfaringer med en vellykket implementering av blockchain teknologi ved bruk av «inhouse» eller «outsourcet» resurser.
2. Dine oppfatninger på hvordan man skal få til hvordan man håndterer cyber risk, trusler og sårbarheter før/under/etter implementasjon av blockchain.
1. Din innsikt i hvordan dere gjøre endringer til organisasjonen sin struktur, for å tilrettelegge implementasjon av teknologien.

Hvem er ansvarlig for forskningsprosjektet?
Universitetet i Agder er ansvarlig for prosjektet.

Hvorfor får du spørsmål om å delta?
Vi spør deg om å være med, fordi du er vurdert til å være en relevant kilde til informasjon. Du er i utvalget, kun fordi du har erfaring med implementering/salg av produkter innen blockchain teknologi. Det er frivillig å svare på spørsmålene og i din rett å velge hvilket svar du gir.

Hva innebærer det for deg å delta?
Hvis du har lyst å delta i forskningsprosjektet, vil vi ha et intervju med deg. Et intervju er en samtale der vi stiller deg forskjellige spørsmål. Spørsmålene vil handle om din egen vurdering av implementasjon av blockchain teknologi. Vi vil gjøre lydopptak av intervjuet og intervjuet vil ta ca. 45 minutter.

Det er frivillig å delta
Det er frivillig å delta i prosjektet. Hvis du velger å delta, kan du når som helst trekke samtykket tilbake uten å oppgi noen grunn. Alle dine personopplysninger vil da bli slettet. Det vil ikke ha noen negative konsekvenser for deg hvis du ikke vil delta eller senere velger å trekke deg.

Ditt personvern – hvordan vi oppbevarer og bruker dine opplysninger
Vi vil bare bruke opplysningene om deg til formålene vi har fortalt om i dette skrivet. Vi behandler opplysningene konfidensielt og i samsvar med personvernregelverket.

Personer som vil ha tilgang til dine personopplysninger er som følger:

1. Kajsa Rosnes Bogen, Masterstudent
2. Henning Van Ta, Masterstudent
   Jaziar Radianti, Førsteamanuensis (Veileder)
   Paolo Spagnoletti, Førsteamanuensis (Veileder)

Hva skjer med opplysningene dine når vi avslutter forskningsprosjektet?
Opplysningene anonymiseres når prosjektet avsluttes/oppgaven er godkjent, noe som etter planen er 31.12.2022. Opptak skal være slettet så snart de er transkribert, og all personlig identifiserende informasjon blir slettet.

Hva gir oss rett til å behandle personopplysninger om deg?
Vi behandler opplysninger om deg basert på ditt samtykke.

På oppdrag fra Universitetet i Agder har Personverntjenester vurdert at behandlingen av personopplysninger i dette prosjektet er i samsvar med personvernregelverket.

Dine rettigheter
Så lenge du kan identifiseres i datamaterialet, har du rett til:

- innsyn i hvilke opplysninger vi behandler om deg, og å få utlevert en kopi av opplysningene
- å få rettet opplysninger om deg som er feil eller misvisende
- å få slettet personopplysninger om deg
- å sende klage til Datatilsynet om behandlingen av dine personopplysninger

Hvis du har spørsmål til studien, eller ønsker å vite mer om eller benytte deg av dine rettigheter, ta kontakt med:

- Universitetet i Agder ved Jaziar Radianti e-post er jaziar.radianti@uia.no
- Henning Van Ta ved hennit17@uia.no
- Vårt personvernombud: Johanne Warberg Lavold, e-post Personvernombud@uia.no

Hvis du har spørsmål knyttet til Personverntjenester sin vurdering av prosjektet, kan du ta kontakt med:

- Personverntjenester på epost (personverntjenester@sikt.no) eller på telefon: 53 21 15 00.

Med vennlig hilsen,

Kajsa Rosnes Bogen, Henning Van Ta,
Jaziar Radianti og Paolo Spagnoletti

Samtykkeerklæring

Jeg har mottatt og forstått informasjon om prosjektet “Blockchain-teknologiens effekt på cybersikkerhetsstyring”, og har fått anledning til å stille spørsmål. Jeg samtykker til:

- ☐ å delta i Intervju

Jeg samtykker til at mine opplysninger behandles frem til prosjektet er avsluttet den 03.06.2022

(Signert av prosjektdeltaker, dato)