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The Blockchain technology´s applicability

A research project within governments and sustainability

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Abstract

The Blockchain technology is still in the progress of reaching its plateau of productivity, even though it has been emerging since the release of the Bitcoin whitepaper in 2008. This is illustrated as the concrete applicability and benefits of the Blockchain technology for governments and other organizations is still to be emphasized. Additionally, the Blockchain technology hasn't been made understandable for the majority of the public, due to its relatively high demand of technical knowledge and flair.

Research show that the Blockchain technology has the potential to change the world equivalent to what the internet did, which is why the abovementioned is concerning. This is the motivation behind this research project, which purpose is to examine how the Blockchain technology can be beneficial for governments, and especially with a sustainable purpose.

The research project proposes recommendations to an ongoing Swedish project called R:ekobyn, which wants to investigate the applicability of the Blockchain technology. The recommendations are within the Blockchain technology´s applicability for governments, governance and sustainability. Additionally, recommendations related to optimizing governments´ ability to transform will be proposed.

The research project enlightens the Blockchain technology´s challenges and identify areas where governments have to be cautious and remember that not everything that can be digitalized should be digitalized. The proposed recommendations concludes that the Blockchain technology´s applicability in governments can be beneficial as well as foster sustainability. All of the research project´s recommendations can be applicable for all types of organizations and are not relevant for governments.

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1. Introduction

1.1 Opening

The Blockchain technology emerged for the first time when the Bitcoin protocol was released in 2008. The Bitcoin cryptocurrency got enormous attention and was, in the first years, the front runner for the Blockchain technology. As time went, and the Bitcoin´s hype decreased, the technology behind Bitcoin, the Blockchain technology, began to catch attention. This attention has led to the perception that the Blockchain technology has the potential to change the world equivalent to what the internet did (Tapscott D., et al., 2016). This has led to initiatives being launched, but as the Blockchain technology still is in its early stage, research for how it can be applied is still necessary. Research directly towards the Blockchain technology has, until now, been relatively low, as only 20% of the total research regarding the Blockchain technology is enlightening other Blockchain technologies/applications than Bitcoin (Yli-Huumo J, et al, 2016). Despite the relatively low research, research has still exposed that the Blockchain technology potentially can improve governance and sustainability. This can be achieved through some of the main benefits that is connected to the Blockchain technology which are, security, decentralization, transparency and traceability (Cagigas D., et al., 2021, Ølnes S., et al., 2017, Strebko J., Romanovs A., 2018, Geroni D, 2021). For organizations, which have sustainability in focus, the Blockchain technology is very promising as it could foster sustainability (Kaskikallio D., 2021). This research project aims towards investigating how the Blockchain technology can improve governance and foster sustainability.

1.2 Problem definition

The current situation in the world regarding the environmental challenges and the emergence of the Blockchain technology, which potentially can contribute to a more sustainable world, provides a unique possibility of applying theory and literature to investigate how the Blockchain technology can influence the world. In relation to the abovementioned the research project´s purpose is to answer the following research questions:

- *How can public service delivery of the municipality be improved by means of this promising technology?*

- *How can governmental organizations increase their sustainability by implementing Blockchain?*

1.3 Structure

This section will walk through the research project´s structure. Section 1 will cover the research project´s introduction, and opening, problem definition and delimitation. Section 2 will present the research project´s methods, research philosophy, research approach, research design, techniques and procedures and validation, reliability and sufficiency. Section 3 will present the Blockchain technology to achieve a thorough understanding of the technology. Section 4 will present the governance as a term, including Elinor Ostrom´s eight design principles and the Social-Ecological Systems framework. Section 5 will present a project description of the theoretical case the research will target its findings towards. Section 6 will describe the applied data and the theoretical case´s purpose for the research project. Section 7 will present the theoretical framework which will set the stage for the analysis together with section 8, the literature review of the Blockchain technology in governments. Section 9 will analyze the Blockchain technology´s benefits and challenges. The challenges lead to the next section, section 10, where the challenges related to governments and the Blockchain technology will be discussed. Section 11 will finally conclude on the research project´s findings and results. At last, section 12 will evaluate and sum up the research project.

1.4 Delimitation

This section will clarify the boundaries which the author has been subject to. The first section below will enlighten the technical level and the type of organization which is in focus in the research project.

The first point of the delimitation is the technical perspective in the research project. This research project is not a technical research project where there will be made any in-depth thorough technical analysis of the Blockchain technology or any related concept. This research project will enlighten several technologies, but there will be no solution design at a technical level.

The next point is related to the type of organization in the research project. The research project will have its core focus on governments which is seen in the literature review, analysis, discussion and conclusion. Even though the focus is on governments, it is important to mention that it doesn't entail that other types of organizations can´t benefit from the research project, as the majority of the findings and recommendations is applicable for all types of organizations.

2. Methods

This section will elaborate and seek to account for the decisions which has been made according to the approach and reflection regarding the chosen methods during the research project. The section will therefore present the assumptions behind the theoretical and philosophic decisions for the research project. This will include selection, collection and analysis of data (Saunders, Lewis, & Thornhill, 2016). The purpose of this section is to identify the most optimal methods to answer the research projects research questions. To structure and organize this section, the author has created *The Research Onion*, through inspiration from Saunders et al. (2016). *The Research Onion* compose a total of six layers which each contain underlying steps that are instrumental when data collection and analysis procedures is to be decided. *The Research Onions* outer layers elaborate on the methodologic considerations and the inner layers elaborate on project specific reflections. Through the adaptation of this model, it will be used to consider and justify the choices related to methodology. The model will furthermore secure coherence due to the methodic being addicted to former methodic considerations (Saunders et al., 2016).

The Research Onions outer layers consist of (1) *research philosophy* and (2) *research design*, then the model reach the inner layers (3) *research strategy*, (4) research choice, (5) *time horizon* and (6) *technique*.

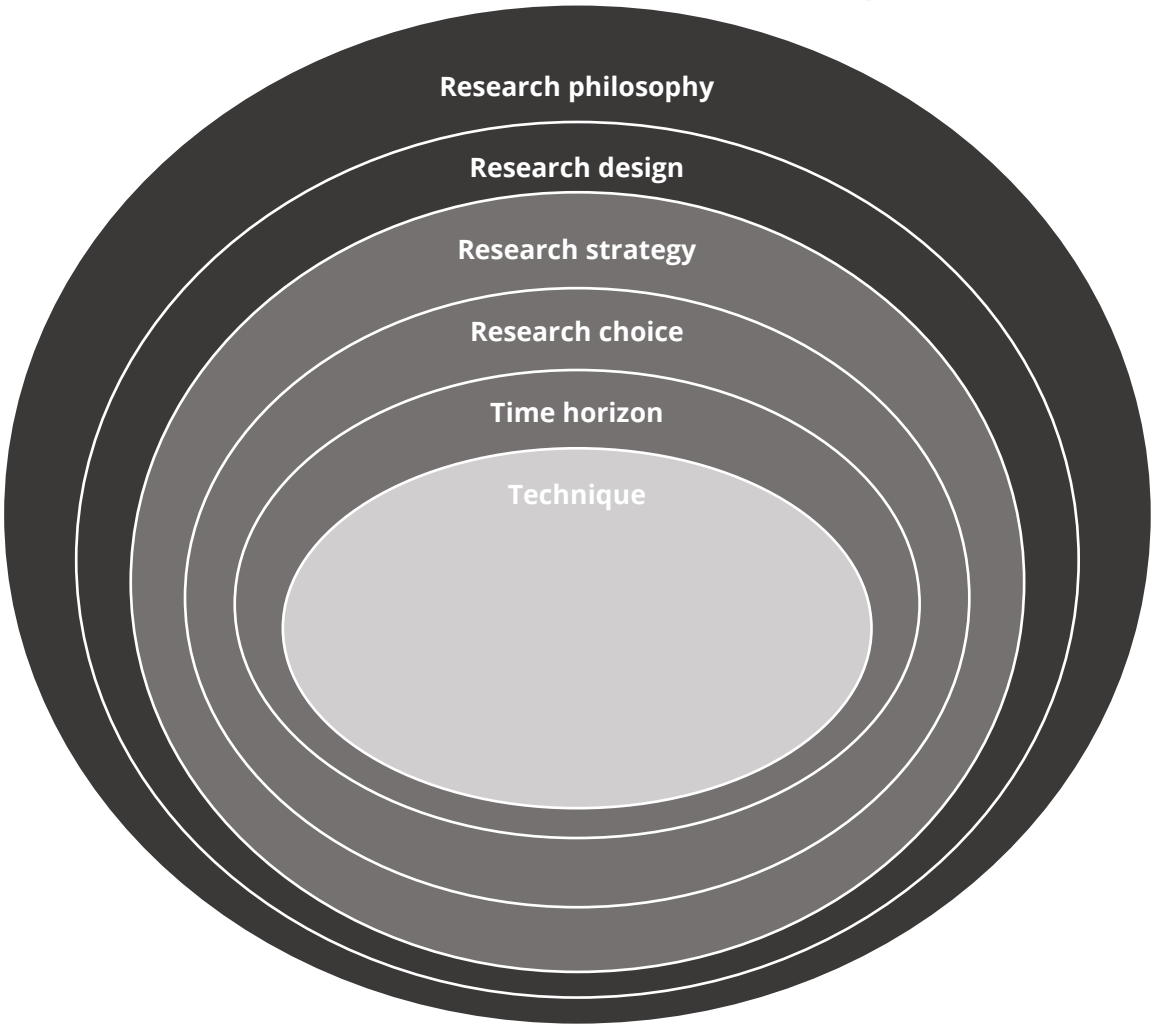

Figure 1.1. The research onion. Source: With inspiration form Saunders et al. (2016), but with own modifications.

2.1 Research philosophy

According to Saunders et al. (2016) *research philosophy* does refer to a system build from convictions and assumptions about progression of knowledge. It is essential for research scientists to master the ability to distinguish between these assumptions when you refer to them in a research project. To create a coherent research project and answer the research question, it is essential to be aware that there will be created different types of assumptions which will influent the research project and the way of thinking. When we as scientist investigate scientific research, we work with two aspects which has an essential influence on the methodology. The first aspect is Ontology which is the philosophical study of being. The second aspect is epistemology which is the philosophy concerned with knowledge (Holm, 2016).

If we take a look at natural scientists, they wish to explain phenomenon through objective and quantitative data which result in their predictions. These predictions occur through causality which is the relation between cause and effect. Through a scientific theoretical approach, this research project will be based on the positivistic paradigm (Holm, 2016). The essential part of the positivistic paradigm is that the empiric observations foster the scientific process. The empirical observations result in theories which enables scientist to create "law of cause" (everything that happens has a cause, and that same cause always produces the same effect). Positivism has a realistic ontological vision on what is real. As earlier described, ontology is the philosophical study of being, and scientific theory deal with the relationship between the observer and the observer's observation. The reality within positivism is materiel and consists of objects and individuals. This led to objects which can be observed and investigated exists independent of the observer (Holm, 2016).

The positivism is through its epistemological conviction that knowledge can be secured and therefor be objective. This imply that the "law of cause" is the positivisms ideal because it is possible to acquire knowledge which is objective independent of the observer. To verify scientific work, which is essential for the positivism, it occur when the work is being observed and therefore can be verified (Holm, 2016).

Quantitative methodology is often being used within the positivism. This is done by collecting a large number of observations which purpose is to confirm the "law of cause". The research project has used the abovementioned scientific method to substantiate several points during the research project.

2.2 Research approach

Having determined the philosophical choices of the study, the next step is the considerations of the research project´s approach. There is three different reasonings that can be used to develop theory, deductive, inductive and abductive. The reasonings vary from what extent we, as researchers, are aware of the theory at the beginning of our research. The deductive reasoning takes a hypothesis-driven approach related to existing theory

(Nisbet R., et al., 2018). The inductive reasoning involves collecting data to explore a phenomenon and from there develop a theory (Saunders et al., 2016). The abductive reasoning starts with the researchers wonder or surprise at an observation, phenomenon or case and then tries to understand the observation by making the surprise less surprising through the use of theory (Saunders et al., 2012).

This research project originated from the abductive reasoning by being curios regarding the Blockchain technology and the technology's potential, especially in relation to sustainability. Therefore, the abductive reasoning is the reason behind this research project´s creation and will have a natural and essential role to play during the research project. Furthermore, this research project will also use the inductive reasoning which also characterize the positivistic paradigm. The purpose by using the inductive reasoning is to conclude something generally from a few cases. A minority of empirical cases are collected, and it is assessed what these have in common, in order to then derive theory (Holm, 2016).

2.3 Research design

After having elaborated on the first two layers of *the research onion* this section will clarify the research design. In the research design, you find the next three layers in *the research onion*: *methodological choice, research strategy* and *time horizon*, which will be covered in this section (Saunders et al., 2016). The research design is the plan for how the research project intend to

answer the research questions and it specifies the sources the study has used to collect data, as well as how this collection is intended (Saunders et al., 2016).

2.3.1 Methodological choice

This research project will use the quantitative research because it fits both the abductive and inductive reasoning when developing new theory through the collected data (Saunders et al., 2016). Quantitative data are being used in the research project several times to substantiate the findings. Quantitative data is very useful to make a point clear by draw in quantitative facts. The positivistic paradigm is often associated with the quantitative

research which strengthens the research project´s use of this method and use of the positivistic paradigm.

2.3.2 Research strategy

After having clarified the methodological choice, the research strategy needs to be considered and determined. The research strategy can be seen as a plan for how the project will achieve its targets (Saunders et al., 2016). This research project uses an experiment as research strategy which is characterized by researching the effect and potential the Blockchain technology can have in relation to governance and sustainability. This is seen when the research project is mapping the Blockchain technology, first to Elinor Ostrom´s eight design principles, and second to sustainability.

2.3.3 Time horizon

The time horizon for this research project is cross-sectional because the research project´s goal is to explore the possibility to govern Blockchain and investigate how Blockchain can foster sustainability (Saunders et al., 2016). The research project does not use any of the observation's multiple times at different times nor follow any development of the observations over periods, which would have made the research project´s time horizon longitudinal (Saunders et al., 2016).

2.4 Technique

The last layer in the research onion touch upon the technique the research project has used. This section will therefore clarify the research project´s data collection.

2.4.1 Primary and secondary data

Data can be categorized in two, primary and secondary data. Primary data is data collected by the author and secondary data is data collected by other sources (Saunders et al., 2016). This research project will be using only secondary data and no primary data. The secondary data which the research project has made use of is academic studies, articles and books to compose the research project. By collecting data from several sources, the research project is using triangularity in order to get a thorough perspective on the chosen area of interest (Arksey H, & Knight P., 1999).

2.5 Validation, Reliability and Sufficiency

To round off the methods used in the research project and evaluate the research´s quality it is essential to enlighten the project´s reliability, validation and sufficiency. These three terms are essential when working with quantitative research (Saunders et al., 2016).

Validation evaluates the research project´s correlation between the term or subject which is being enlightened and the used data. To secure the validity, it must be assessed whether what is desired to be described is also what is measured on (Saunders et al., 2016). The research project aims towards creating recommendations to the R:ekobyn project regarding implementation of the Blockchain technology to achieve more sustainability and to investigate the applicability of the Blockchain technology for governments. To enable this, data has to be extracted from a lot of different sources because the Blockchain technology still is in its early stages of emergence. The different sources include academic studies, articles, research papers and books. Especially, research papers will be used frequently due to the high level of research which the research project will perform. To enable the evaluation whether the research project has achieved is purpose, it has to be made measurable. But as this is a research project, the purpose is to find at least one solution to the research question (Namakhwa R., 2018). As this is presented in the conclusion as recommendations, with the mention that this isn't an end-to-end solution, the research project can be thoroughly validated.

Reliability describes the research project´s accuracy and credibility (Saunders et al., 2016). Complete reliability designates that if the exact same research project was performed once again, the conclusion will be the same. As this is a research project´s purpose broad and could go in many directions it is hard to expect that the exact same conclusion would be performed. In order to have achieved a higher degree of reliability, the research questions should have been more precisely stated and with a technology which was more mature. But as stated in the delimitation the research project gets more precise and the reliability strengthens.

The research project´s sufficiency is determined by the applied data and the conclusions that can be drawn on the basis of this (Holm, 2016). Because the research project has limited itself to investigating the Blockchain technology in relation to governments and sustainability, it would be hard to copy the conclusions to other technologies. But is would very much be applicable for other organizations than governments to use the research project to investigate potential benefits within the Blockchain technology. This research project can be relevant for all types of organizations.

3. The Blockchain technology

This section will distinguish the Blockchain technology which will be a paramount section for the research project in order to achieve a higher knowledge for the Blockchain technology´s history, applicability, current and potential influence and benefits. First of all, to gain the best understanding of the Blockchain technology as possible, the next section will explain the essential key concepts and underlying technologies within the Blockchain technology.

3.1 Introduction to the Blockchain technology and its concepts

This section will explore and explain how the Blockchain technology works. It will be broken down in sections where each concept will be explained. The reader is expected to possess a certain level of technical understanding, but with the explanation the goal is to make it understandable for everyone. The concept´s, which are about to be explained, is the hidden workers that runs the Blockchain technology, the key characteristics as well as the advantages of the concepts.

3.1.1 Public key cryptography

The first concept which will be explained is the public key cryptography. The public key cryptography is used to encrypt and decrypt which it does through a public key and a private key. The public key is used to encrypt data and the private key is used to decrypt data. The public key can be shared widely while the private key shouldn't. The public key

and private key are linked together meaning that the specific public key only can be decrypted with the linked private key (Salomaa A., 2013).

3.1.2 Digital signatures

The second concept is digital signatures. This concept is used to verify the authenticity of a message or document and is based on the public key cryptography explained above. The digital signature´s purpose is to verify that it is the original message and that it hasn't been tampered (Salomaa A., 2013).

3.1.3 Cryptographic hashes

The third concept is cryptographic hashes. This concept´s functionality is to take any input and make it into an output with a fixed length. The cryptographic hash is only performed one way and therefore it can´t be decrypted to reveal the original message (Thomsen S. S., 2009).

3.1.4 Smart contracts

The fourth concept is smart contracts. Smart contracts are software which contain a contract. The smart contract can execute and fulfil what is stated in the contract automatically. It will be activated by a dependency. This can be used to foster automatically control and if the rules aren't obeyed the contract will execute and penalize the violator automatically (Stuart D., et al., 2018).

3.1.5 Decentralization

The fifth concept is decentralization, which is present because there is no central authority who needs to validate each transaction. Instead, every node in the network can validate a transaction, which improves security as central authorities could be compromised through internal corruption and fraud or external attacks (Cagigas D., et al, 2021).

3.1.6 Persistency

The sixth concept is persistency, which is done through the use of consensus mechanisms, timestamps and cryptography. Persistency mitigates the risk of invalid transactions and makes it close to impossible to edit, delete or copy transactions which are already on the Blockchain (Cagigas, D., et al, 2021).

3.1.7 Anonymity

The seventh concept is anonymity, which is protected by public-key cryptography and identification through ”zero-knowledge-proof”-protocols (Cagigas, D., et al, 2021).

3.1.8 Auditability

The eighth concept is auditability, which is the storage of all transactions in chronological order. Each block contain data from the previous hash from the previous block. This foster transparency of all transactions and makes irregularities in the transaction history very easy to discover (Cagigas, D., et al, 2021).

3.1.9 Tokenization

The ninth concept is tokenization, which is an essential feature in the Blockchain technology as it is the process of transforming the rights to perform an action on an asset to a transferable data element, also called a token, to the Blockchain. The tokenization has, e.g., been used to an authorization regarding access to specific reports (Azaria A., et al., 2017, Liu M, 2016). Tokenization is in Bitcoin used as an abstraction of the actual coin, which is being used to make transactions between people. The cryptocurrencies have actually led to being a product of the tokenization due to the Blockchain´s facility for the creation, transfer and management of the tokens. Furthermore, the tokenization has made third parties unnecessary when transactions between users are happening (Huckle S., White M., 2016, Rozas D., et al., 2021).

3.1.10 Tokenization

The tenth concept is DAOs, which present and surpasses all former levels of autonomous software agents because the DAOs don’t have any central servers (Franklin S., Graesser A., 1997). Once the DAOs has been started it can´t be shut down, only if a shutdown function has been programmed in the DAO´s code. The DAOs are 100% autonomous and continues to function if there is an individual or software which are interacting with the DAOs. The DAOs can interact as autonomous users where their functionalities can vary from holding tokens, making transactions with other DAOs etc. DAOs are actually so autonomous that they can hire users to solve tasks, sell their own services and resources. DAOs are so autonomous that they can charge users by selling their services in order to

be able to pay for services that they need themselves (Di Filippi P., Hassan S., 2016, Rozas D., et al., 2021).

The abovementioned concepts are what the Blockchain technology can bring to a lot of different areas, private companies, public institutions and industries. It can have its influence in various ways, be used for many purposes and bring many possibilities. The next section will explain the Blockchain technology´s history briefly.

3.2 The history of the Blockchain technology

The Blockchain technology is still quite new to a lot of people, but it was actually already described in 1991 for the very first time by Stuart Haber and W. Scott Stornetta (Javatpoint, "History of Blockchain", n.d.). In the article, "How to time-stamp a digital document" by Haber and Stornetta (1991), they came up with the idea to timestamp digital documents so they could be secure from being altered or tampered. Their next thought was to create a system where the documents could be stored and secured, their idea was to create a cryptographical secured chain of blocks (Javatpoint, "History of Blockchain", n.d.). Haber and Stornetta kept working on it and in 1992 they implemented a mathematical data structure called Merkle Trees created by Ralph Merkle around 1979. The Merkle Trees is also known as the Hash Tree because it is composed of hashes of different blocks of data. The Merkle Tree´s function is to summarize all the transactions within one block (Javatpoint, "Blockchain Merkle Tree", n.d.) The Merkle Tree is still being used in modern Blockchain projects and was the foundation for Bitcoin, a cryptocurrency and one of the most known Blockchain technology use cases. To understand what the Blockchain technology enables the EU-Commission has defined it in the following quote: *"Blockchain technology allows people and organizations who may not know or trust each other to collectively agree on and permanently record information without a third-party authority. By creating trust in data in ways that were not possible before, blockchain has the potential to revolutionize how we share information and carry out transactions online"* ("Understand how EBSI is managed and discover", n.d.). To sum up the Blockchain technology, it is a data structure which hides and tracks data transactions in a secure and transparent way without any individual

or organization owns or control the system (Dehlin J., et al., 2021). To achieve the highest understanding of the Blockchain technology and its current applicability, the cryptocurrencies and especially Bitcoin will be enlightened in the next section.

3.3 Cryptocurrencies

This section will introduce the fundamentals within cryptocurrencies and deep dive into the cryptocurrency Bitcoin. First, the next section will explain some of the most essential concepts within the cryptocurrencies and especially Bitcoin.

3.3.1 Introduction to cryptocurrencies and Bitcoin

A cryptocurrency is a digital currency which is built through the use of the Blockchain technology. The cryptocurrencies only exist digitally and are using cryptography to make it nearly untamperable and avoid double-spending. The key characteristic is that cryptocurrencies aren't controlled or governed by any governments or regulating authorities and is instead distributed decentralized. This means that no one has to verify the transactions because it is a decentralized peer-to-peer system which enables anyone to send and receive payments (Ashford K., Schmidt J., 2022). To get a thorough understanding of the cryptocurrencies, the cryptocurrency, Bitcoin, will be explained.

Bitcoin was introduced by an unidentified person or group under the pseudonym Satoshi Nakamoto in 2008 when the Bitcoin whitepaper was released (Nakamoto, 2008). By the introduction of Bitcoin, the technology allowed users to send and receive funds through a decentralized peer-to-peer system, without interacting through a third party, e.g., a financial institution. Bitcoin is built on cryptography, like Haber and Stornetta described in 1991, which eliminates the trust issue. According to the whitepaper, a chain of digital signatures, defined as an electronic coin, enable transactions between users. Every time a transaction occur the owner of the coin transfer the coin to the next owner by digitally signing a hash of the previous transaction and adding the public key of the next owner to the end of the coin (Nakamoto, 2008). The Bitcoin Blockchain is distributed among its users as an unlimited growing untamperable database. To securely execute a transaction and get stored at the ledger, each transaction goes through the mining process

(Frankenfield, J., 2022). In the mining process, users on the network try to solve a puzzle called Proof-of-Work. The puzzle is a 64-digit hexadecimal number called a hash, which the users shall try to come up with something equal or less than the hash (Frankenfield, J., 2022). The first user who solve the puzzle is added to the Blockchain and is rewarded with Bitcoin and the ledger will then be distributed to all the participants and validation is affirmed and double spending is avoided. This is the mining process, simply explained, which makes transactions irreversible and allows users to make transactions among each other without using a third party (Nakamoto, 2008). The Blockchain technology has its benefits within and is appropriate at managing challenges regarding data integrity, quality and transparency, enhancing security and privacy, and mitigating fraud and manipulation. The Blockchain technology can additionally reduce corruption and enhance trust through digital governance (Ølnes S., et al., 2017). The Blockchain technology is able to enhance these benefits through its key characteristics which will be briefly explained below (Batubara, R. F., et al, 2018):

3.3.2 The concepts behind the cryptocurrencies

The first concept which will be explained is blocks. When a transaction is made, the block is placed in the network so it can be confirmed. The block is containing a list of previous transactions with data on each of the blocks. By going through all the blocks, it enables confirmation of the latest block. This is securing the transactions and adds trust to it as well (Nakamoto S., 2008).

The next concept is mining which is connected to the blocks. Mining is the process of how new coins are added and confirmed on the network. In this concept the blocks are linked together to form a blockchain and sorted by time. To validate a block, the block has to refer to a previous block. This is an extremely complex mathematical problem and the first computer to find the solution receives the next block which starts the process again. The overall advantage and purpose of mining is to legitimize, monitor and validate transactions (Hong E., et al., 2020, Becker J., et al., 2013).

The third concept is consensus mechanism which is used to validate the authenticity of and securing the transactions. The purpose of the consensus mechanism is to reach

agreement. The cryptocurrency Bitcoin uses Proof-of-Work (PoW). PoW is requiring decentralized participants who validate that blocks. These validators are in Bitcoin known as miners. The miners compete to process the block´s transaction and add it to the blockchain ("WisdomTree market insight consensus mechanism overview", 2021).

The fourth concept is zero-knowledge-proof. This concept is used to foster immutability and security. There are two roles, the prover who needs to prove something, and the approver who approve. The advantage of the zero-knowledge-proof is that the prover can prove the truth of specific data or information without revealing the data or information (Enwood D., 2021).

3.3.3 The relationship and influence between Blockchain technology and Bitcoin

Bitcoin has acted as the front runner for the Blockchain technology since it emerged, and several cryptocurrencies have been created afterwards and have adopted the Blockchain technology. Bitcoin and other cryptocurrencies are strongly associated with each other through the blockchain technology, and the general public has the perception that it is the same. To explain and distinguish between Bitcoin and Blockchain the research project will make use of a well-known analogy. If you think of a lightbulb, Bitcoin is the lightbulb and the Blockchain technology is electricity, which gives the lightbulb power. While the lightbulb is dependent on the electricity, the electricity isn't dependent on the lightbulb and can be used for more than this purpose. The same goes with Bitcoin and the Blockchain technology. Bitcoin is dependent on the Blockchain technology, but the Blockchain technology isn't dependent on Bitcoin and can be used for more than this purpose.

Most people in the digitalized part of the world have encountered Bitcoin and other cryptocurrencies and therefore the Blockchain technology. Bitcoin and other cryptocurrencies are constantly expanding the markets they are available at. This had brought Bitcoin´s value up to 68.000 USD, at its highest (DeMatteo, M., 2022). Bitcoin and cryptocurrencies have gained massive exposure in the media during the last years but the mistrust to Bitcoin and other cryptocurrencies has a huge effect on the spreading of the Blockchain technology. The Blockchain technology suffers under the bad rumors connected to

cryptocurrencies which has to be stopped in order for the Blockchain technology to fulfill its purpose. From this point, the thesis will no longer be having its focus on Bitcoin and cryptocurrencies but have its core focus on the Blockchain technology´s possibilities and potential.

3.4 The Blockchain technology in governments

This section will enlighten the Blockchain technology´s current state and possible influence in governments. Furthermore, how and where the Blockchain technology can influence governments will be highlighted and who the actors are.

The adoption of the Blockchain technology is indisputable and investments during recent years has increased heavily. The size of the Blockchain technology market worldwide has grown from 1.2 billion U.S. dollars in 2018 to 12.7 U.S. dollars in 2022 and are expecting to hit 39.7 billion U.S. dollars in 2025 ("Blockchain technology market size worldwide 2018-2025"., 2022). The Blockchain technology has the ability to completely change organizational structures and communication and it is often being categorized as a disruptive technology, perhaps the most disruptive technology in decades (Venkatesh, C. R., 2018). Several governments and organizations have invested in the Blockchain technology in order to distinguish the possibilities through the Blockchain technology. An example of this is the EU Blockchain Observatory & Forum´s initiative which is initiated by the European Commission. The initiative is intended to *"The EU Blockchain Observatory and Forum's goal is to create a community to discuss and highlight key developments of blockchain technology and strengthen partnerships in Europe and beyond. It is committed to enhancing the understanding of the blockchain technology, its applications and the larger economic ecosystems in which it can play an important role"* ("EU Blockchain Observatory & Forum", n.d.). With the Blockchain technology´s number of initiatives in governments being relatively low (Killmeyer J., et al., 2017), the EU´s involvement, investment and initiation of the EU Blockchain Observatory & Forum initiative are assuming to affect the future number of initiatives to be higher in the coming years. Blockchain projects is expected to rise within the following areas in governments in the future (Dehlin J., et al., 2021):

• Title/asset registrations: including land or business registry.

• Educational certification and credentials.

• Healthcare: including data for research or patient ownership of data and records. Given the sensitive nature of the data and problems with sharing data in multi-provider systems. Blockchain also offers a clear audit trail and ownership.

• Government funding: increasing accountability in aid spend or increased transparency in government expenditure.

• Supply chain traceability and tracing: ensuring food safety or traceability of goods, as well as tracking volume of trade in goods.

• Taxation and excise: combatting VAT fraud, streamline VAT systems and how tax is calculated and collected.

• Democracy and dialogue: for instance, e-voting or the introduction of liquid democracy systems and improved.

• Identity: perhaps the widest use case for blockchain in government is that of digital identity.

Source: Kommunerna och blockkedjan – en analys av de svenska kommunernas användning av blockkedjetekniken by Jörgen Dehlin – Hanna Wallin – Jelena Zec

The abovementioned areas are the ones where the Blockchain technology has its biggest potential to influence and possibilities within the Swedish public sector according to Jörgen Dehlin, Hanna Wallin and Jelena Zec. In order to achieve the best recommendations as possible, this research project will not distinguish all of the areas above.

To enable further research this research project will, in this section, distinguish where its main focus regarding different actors will be. To do this, the different key actors and their potential will be described. The three key actors who can gain advantages from the Blockchain technology is governments, civil servants and citizens (Cagigas, D., et al, 2021). For governments the Blockchain technology can improve efficiency in bureaucratic processes and data management, which will lower the risk for human errors and minimize costs. For civil servants the Blockchain technology can reduce the amount of bureaucracy,

paperwork and errors in their daily work. For the citizens the Blockchain technology can be used to secure their data, create transparency in the public sector and give the citizens control over their personal data (Cagigas D., et al, 2021). The academic literature contains several examples where the Blockchain technology can be beneficial for governments and the public sector, but a vast majority of these does not include empirical evidence (Ølnes, S., et al., 2017). The reason behind this is that there are common concerns regarding scalability, flexibility and security, due to the continuously negatively affection and steadfast perception of the cryptocurrencies (Ølnes S., et al., 2017, Batubara R. F., et al, 2018, Cagigas D., et al, 2021, Lyons T., Courcelas L., 2020, Meng T., et al, 2021). But with the initiative mentioned before, by the EU Blockchain Observatory & Forum, the development of evidence regarding the Blockchain technology´s deployment in governments and the public sector are assumed to rise in the nearest future. This research project will have its primary focus on the application of the Blockchain technology in governments. The purpose of this research project is to serve as a basis for future development and supply the reader with recommendations within the area. To do this, the research project will try to connect its findings to a current project from Sweden, which will be described in section 5.

4. Governance

In this section the governance term will be enlightened in order to connect the term with the Blockchain technology later in the research project. The section will contain a description of how governance is understanded, achieved and being thought of today. Furthermore, Elinor Ostrom´s eight design principles will be described in order to connect the governance term with Elinor Ostrom´s design principles which later in the research project will be connected to the Blockchain technology. Lastly, the Social-Ecological Systems Framework will be used to connect the Blockchain technology and governance with sustainability.

4.1 Governance explained

The governance term can be defined as a system by which entities are handled and controlled. Governance is applicable for decision making, behavior, accountability,

management and control within structures and processes and has influence on how an organization function and how it achieves and fulfil its purpose. Governance is not a single activity by which you secure a healthy and working governance in your organization. To achieve a successful governance it requires strategic planning, performance evaluation and risk management. Governance is a key element in every successful organization ("Governance can be defined as", 2022).

A successful governance in an organization can help strengthen and preserve stakeholder trust which can result in various benefits for the organization through the social and emotional support from the stakeholders. If trust isn't achieved between an organization and its stakeholders, it can have fatal consequences for the organization. Through good governance an organization can support its management and staff to perform their best as possible. To establish the basis for a high-performance organization, through governance, the board must provide the framework for planning, implementing and monitoring the performance. Without this high-performance governance, it will be hard to succeed in building a high-performance organization. As all organizations aim towards being high performing, the governance within this area is all organizations´ goal. To ensure that an organization is capable of keep being a high-performance organization, big requirements are necessary. As all organizations are competing in a fast-paced environment with constant changes, the time to respond to changes is crucial. Technology is the key driver for this transformation, and for organizations to keep being alive and profitable, they need to have a governance which supports the organization to identify threads, changes and emerging technologies. Even though threads, changes and emerging technologies are occurring faster than ever, they don't just appear "over-night", and a well-structured governance system can prevent an organization from being disrupted to being the disrupter ("Governance can be defined as", 2022).

4.2 Elinor Ostrom´s governance

Elinor Ostrom (Ostrom) was an American political scientist who investigated the borderland between political science and economics. She had her main focus on the use and distribution of natural resources such as forests and fisheries, and how this could be

improved. She referred to these common pool resources (CPR), e.g., fisheries, forests, grazing fields etc., as commons. In 2009 she received the Nobel prize in economy for her analysis of how local cooperation can solve collective problems in connection with the governance of common resources - and at least as effectively as state regulation or privatization. Ostrom meant that cooperation increases the legitimacy of decisions among citizens and users of a resource. The key is that the concrete, locally designed institutions create the conditions for trust and self-regulation. Ostrom's studies imply that human rational actions are bound to circumstances and also based on morality and values (Pedersen, K., H., et al, 2019).

The commons are as David Bollier (2011) defines it as a social system of resources which preserves shared values and community identity. The system is self-organized, and the community manages the resources which are depletable and replenishable. The resources have minimal or close to no reliance on the market or state (Bollier D., 2011). David Bollier (2011) additionally adds that the commons are *"The wealth that we inherit or create together and must pass on, undiminished or enhanced, to our children. Our collective wealth includes the gifts of nature, civic infrastructure, cultural works and traditions, and knowledge. A sector of the economy (and life!) that generates value in ways that are often taken for granted – and often jeopardized by the Market-State"*. There is no overall inventory system in relation to the commons. The commons arises whenever the community decides to manage the resource in a collective manner. The action of starting to manage a resource often occur when the resource isn't perceived as infinite. The commons aren't just a resource, it is a resource but with a layer of rules applied on the resource in order to manage it which is defined by the community. A lot of resources have changed from just being a resource to being a commons because of the humanity´s knowledge has evolved, e.g., oceans and atmosphere. A commons isn't a commons without being commoning. Commoning is the rules and norms for how to manage a resource to achieve a collective benefit for the community. There are different forms of commoning dependent on the commons and there is no standard for how to perform commoning, only patterns and principles (Bollier D., 2011). David Bollier (2011) states a problem which has occurred due to the enclosure of the commons, the expropriation and commercialization of shared

resources, which typically is done for the private market´s gain. The enclosure can be seen in the amount of patenting, the use of copyrights, the privatization of oceans and land, and attempts to transform the internet into a closed. David Bollier (2011) depicts that enclosure is related to dispossession and that it privatizes and commodifies resources which belong to a community or to the whole world and spoil a commons-based culture with a market order. The market order tends to have less commitment towards locations and cultures besides those parameters being indispensable. A classic commons are a small-scale resources which are having its focus on natural resources and exactly this, are more than two billion people depending on in their everyday life. Examples on the classic commons are forests, waters, fisheries, wildlife and other natural resources. To protect the commons and enable the commoners´ to work at larger scales and protect their resources from market enclosure there is a need for new laws and social practices. The network has been a natural infrastructure host for commons by providing accessible, low-cost spaces where people has been able to develop new forms of governance, rules and social practices. This has resulted in countless examples of productive commons due to the free and open-source software, e.g., Wikipedia, foras, open access scholarly journals, etc.

If the classic commons, like forests, waters, fisheries and wildlife are unhampered used by individuals who have open access to the commons, it can lead to depletion of the commons (Hardin G., 1968). This concept is called the tragedy of the commons. The concept originates as a problem where individuals have an incentive to consume a resource as much as possible at the expense of all the other users. In the end the resource is over-consumed, and the resource is no longer available for anybody (Hardin G., 1968) Hardin (1968) meant that the tragedy of the commons couldn't be governed and therefore not avoided. But Ostrom (1990) challenged this. To prevent the tragedy of the commons a set of rules can be applied which all users of the resource have to accept so the resource can avoid extinction (Ostrom E., 1990, "What is tragedy of the commons", Investopedia, 2022).

To govern and manage the commons between people, groups, communities, governments, companies and countries, Ostrom developed eight guiding principles for managing the commons, which are stated below:

1. Clearly defined boundaries.

   Individuals or households who have rights to withdraw resource units from the CPR must be dearly defined, as must the boundaries of the CPR itself.
2. Congruence between appropriation and provision rules and local conditions.

   Appropriation rules restricting time, place, technology, and/or quantity of resource units are related to local conditions and to provision rules requiring labor, material, and/or money.
3. Collective-choice arrangements.

   Most individuals affected by the operational rules can participate in modifying the operational rules.
4. Monitoring.

   Monitors, who actively audit CPR conditions and appropriator behavior, are accountable to the appropriators or arc the appropriators.
5. Graduated sanctions.

   Appropriators who violate operational rules are likely to be assessed graduated sanctions (depending on the seriousness and context of the offense) by other appropriators, by officials accountable to these appropriators, or by both.
6. Conflict-resolution mechanisms.

   Appropriators and their officials have rapid access to low-cost local arenas to resolve conflicts among appropriators or between appropriators and officials.
7. Minimal recognition of rights to organize.

   The rights of appropriators to devise their own institutions are not challenged by external governmental authorities.

For Common Pool Resources (CPR) that are parts of larger systems:

8. Nested enterprises.

   Appropriation, provision, monitoring, enforcement, conflict resolution, and governance activities are organized in multiple layers of nested enterprises.

Source: Elinor Ostrom, "GOVERNING the COMMONS", 1990.

Ostrom´s eight design principles will be used in the research project to investigate if and/or how the Blockchain technology can support the design principles to achieve better governance.

4.3 Social-ecological systems framework

In relation to the section above regarding Ostrom´s governance and eight design principles, this section will distinguish the social-ecological systems framework which is ideal to identify interactions and outcomes in social-ecological systems.

The social-ecological systems framework (SESF) is a conceptual framework and is providing variables which may be interacting and effecting several outcomes in social-ecological systems (SES) (Ostrom E., 2007, Ostrom E., 2009, Poteete A., et al, 2010). The origin of the framework comes from a long history of research within the commons, institutions and collective action e.g., Ostrom E., (1990), Agrawal A., (2001), Meinzen-Dick R., et al., (2002), Anderies J., et al.
(2004), Wollenberg E., et al., (2007), and Poteete A., et al., (2010).

This long history of research resulted in a correlation between the variables and types of institutional arrangements which where the most likely to enable individuals to work together and solve the social dilemmas regarding public goods and common pool resources (Ostrom E., et al., 1994, Olson M., 1965, Schlager E., 2004). This work challenged the former perception by Hardin (1968) which was, as mentioned earlier in the research project, that the tragedy of the commons was inevitable (Hardin G., 1968, Partelow S., 2018). The research illustrate that the actors actually can develop self-organized institutions to govern the commons, without privatizing of the commons or make use of state regulation (Partelow S., 2018). This has resulted in an empirically list of variables which showed the multitude of influences that affect the development of governance institutions (Ostrom E., 2005, Anderies J., 2004, Agrawal A., 2003). The variables form a list of social and ecological variables which are influencing cooperation and self-organized governance in the collective action theory (Ostrom E., 1990, Olson M., 1965, Poteete A., et al., 2010). The theory of collective action in the commons literature explores the hypothesis regarding whether if

actors can cooperate and self-organize the development of institutions for natural resource governance (Partelow S., 2018). The success of this cooperation is determined by different social and ecological conditions. Another dependency regarding the success of the collective action theory is the understanding of the complex and interdependent linkages between social and theoretical variables. It became problematic to establish theoretical claims, regarding that a specific group of variables would affect the sustainability in predictable and generalizable ways across different cases. This led to the creation of a nontheoretically list of variables which acted as a checklist of potential variables that had influence on the specific case and it´s outcome. The list of variables shifted to act as a checklist from which it enabled users to diagnose key variables and interactions which could influence the outcome. The shift to a diagnostic approach has been described metaphorically as being similar to a medical process where patients are diagnosed through the use of a standardized checklist (McGinnis M. D., Ostrom E., 2014, Partelow S., 2018). The diagnostic approach can enable key variables to be identified to help solve the desired problem. To solve the environmental problems, the SESF presents a list of generalizable variables which can be used to enhance sustainability (Ostrom E., 2007, 2009). However, the diagnostic approach has challenges regarding not being explicitly linked to the collective action theory, it is a proven theoretical construction that it is under the collective action theory (Ostrom E., 1990, 1998, Ostrom E., et al., 1994, Poteete A., et al., 2010). The challenge is what the theoretical inclusion criteria for new variables in order to modify the SESF is (Partelow S., 2018).

The SESF is structured in two tiers of concepts and variables, the first tier contains Resource System (RS), Resource Units (RU), Governance System (GS), Actors (A), Social, Economic and Political Settings (S), Interactions (I), External Ecosystems (ECO), and Outcomes (O) (Partelow S., 2018). The second tier is also concepts and variables, but much more specific, which are mapped under each of the first-tier concepts and variables. The SESF places an institutional and anthropocentric lens on the analysis of the use of natural resources regarding commons. Additionally, the SESF also creates understanding between how and why cooperation can influence governance structures, activities and their ability to achieve a sustainable outcome. Furthermore, the SESF´s ability to diagnose the

sustainability and develop new theories in the SES has been proven (Ostrom E., 2009, Cox A. G., et al., 2016).

The SESF is moving towards being considered and used as an action theory tool to identify sustainability in SES, rather than a theoretical framework (Ostrom E., 2009). This shift has made the SESF much more applicable and relevant in today's society, as sustainability is one of the most discussed themes all around the world (Partelow S., 2018, Fischer J., et al., 2015, Liu C., et al., 2007).

5. Project description

This section will enlighten the specific project the research project has chosen to use as a theoretical case. This project will later in the research project be used to propose the recommendations to and similar projects will be able to benefit from the recommendations. Furthermore, the project will be used to establish a basis for future development within the area of the Blockchain technology´s implementation and involvement in governments.

The project the research project will use is a project which is part of the BLockchain IN Government (BLING) project. The BLING project´s purpose is to *"combining the expertise of knowledge institutions and the playingfield of municipalities and governmental organisations together with businesses and citizens, investigate what role Blockchain can be for governments"* (BLING - BLockchain IN Government, n.d.). The research project will enlighten the project called R:ekobyn which is located in Röstånga in Sweden. R:ekobyn wants to create conditions for ecological, social and economic housing and are investigating circularity. Circularity is a model regarding consumption and production, which use materials, products and resources as long as possible (Kirchherr J., et al, 2017). The non-profit association that runs R:ekobyn wants to find climate-sustainable technical solutions for the common challenges that exist around heating, energy and construction technology. They also want to create common spaces and activities, such as a common workshop, for a more efficient use of resources. However, there is no framework, based on evidence-based research, for how projects such as R:ekobyn should be managed when goals, visions and resources are

common and involve several different parties such as future residents as well as public and private actors (R:ekobyn - Utkast projektskiss).

The R:ekobyn´s purpose is to provide a feasibility study, which intends to create a network based on Ostrom's (SES) framework and blockchain technology. The R:ekobyn´s idea is to make an evaluation of the feasibility study after one year, where lessons learned from that will be analyzed. The evaluation is important because the network is partly based on a relatively new technology, the Blockchain technology, and partly on a theoretical framework that may be difficult to understand at first. The evaluation element can also be useful for drawing lessons for future similar networks in other projects in the Öresund-Kattegatt-Skagerak region. In the long run, the networks can collaborate and learn from each other.

The purpose of bringing in the R:ekobyn project in the research project is to provide a valuable basis for future implementation projects regarding the Blockchain technology in governments. The R:ekobyn project will furthermore promote the creation and governance of common resources and foster sustainability through the Blockchain technology, which is an important part of the transformation to a more sustainable world.

6. Data

In this section the research project´s data will be enlightened. The data the research project has been using is articles, research literature and theory. This emphasize that the research project only has used secondary data, because the research project hasn't conducted any interviews it-self or created any type of surveys. The research project has not used the applied case, R:ekobyn, to collect specific information, e.g., creating surveys, conducted interviews at all. The reason behind using the R:ekobyn project as a case has solely been to recommend how they can implement and apply the Blockchain technology. All recommendations have been made through research within the field of the Blockchain literature. This determine that the research project has used the case, the R:ekobyn project, as a theoretical case.

7. Theorical framework

In this section the research project´s theories will be introduced. Common for the theories is that they will be used to explore how the Blockchain technology can be used in relation to Ostrom´s eight principles. The research project has chosen to enlighten the PESTEL framework which will be used to achieve an overall and complete understanding of the Blockchain technology and the environment it acts in. Additionally, Gartner´s hype cycle will be used to distinguish what phase the Blockchain technology current is in and what the next phase will be subject to. The ending of the research project will connect the theories, Blockchain technology and Ostrom´s eight principles with the R:ekobyn project, which will create a basis and inspiration for future similar projects.

7.1 PESTEL framework

This section will make use of triangularity which favors range over precision and contribute to get a complete overview of a certain area, technology, business etc. The PESTEL framework is being used to secure that the research project is getting a thorough understanding of the Blockchain technology in order to answer the project definition the best as possible (Arksey H, & Knight P., 1999).

Even though the PESTEL framework commonly are being used to enlighten a whole organization or company, the Blockchain technology fulfils all the criteria for analyzing it through the PESTEL framework despite being a technology.

As the research project originate from the abductive reasoning by being curios regarding the Blockchain technology the PESTEL framework is very useful to examine a market or area and is often used in connection with Porters Five Forces and SWOT analysis. The PESTEL framework supplies with an essential understanding of the external environment, which is crucial when describing a company or organization, and in this research project the Blockchain technology (Albu P., 2014), which is exactly what will be done. In this section the foundation of the PESTEL analysis will be established in order to achieve a higher understanding in the analysis. Each letter in the PESTEL framework has a specific meaning as seen below:

P = Political

The political factors determine the extent to which a government can influence the economy or a particular industry, in this research project the Blockchain technology. An example might be that a government introduces a new tax or duty that can change the structure of the business.

E = Economic

The economic factors have an important influence on how a business conducts business and also how profitable they are. They include economic growth, interest rates, exchange rates, inflation, disposable income and consumer disposable income and unemployment.

The factors in the economy can have a direct or indirect long-term impact on a company, as it affects the purchasing power of consumers and may change supply / demand in the economy.

These factors can also be divided into macroeconomic and microeconomic factors. Macroeconomic factors deal with the management of demand in a given economy. A government will use interest rate controls, tax policy and public spending as their main mechanisms.

S = Social

The social factors are the areas that involve the common beliefs and attitudes of the people. This includes population trends such as population growth, age distribution, income distribution, career attitude, safety weight, health awareness, lifestyle attitudes and cultural barriers. Those factors are especially important for making a targeted marketing as it is in this factor the companies can really understand the customer.

An example of this can be buying trends for Scandinavian countries, where there is great demand during the holiday season.

T = Technological

The technological factors are constantly changing and affects companies in the market. These factors can influence decisions to enter or not enter certain markets, to launch or not to launch certain products, or to outsource production activities abroad.

E = Environmental

The environmental factors are something the companies can't downgrade and therefore it is an important factor in the PESTEL analysis.

These factors include ecological and environmental aspects such as weather, climate, environmental offsets and climate change, which can particularly affect agriculture and tourism.

L = Legal

The legal factors are the need for knowledge regarding what is and what is not legal to be an ethical company. If a company has plans to join new global country, it is important that they familiarize themselves with the legal rules. In addition, the company must be aware of any changes in the legislation and the impact it may have on the company.

7.2 Gartner´s hype cycle

In order to dive deeper into the Blockchain technology and its external environment, which has been elaborated on through the PESTEL framework (section 7.1), Gartner´s hype cycle will allow the research project to distinguish in what state the Blockchain technology are in and through that try to predict where it is going in the coming years. Gartner´s hype cycle is a graphical depiction of a common pattern that all technologies and other innovations go through. Gartner´s hype cycle distinguishes between five phases and the overall goal for Gartner´s hype cycle is to track a technology´s or innovation´s maturity and potential. The five phases are technology trigger, peak of inflated expectations, trough of disillusionment, slope of enlightenment and plateau of productivity ("Gartner´s hype cycle", n.d.). The five phases will be enlightened below.

The first phase a technology and innovation will go through is innovation trigger. In this phase, the technology and innovation will be emerging and the potential for a possible

breakthrough arises. The technology and innovation are gaining interest from the public due to the medias who will hype the technology and innovation. The next phase a technology and innovation will go through is peak of inflated expectations. The technology and innovation have now gained media coverage and the "wow effect" takes off. This results in the hype deflates, as no one is making use of the technology and innovation. After having faced the first amount of adversity, the technology and innovation will enter the stage of disillusionment in the phase called trough of disillusionment. In this phase the technology and innovation will fail to deliver what was expected as experiments and implementations fail to deliver. The technology and innovation will only survive this phase if they improve their use of the technology and innovation so early adopters sees satisfactory benefits. The second to last phase the technology and innovation will go through is the slope of enlightenment phase. In this phase the satisfactory benefits are spreading, and more successful examples of the technology and innovation emerges. The technology and innovation are being widely understood in the public and the benefits is starting to become crystal clear. Additionally, second- and third-generation products appear as more companies, enterprises and organizations investigates the technology and innovation and launch pilots. The more conservative and cautions companies, enterprises and organizations are still not investigating the technology and innovation. The last phase is plateau of productivity. In this phase the technology and innovation are becoming mainstream as the accessibility, viability and applicability are clearly defined. The pilot projects are proving their relevance and maturity are reached ("Gartner Hype Cycle, Interpreting technology hype", n.d.).

8. Literature review of the Blockchain technology in governments

In this section the research project will establish a thorough theoretical foundation for the Blockchain technology in governments. The literature review will investigate the Blockchain technology's applicability and governance promises drawing on some of the most important contributions within the literature. After providing a thorough understanding of the Blockchain technology´s applicability and governance promises, the literature review will enlighten the Blockchain technology in relation to sustainability in order to drag a clear line towards the R:ekobyn project later in the research project. After the literature

review the analysis will be initiated which will be guided from the theoretical framework and the literature review.

Since the Blockchain technology entered the market, it has been heavily discussed and researched. Most of the discussions and research have been centered around bitcoin due to its new perspective on the monetary system. One of the academic research papers which has had its core focus on the Blockchain technology is Yli-Huumo J, Park Sooyong P, Choi S, Smolander K, (2016). This article has investigated the current state of the Blockchain technology, and their findings show that only 20% of the total research is enlightening other Blockchain applications than Bitcoin (Yli-Huumo J, et al, 2016). A reason for this could be that it can be very time consuming to conduct academic research and since the first concept related to the Blockchain technology which really gained the media´s and public´s interest was bitcoin, it is off course the most researched topic. If you move forward with this assumption the future will bring more academic research in the direction of the Blockchain technology in general. The literature review will try to enlighten the top of line academic research in relation to the Blockchain technology, and its applicability and governance promises.

8.1 Enlighten the Blockchain technology´s value

As the research project earlier has delivered an understanding of the Blockchain technology this section will aim towards defining the Blockchain technology´s value. The Blockchain technology is often mentioned as the technology who can solve several problems regarding transparency, security, costs, traceability and speed. This section tries to enlighten how the aforementioned benefits can be achieved through the implementation of the Blockchain technology. This section will be covering a full understanding of what value the Blockchain technology can bring.

8.1.1 Transparency

The first benefit the research project will enlighten is transparency. Lack of transparency is a worldwide issue and all organizations have tried to achieve better transparency through implementing more rules and regulations (Strebko J., Romanovs A., 2018). Some of the initiatives organizations have made has included centralization and especially this

concept doesn't foster transparency. The Blockchain technology gives organizations the possibility to aim for a complete decentralized network where no third-party or centralized authority are improving the transparency (Geroni D, 2021, Ølnes S, et al, 2017). The Blockchain technology perform transparency through the consensus method which are explained in section 3.1.

8.1.2 Security

The second benefit is security. The Blockchain technology enhance security due to its record-keeping system, which function is to record all transactions made and verify that they are identical according to the consensus method. All transactions are encrypted and has a link to the former transaction through the hashing method. Security is further achieved due to each node containing a copy of all the transactions ever performed on the blockchain. This makes it very close to impossible for any malicious actor to make changes in the transactions because the nodes will reject the request to make changes. The Blockchain technology is immutable which means that when the data is stored it can´t be changed or deleted (Geroni D, 2021, Ølnes S, et al, 2017).

8.1.3 Reduced costs

The third benefit is reduced costs because every individual and actor spend a lot of money on third parties. By the implementation of the Blockchain technology the need for a third party is no longer necessary as the Blockchain technology has no centralized authority who validates transactions (Strebko J, Romanovs A, 2018).

8.1.4 Traceability

The fourth, and last, benefit the research project will enlighten in this section is traceability. This can be very useful in relation to e.g., supply chains which unlock possibilities for both the vendors and suppliers. Traditionally it has been hard to trace products which historically has led to multiple problems which are including theft, counterfeit and loss of goods. With the implementation of the Blockchain technology the supply chain becomes traceable and transparent because it enables every party to trace the goods and make sure that nothing in the supply chain process is going wrong. And if/when something is going wrong, it is easy to figure out where it went wrong because it is impossible to change or delete in the transactions (Geroni D, 2021).

8.2 The Blockchain technology in governments

As stated in section 8.1, the Blockchain technology brings several benefits. These benefits have the potential to improve governmental services, foster fair and transparent citizen rights, optimize processes and provide secure and efficient sharing. This section will elaborate on how the Blockchain technology can be used in governments (Anwar H, 2019).

8.2.1 Pain points in governments

First, this section will provide some of the most crucial pain points governments are facing, which in section 8.2.2 will be solved by the Blockchain technology.

The first issue in governments is that they tend to be extremely centralized which often doesn't support fairness, fast adoption and development. Especially corruption can occur and be an effect of too much centralization as a very few number of people has the power and decision rights. This centralization tends to split the government and the citizens which only will worsen the relationship between them. Most citizens have the perception that governments aren't doing what they are able to do for the citizens and there are some specific pain points where this perception derive from ("OECD, Citizen satisfaction with public services", 2020). One of the pain points is opaque operations which is the lack of transparency. The common perception from citizens is that the government´s processes and interactions all seem mysterious which are hurting the relationship between governments and citizens. Another pain point is the inefficiency which is caused by the slow processes. Citizens has the perception that the government´s processes, systems, applications and procedures are slow, old and not well designed ("OECD, Citizen satisfaction with public services", 2020). This has a strong link to the abovementioned pain point regarding the heavy centralized structure which makes it complicating to react to the rapid changing environment we are living in. Another pain point is the lack of digitization. Government´s aren't well-known for being updated on the newest technologies which lead to old systems and applications (Anwar H, 2019, Ølnes S, et al, 2017).

8.2.2 Optimization of governments through the Blockchain technology

As the frequent pain points in governments has been enlightened in section 8.2.1, this section will aim towards solving these pain points and enlighten other areas where governments can benefit through the use and implementation of the Blockchain technology.

The Blockchain technology can offer security to governments which they can benefit from. The amount of data, and especially sensitive data, is huge and through the Blockchain technology governments can store and secure their data more securely. Governments is also one of the primary targets for hackers who tries to steal personal data ("Purplesec, 2021 cyber security statistics", 2021), so implementing the Blockchain technology to secure the data, is an area where governments can gain a huge benefit. Another area where the Blockchain technology can affect governments positive is regarding the ability to have immutable data. This will secure that data won't be tempered and corruption will be much harder to get away with. Additionally, when corruption occur, it will be easy to track down and punish the responsible individual. The Blockchain technology can furthermore influence the voting system which on several occasions have been subject to allegations of fraud. An implementation of the Blockchain technology would eliminate the risk of fraud during elections. Another area where the Blockchain technology can revolutionize the governments is in the monetary system. This can be done by implementing a digital currency which would give the government a complete overview of all money and would make it much easier to control the currency flow. In relation to currencies, another area where the Blockchain technology can optimize is regarding to budgeting. It has been seen several times that budgets don't get kept and where the money actually ended is not traceable. Last, the Blockchain technology can help secure processes and decision rights, and decentralize the system (Anwar H, 2019, Ølnes S, et al, 2017). These are some of the areas where the Blockchain technology can optimize governments and help strengthen the trust between governments and citizens.

8.2.3 The Blockchain technology´s relation to sustainability

This section will use the sections above and investigate how the Blockchain technology can be used to foster sustainability.

The first concept which this section will cover is smart grids. Smart grids are believed as being helpful towards creating more sustainability. The smart grid enables more security in relation to electricity supply, but also comes with more complexity. Smart grid is defined as *"... an electricity network that can cost efficiently integrate the behaviour and actions of all users connected to it – generators, consumers and those that do both – in order to ensure economically efficient, sustainable power system with low losses and high levels of quality and security of supply and safety. A smart grid employs innovative products and services together with intelligent monitoring, control, communication, and self-healing technologies"* ("ETSI Smart Grids and Meters, n.d.). Smart grids are using advanced information and communication systems to link consumers, distribution stations and power generators. The advanced data processing enables a more efficient, decentralized, reliable, secure and flexible electricity distribution. Additionally, a smart grid will enable the integration of using renewable energy to supply electricity demand (Faheem et al., 2018). By implementing the Blockchain technology in smart grids through ensuring consensus could be an important feature to make smart grids even more applicable and relevant. The smart grid is, as mentioned above, distributing electricity between consumers, which consume electricity, distribution stations, which distribute electricity and power generators, which generate electricity. These three entities are together creating a peer-to-peer network between them to ensure an efficient distribution by minimizing losses, keeping a high level of quality and securing the electricity supply (European Technology Platform, 2010). Research has been made towards exploring the possibility of implementing smart contracts through the Blockchain technology to enable the energy distribution to occur without the use of an intermediary (Hahn A., et., 2017, Münsing E., et al., 2017). Another benefit which the Blockchain technology can apply to smart grids is the traceability, which can enable smart grids to attach a green certificate which is used to indicate that the energy is generated from renewable sources (Imbault et al., 2017). This green certificate can´t be changed, deleted or tampered due to the Blockchain technology´s consensus method.

The smart grid will be able to facilitate the connection and operation of generators better, allow consumers to participate in optimizing the operation of the system, provide consumers with more knowledge including options for how to use their supply and reduce

the environmental impact (“ETSI Smart Grids and Meters, n.d., EU Commission Task Force for Smart Grids, 2010).

The second concept, the research project will link the Blockchain technology to, in relation to sustainability, is supply chains. The Blockchain technology can strengthen the traceability in supply chains which can reduce environmental crime. Environmental crime is seen as greenwashing which is when companies and organizations are conveying a false impression or providing false information regarding its environmentally sound. Greenwashing is being used by companies and organizations to deceive their consumers into believing that the product is environmentally friendly. As it is still very hard to identify a product´s original environmentally sound because the data easily can be tampered (Lund E. H., et al., 2019). To solve this problem and make it impossible to tamper the data, proof-of-work has been emphasized by several projects (Alejandro J., at al., 2017, Imbault F., et al., 2017, Qinghua L., et al., 2017). These projects have a clear link to be innovated by the Blockchain technology in order to secure the certificates better. The Blockchain technology enable companies and organizations to record information about all activities in the supply chain in a single, chronological and unchangeable record. Through the Blockchain technology companies and organizations can furthermore trace products from the raw material extraction and all the way to the final usage. This will enable governments and public institutions to review all product´s environmentally sound because the whole supply chain can be identified and evaluated (Wright L., 2022, Giungato P., et al., 2017). The ability to verify the product´s supply chain can also be enabled for the consumers, which would extend the transparency and strengthen the trust all the way from the supplier to the consumer.

The third point the research project will distinguish is the Blockchain technology´s relation and possibilities within smart cities. The Blockchain technology has previous in the research project been clarified as a technology which can be applied in many sectors in the future. The reason behind this is that the Blockchain technology´s content is data and information which can be, and currently are, used everywhere. The Blockchain technology is an innovation which represent a promising catalyst for achieving sustainable

development goals on a global scale (Kewell B., et al., 2017, Giungato P., et al., 2017). One of the concept which has occurred, and where the Blockchain technology can enhance sustainability is regarding smart cities. Smart cities have emerged as a possible solution for the environmentally challenges we are facing. Today, around 55% of the population in the world live in the cities and it is estimated that close to 70% of the global population will be living in the cities in 2045 ("Urban development, 55% of the worlds…", 2020). As the cities currently are using around 2% of the earth´s surface and consume more than 75% of its natural resources, the expansion and creation of cities is inevitable. The consumption of materials such as energy, raw materials, fossil fuel, water and food, related to cities was 40 billion tons in 2010 and are expecting to reach 90 billion tons by 2050 (UNEP, 2018). This is expected to result in challenges regarding growth, performance, residents´ livelihood and competitiveness ("McKinsey, how to make a city great", 2013). These challenges are related to deterioration of liveability including waste management, scarce resources, air pollution and traffic congestion which can result in human health concerns (Washburn D., et al., 2009). A possible solution to these issues is the smart cities concept. The definition of a smart city is a city which aims towards making itself smarter, more efficient, more equitable, more sustainable and liveable (O´Grady M., O´Hare G., 2012). The smart cities are especially related to the 11th United Nation´s (UN) Sustainable Development Goal, which is aiming on making cities inclusive, safe, resilient and sustainable (UN, 2018).

The Blockchain technology can be the catalysator in building the smart cities around the world through the development of shared economic services (Yan J. S. J., Zhang, K. Z. K., 2016). The principles, which the Blockchain technology can supply the smart cities with, is in relation to the security aspect where the Blockchain technology has it core strength. This is a security aspects like confidentiality, integrity and availability, which the Blockchain technology can help strengthen and implement in the smart cities. The reason behind the Blockchain technology´s advantages regarding the security aspect is the decentralized protocol where all data and information is stored securely and does not rely on an intermediary. Additionally, integrity is reached because all participants keep copies of the data and information which only can be changed through the consensus method (Giungato P., et al., 2017).

9. Analysis - Unlock the true potential of the Blockchain technology

In this section the theory and literature will be analyzed to provide valuable findings to answer the research questions. The theoretical framework, PESTEL, presented in chapter 7, provides a thorough structure for the analysis. The analysis will begin by examining the technological aspect of the Blockchain technology and particular its current and future state. After having achieve that, Ostrom´s eight principles will be applied to the Blockchain technology to analyze the advantages that can be achieved by combining the Blockchain technology with Ostrom´s eight design principles. Lastly, the Blockchain technology´s impact and possibilities on sustainability will be distinguished and linked to the social-ecological system framework.

9.1 The Blockchain technology´s current and future state

This section will analyze the Blockchain technology´s technological aspect by using Gartner´s hype cycle to distinguish in what state the Blockchain technology is in, what journey it has been on and try to predict where it its heading in the coming years. This section will cover the technological factor from the PESTEL framework.

The Blockchain technology has been represented on Gartner´s hype cycle of emerging technologies since 2017, where it was in the peak of inflated expectations state (Panetta K., 2017). At that time, the Blockchain technology was about to descend to the trough of disillusionment state and was estimated to reach the mass market within five to ten years (Ordovás J., 2021). But, actually, 2017 wasn't the first year where something related to the Blockchain technology was represented on Gartner´s hype cycle. In 2015 it was able to find cryptocurrency exchange on Gartner´s hype cycle for emerging technologies ("Gartner´s 2015 Hype Cycle for Emerging Technologies", 2015). When the cryptocurrency exchange was present in 2015 it was in the peak of inflated expectations state on Gartner´s hype cycle which illustrated the turning point for the first wave of cryptocurrency and especially Bitcoin adoption. A lot of companies were in this period investigating the cryptocurrencies as a potential payment method for customers. But as the companies didn't

find any clear return by implementing cryptocurrencies as a payment method, they didn't move forward with it. Additionally, the cryptocurrencies started to get associated with criminality because of the anonymity and the amount of people using the cryptocurrencies to make transactions on the dark web (Ordovás J., 2021). This was some of the reasons behind the cryptocurrency exchange´s fall into the trough of disillusionment state in Gartner´s hype cycle.

From 2015 to 2017 the expectations to the cryptocurrencies deflated massively. But as a consequence, to the deflation, companies started to look at the underlying technology of the cryptocurrencies. The companies realized the potential for a decentralized database where data and information are stored without the involvement of intermediaries which increases the security and decreases the chance for tampering of the data (Ordovás J., 2021). The shift from having the focus on cryptocurrencies to the Blockchain technology is seen in Gartner´s hype cycle for emerging technologies in 2017 as well. Instead of being highlighted as cryptocurrencies it changed name or got replaced by the Blockchain technology ("Gartner´s 2015 Hype Cycle for Emerging Technologies", 2015, "Gartner´s 2017 Hype Cycle for Emerging Technologies", 2017).

The focus on the Blockchain technology emerged due to companies started to invest and research within the Blockchain technology. In the beginning it was based on the basic concepts of the Blockchain technology which companies and individuals tried to understand and make applicable. Specifically, the smart contracts got attention because smart contracts enable more security, immutability, traceability and transparency of data by making data tampering close to impossible (Ordovás J., 2021). The Blockchain technology is now heading towards the slope of enlightenment state where the satisfactory benefits are spreading as mentioned above. The Blockchain technology is moving towards the plateau of productivity state where it will become mainstream and easily accessible and applicable.

Even though the Blockchain technology, nor any related concept, has been presented on Gartner´s hype cycle of emerging technologies since 2017, it is still applicable for the Blockchain technology ("Gartner´s 2019 Hype Cycle for Emerging Technologies", 2019). In

2019 the Blockchain technology got it´s own hype cycle ("Gartner´s 2019 Hype Cycle for Blockchain Business", 2019). This emphasize that the Blockchain technology has evolved to a stage where it is still considered as an emerging technology but as an emerging technology with several underlying technologies. The creation of a hype cycle specifically for the Blockchain technology will help to identify in which state the underlying technologies are located in. This can be used for companies and organizations, who is considering implementing the Blockchain technology, to identify which of the underlying technologies which are most mature and therefore easiest and most applicable to implement and investigate further regarding an eventual implementation.

In Gartner´s hype cycle for Blockchain from 2021 the majority of the underlying technologies in the hype cycle are located in the innovation trigger and peak of inflated expectations state and are estimated at reaching its plateau within two to five and five to ten years. There is no of the listed underlying Blockchain technologies which are estimated to reach the plateau of productivity within two years. This witness that the underlying Blockchain technologies still need to be investigated deeper before companies and organizations can benefit from it. Some of the underlying technologies, which are estimated to reach the plateau soonest is cryptocurrencies, Blockchain wallets and consensus mechanisms. These are the top three which companies and organizations can expect to apply in the nearest future (Litan A., 2021). But as the hype cycle show the underlying Blockchain technologies will not reach the plateau of productivity state at the earliest within two to five years ("Gartner´s hype cycle for Blockchain 2021", 2021).

9.2 The Blockchain technology driven governance

Ostrom´s studies have shown that common pool resources can be governed by local communities. Despite that, challenges regarding monitoring and enforcing it has occurred on several occasions. By applying the Blockchain technology on the governance of the common pool resources better monitoring and enhancing can be achieve. Additionally, a new form of Blockchain-based governance can be distinguished and optimized. This section will therefore examine how the Blockchain technology can enhance governance in

relation to Ostrom´s eight design principles. This section will cover the political, economic, social and legal factors from the PESTEL framework.

As seen in the literature, the research within the usage of the Blockchain technology to facilitate governance processes has gained attention during the last years (Risius M., Spohrer K., 2017). This section will map the Blockchain technology´s values to Ostrom´s eight design principles in order to achieve a structured overview of which of Ostrom´s design principles that can be beneficial of the application of the Blockchain technology´s benefits.

Blockchain Benefit/ Ostrom´s Principles	**Tokenization**	**Self-enforcement and formalization of rules**	**Autonomous automatization**	**Decentralization of power over infrastructure**	**Increasing transparency**	**Codification of trust**
1. Clearly defined boundaries	X					
2. Congruence between rules	X	X		X		
3. Collective-choice arrangements	X			X		
4. Monitoring		X	X	X	X	
5. Graduated sanctions		X	X			
6. Conflict-resolution mechanisms			X		X	
7. Minimal recognition of rights to organize		X		X		X
8. Nested enterprises			X			X

The Blockchain technology´s benefits will in the following section be enlightened and analyzed in relation to how they can be applicable for Ostrom´s eight design principles to achieve a higher level of governance.

9.2.1 Tokenization

The first of the Blockchain technology´s benefits which will be enlightened is tokenization. The capacity of the tokenization of the Blockchain technologies supply the users with affordances for technological artifacts which can facilitate and drive governance, which is why tokenization can be connected to several of Ostrom´s eight design principles (Rozas D., et al., 2021).

The first of Ostrom´s eight principles which the tokenization can foster is the first design principle, clearly defined boundaries. Ostrom´s first design principle deals with the definition and boundaries for governance within a group of individuals and/or a community. The boundaries can be reflected in the rules within the embedded software. The rules within the software can be used to define rights and permissions to access and/or modify resources and/or community rules. In that context, tokenization can be used to construct tools so the rights and permissions more easily can be defined, propagated and revoked. In a use case, the tokenization can be used in a community network where access to the resources could be controlled through tokenization. This can be done so the people who, e.g., have contributed to the infrastructure can access the infrastructure and those who haven't, can´t access the infrastructure (Rozas D., et al., 2021). The definition of boundaries and rules and their influence in the technical artifacts, connects the Blockchain technology to the second and third design principle by Ostrom which also can benefit from tokenization. The second design principle is congruence between appropriation and provision rules and local conditions, and the third design principle is collective-choice arrangements. These design principles are relevant because the communities constantly have to develop and modify the collective boundaries and rules (Rozas D., et al., 2021). The ability to respond on changes have become more crucial than ever due to the rapidly changing environment companies and organizations are competing in. Additionally, the time to respond has become essential because it can cause companies and organizations to be disrupted if they don't manage to respond within the right time. This has led communities to constantly being aware of occurring changes which demands the governance processes to be capable of changes and to responding to them (Forte F., et al., 2009, Rozas D., et al., 2017, Schweik C. M., English R., 2013). The potential for governance with the use of tokenization is definitely clear and could be used to readdress the latent power within

organizations and communities. The dialog in these organizations and communities would be mediated through the tokenization which would include an exercise by the company and organization in order to specify the tasks which should be completed. This give the company and organization the opportunity to address tasks which otherwise would be forgotten, e.g., care work. Tokenization can help companies and communities to rethink how the power dynamics are structured and address the imbalance of invisible labor which the Blockchain technology can help enlighten through the tokenization of governance (Rozas D., et al., 2021, Orozco, P. A., 2014).

As the techno-deterministic discourse assumes that a society's technology develops by following its own internal logic of efficiency while determining the development of social structure and cultural values, technological progress is fundamentally an anti-democratic force (Kline R. R., 2001). If the Blockchain technology follows the techno-deterministic discourse, everything that can be decentralized, will eventually be decentralized (Johnston D. A., 2014). If this discourse is applied to the tokenization, at least partially, risks can occur. One of the risks that tokenization can foster is extreme quantification and data fetishism (Sharon T., Zandbergen D., 2017). As this risk is relevant, it is necessary for companies and organizations to distinguish the balance between what should or should not be tokenized. This enlightens the need for further research within the tokenization field which confirms Gartner´s hype cycle regarding the Blockchain technology in general (Rozas D., et al., 2021).

9.2.2 Self-enforcement and formalization of rules

The second of the Blockchain technology´s benefit which will be enlightened is self-enforcement and formalization of rules. The Blockchain technology contains affordances for self-enforcement and formalization of rules that are entangled with Ostrom´s eight design principles. This is because of the rules which regulate monitoring and graduate sanctions is represented in Ostrom´s fourth and fifth design principles. This can be used when companies and organizations have to define rules regarding allocation of common resources which can be automatically enforced. This can be done by implementing a rule which, e.g., automatically penalizes any misuse of the common resources. This can save a lot of time and money regarding monitoring as it will not require any user in the

company or organization to manually monitor the common resources. In order to create this automatically monitoring, the rules have to be unambiguously understood by machines. This leads to the reformulation of the rules because it needs to be formalized due to the language the governance rules usually are formulated in. Research has shown that self-organization in companies and organizations tend to increase formalization regarding decision making. The reason behind that is the advantages companies and organizations can reach through decentralization and that decentralization and formalization makes it easier to grow and scale up companies and organizations (Forte F., et al., 2009, Schweik C. M., English R., 2013, Rozas D., Huckle S., 2021). The development of smart contracts enables the opportunity to make the rules more available and visible for discussion, which is related to Ostrom´s second design principle, congruence between appropriation and provision rules and local conditions. Additionally, the self-enforcement and formalization of rules relates to Ostrom´s seventh design principle, minimal recognition of rights to organize, because local nodes enable companies and organizations to ensure jurisdiction and enforcement of rules (Rozas D., et al., 2021). This can be used in companies and organizations through the application of nodes, e.g., in a company or organization where local nodes are enabled, each node contains local autonomy to create, modify and change its own rules. This can be structured in clusters, so it is able to create a node which covers all nodes in the cluster and then the local nodes can make its own rules, as long as it complies with the node above, the cluster node. Exactly this type of structure and decentralization of autonomy is one of the key strengths of the Blockchain technology (Rozas D., et al., 2021). As with the tokenization, there are possible issues which can occur, and further research is therefore necessary to be done regarding the affordances of self-enforcement and formalization.

First, rules embedded in smart contracts rely on forecasts and not on actual results (Di Filippi P., Hassan S., 2016). There is no intermediary who monitors the rules as the rules automatically is enforced from previously agreed agreements between the company or organization. As the rules are automatically strengthening the security as it gets very hard to breach, but as security is strengthened, the difficulty regarding modifications and exceptions rises (Di Filippi P., Hassan S., 2016). The work which needs to be done within this

issue is to apply Ostrom´s second design principle, congruence between appropriation and provision rules and local conditions. This design principle can make it more accessible to modify the rules embedded in the smart contracts (Di Filippi P., Hassan S., 2016, Rozas D., et al., 2021).

Second, the formalization of the rules has raised the requirements in relation to the technical knowledge because the translation from rules to source code is necessary. Formalization will in this case help ease this process and enable the possibility to discuss the rules, but the individuals who code the rules is possessing power (Di Filippi P., Hassan S., 2016, Rozas D., et al., 2021).

Third, as with the tokenization there is a risk regarding the extreme formalization in the rules. Again, this is a field where research isn't sufficient which once again confirms Gartner´s hype cycle in its prediction about the Blockchain technology to reach its plateau of production within two to five years or at least not yet. Ostrom has highlighted this risk and drawn in the relevance of establishing a social norm, which individuals are expecting to comply with (Ostrom E., 2000, Rozas D., et al., 2021).

9.2.3 Self-enforcement and formalization of rules

The third of the Blockchain technology´s benefits which will be enlightened is autonomous automatization. The autonomous automatization is being driven by DAOs which can participate in strengthening some of Ostrom´s design principles through smart contracts. As mentioned earlier in the research project, smart contracts can strengthen monitoring and sanctioning. The DAOs can strengthen the monitoring even more because companies and organizations rely on automated actors for monitoring and sanctioning. This appeal to Ostrom´s design principle number four and five. As with the two former sections regarding the Blockchain technology´s benefits, there are challenges regarding this new technology. As the DAOs are acting on behalf of the company or organization it eliminates the natural reaction from the sanctioned actor which is to reacting badly against the actor who performs the sanction. But at the same time, it can trigger frustrations and impotence towards the machines (Frost R., Postman N., 1993, Rozas D., et al.,

2021). The DAOs may also foster a higher degree of automatization of processes regarding facilitation of scaling up and the creation of nested entities, as Ostrom´s eighth principle describes. As the research project has stated earlier, scaling up companies and organizations may be accelerated by increasing formalization and bureaucratization, the DAOs can apply more autonomous processes which can reduce the burden of bureaucracy and accelerate and make processes more effective (Forte F., et al., 2009, Rozas D., et al., 2017, Schweik C. M., English R., 2013). Currently, a lot of companies and organizations rely on software to automate actions which still needs to be governed by humans or by an intermediary. In that context, by implementing DAOs, they can facilitate this interaction and coordination across the nodes. And when the rules are agreed on, between the actors in the company or organization, the DAOs can be setup, and a large proportion of processes has been automated because the DAOs monitor the nodes´ actions, facilitating coordination, transferring value and resources. The DAOs can even be structured to coordinate and control other DAOs which can scale up companies and organizations easily, which can foster cooperation between companies and organizations (Rozas D., et al., 2017).

At last, the DAOs can affect Ostrom´s design principle number six, conflict-resolution mechanisms. In relation to Ostrom´s sixth design principle, the DAOs will supply companies and organizations with a space where governance is digitalized and formalized. This means that the DAOs investigate the potential conflicts that can arise and at the same time the potential resolutions. In this space the DAOs make conflicts explicit for the whole company or organization. This will drive companies and organizations to establish mechanisms to resolve the conflicts, which will be done as automated as possible in order to standardize to reduce time and increase the possibility for scalability (Rozas D., et al., 2017, Baig A. A., et al., 2015). But as earlier, this Blockchain technology benefit doesn't come without challenges and potential issues. As the DAOs are digitalizing as much as possible, the physical part of the world still plays with its own rules. E.g., in an e-voting situation the challenge is, that the DAOs can´t distinguish if a human voting is the human it pretends to be or if the human is being forced to perform a specific action (Le Breton D., 2015). As the DAOs tries to digitalize and automate as much as possible, it simply can´t solve several challenges regarding the law (De Filippi P., Wright A., 2018, Rozas D., et al.,

2017). The DAOs are very promising and opens up a new world of automatization, but as Gartner´s hype cycle predicts, there is still room and need for further research in order to achieve the plateau of productivity.

9.2.4 Decentralization of power over infrastructure

The fourth of the Blockchain technology´s benefits which will be enlightened is decentralization of power over infrastructure. This benefit can be used in relation to communalizing ownership and control of technologies which are employed by the company or organization through the decentralization of the infrastructure they are dependent on. The use of this can be illustrated when researching within the relationship between social and technical power (Forte F., et al., 2009, Rozas D., et al., 2021). Even though decentralization of the infrastructure happens, there will always be a main platform of collaboration which commonly is a point of conflicts and high tensions but as this benefit decentralize as much as possible, the conflicts and tensions will be lower. As mentioned earlier in the research project, companies and organizations which scale up, uses a high degree of formalization. This formalization can, e.g., be rigid organizational processes and clearly defined rules. This formalization demands ongoing negotiations which is related to Ostrom´s third design principle, collective-choice arrangements.

By using decentralized technologies, the relationship between social and technical power will be explored. The ability to "fork", which is taking a software project and maintaining it outside and separately from the original, is identified and facilitated by decentralized technologies (Rozas D., et al., 2021, Jemielniak, J., 2016, Tkacz N., 2014). This can lead to uncertainty for the ones in control of the infrastructure as they fear forking of the whole infrastructure. This is an example of what decentralization of power over infrastructure is capable of. The decentralization of technologies pushes the ones holding power in the company or organization to negotiate and constantly investigate innovation (Thierer D. A., 2016). Examples on the infrastructure which can be decentralized is the monitoring and compensating imbalances of the infrastructure (Rozas D., 2020). The decentralization of infrastructure reduces both the technical cost when forking and the power of the actors who previously were in charge of the infrastructure in the company or organization (Rozas

D., 2021). When the above mentioned are analyzed through Ostrom´s design principles, the first point regarding the demand for negotiations from those who have the power relates to Ostrom´s third design principle, collective-choice arrangements. The second point is relating to Ostrom´s fourth design principle, monitoring, where the ones performing the monitoring can experience demands for their accountability. The third point is the decentralization of power over infrastructure which can foster innovation and autonomy. This can relate to Ostrom´s design principle number two, congruence between appropriation and provision rules and local conditions, and seven, minimal recognition of rights to organize, by distinguishing between new forms of pressure regarding negotiations from local contexts and jurisdictions accepted by authorities (Rozas D., et al., 2021). As with the other Blockchain technologies´ benefits, challenges and risks will occur due to the decentralization of power over infrastructure as well. As previously enlightened in the Blockchain technology benefits regarding tokenization and self-enforcement and formalization of rules, the ones who are coding the rules possess power. Additionally, the demand for negotiations and investigation of innovations can end up by splitting the company or organization up because there constantly will be a high demand of loosen control without losing control, which can be very complicated (Rozas D., Huckle S., 2021, Rozas D., et al., 2021). The risks above confirms that research, within the field of decentralization of power over infrastructure, still needs to be done in order to reach the plateau of productivity as Gartner´s hype cycle confirms.

9.2.5 Increasing transparency

The fifth of the Blockchain technology´s benefits which will be enlightened is the increasing transparency. The increasing transparency is the process of opening up the processes and information by relying on the persistency and immutability which the Blockchain technology foster. The Blockchain technology provide software which can make actions more easily trackable, secure and irreversible. The transparency is related to Ostrom´s design principle number four, monitoring, and six, conflict-resolution mechanisms. The possibility to open up data in the processes is very useful when scaling up processes of monitoring because it increases the legitimacy. The people outside of the processes gain more

trust as the accountability is transparent for them and the data is also commonly used to solve conflicts and in negotiations. The Blockchain technology provides companies and organizations with new possibilities to track and monitor their processes. This can, e.g., be used to track who uses more resources and penalize individuals who consumes too much of the resource. This can help deal with the tragedy of the commons which is a challenge in the common pool resource theory. On the positive side, the transparency can also be used to reward users who, e.g., has produced most green energy (Rozas D., 2020, Baig A., et al., 2015). As with the previous Blockchain technology benefits it shall not apply the techno-deterministic approach and make everything transparent. Transparency should contain limitations in relation to privacy and thorough analysis to distinguish how transparent the information and data should be. The perception in today's society sometimes is that it is impossible to be forgotten and everything is recorded and will forever be stored (Rozas D., 2020, Khan S., 2017, Mayer-Schönberger V., 2009).

9.2.6 Codification of trust

The sixth, and last, Blockchain technology benefit which will be enlightened is the codification of trust. The benefit regarding trust is that the Blockchain technology can enable trustless systems where participants enter into an agreement without the need for an intermediary to provide this trust. The commons-based approach can use the trust the Blockchain technology provides to govern the commons better. To build the trustless systems, smart contracts can be used to facilitate governance. The trust is defined in the code which, as enlightened before, gives power to the one who writes the code. The codification of trust can enhance interoperability, which is systems that can operate with other systems, in companies and organization.

The codification of trust in the infrastructure can relate to two of Ostrom´s design principles, the seventh, minimal recognition of rights to organize, and the eighth, nested enterprise. Codification of trust can facilitate internal interoperability between nodes and groups to structure the company or organizations, or the nested enterprises. E.g., a company´s or organization´s network with local nodes in different locations can be designed to facilitate the governance of the company or organization which are different

dependent on the location. The company or organization can be autonomously governed by the users on each of the nodes and still interoperate between them across the different locations. This can be applied so agreements between nodes, structures the company or organization and enhance their ability to scale up their self-organized processes (Rozas D., et al., 2021). Additionally, the Blockchain technology can act as a common database infrastructure which enhance interoperability through the use of smart contracts. The smart contracts are encoded with agreements between companies´ and organizations´ networks (Rozas D., et al., 2021).

This section of the analysis has been focusing on how the Blockchain technology can support Ostrom´s eight design principles and improve governance in companies and organizations.

9.3 The Blockchain technology´s state and potential in Governments

As the section before analyzed how the Blockchain technology and Ostrom´s eight design principles can improve governance in cooperation, this section will analyze how to transform governments to achieve this new governance. Furthermore, an analysis of how governments´ current ability to transform and respond to new technologies and innovation, which purpose will be to create recommendations regarding initiatives to become more prepared for future transformations in governments. Furthermore, the Blockchain technology´s current state and possible influence in governments will be analyzed, as well as how and where the Blockchain technology can influence governments. This section will cover the political, economic, social and legal factors from the PESTEL framework.

9.3.1 The ability to transform

Transformation is an essential ability to master in today´s society and research has shown that governments are having great challenges when it comes to this, research show that 70% of change programs in the public sector fail to achieve their goals. This challenge is assumed to have an effect on the implementation of the Blockchain technology in governments in the future. The pressure for transformation in the public sector has risen as the satisfaction with digital government services has decreased (Bollyky B., et al., 2021).

Governments has the capacity to transform, but the ability lacks. To improve governments´ ability to transform, four key steps will be analyzed.

The first step is to take stock of reality. This emphasize that transformation is way more than an initiative to save costs and it often bring innovation towards some of the technologies or concepts which are trending. In this step it is essential to engage the individuals in the government in order to get them onboard of the transformation otherwise they will make it very hard to transform. To make that happen, leaders must invest time and energy to communicate the purpose of the transformation to answer the individuals in the government´s most common question, why transform? If the leaders manage to convince the individuals about this, the individuals have energy and motivation to work, because they fulfil a purpose (Bollyky B., et al., 2021). As the Blockchain technology is still very new to a lot of people and research still is being conducted, the need for getting the resources onboard is an essential part of implementing the Blockchain technology in governments.

The second step is to select the right approach. This has a relation to the purpose because this step is clarifying what the transformation will bring of benefits. By clarifying the benefits, the needed resources will be distinguished, and this will supply the government with a clear indication of which resources they need to interact with. By having identified the resources, the right approach needs to be selected (Bollyky B., et al., 2021). It is a time consuming but important task to choose the right approach or approaches because it will influence the whole transformation. As it is possible to get inspiration and knowledge from previous or identical transformations, it is not a 100% applicable because no transformation is identical due to the changing environment the transformation is acting in (Bollyky B., et al., 2021).

The third step is to build the future. When the decision to transform is made it is essential to define a set of specific goals which the transformation shall lead to. The definition of goals will also supply the government with the purpose to transform. This step will also establish the core of the transformation plan which will include three components. The first component is to create momentum for the transformation. In the component the government needs to allocate resources to spend time on demonstrating and hyping the

transformations´ benefits. The next component is to focus on the medium term, which includes governments to keep its focus on the transformation and try to keep some of the momentum. This can be done by implementing a hotline or other places where information and help can be achieved. The third, and last, component is to sustain the change, which is to keep benefitting from the transformation. This will acquire effort, energy and resources to do, in order to achieve the highest potential benefits from the transformation. Additionally, this last component will include ongoing optimization of the transformation to secure the government are updated on the newest features within the transformation (Bollyky B., et al., 2021). The three components are necessary for governments to analyze from the beginning of the transformation to achieve a successful transformation.

The fourth step, and last, is to see it through. This step is to sustain the transformation which is a difficult step in governments. In this step, the leaders of the transformation experience challenge regarding employee resistance, limited budgets and resources, poor communication and inconsistent processes. Actually, the number one reason is that employees resist change is skepticism from past failed efforts and 92% of public sector employees believe better change management would improve citizens´ customer experience (Bollyky B., et al., 2021).

This is the four steps which governments who try to implement the Blockchain technology should keep in mind when settling for transformation. It emphasizes that it is essential and decisive to get people onboard and give them a purpose to participate in the transformation. Research shows that organizations which manage to get people onboard perform twice as good as organizations which doesn't (Bollyky B., et al., 2021, Hemerling J., et al., 2018).

9.3.2 The Blockchain technology´s current state and possibilities in governments

This section has until now distinguished challenges for governments regarding transformation. The rest of this section will analyze the current state of the Blockchain technology in governments, which areas it can influence and how it can influence governments.

Governments around the world are currently on the journey of encouraging research within the potential benefits of integrating the Blockchain technology into governments ("Digital transformation in government and blockchain technology", 2016). As previous distinguished the Blockchain applicability in governments are indisputable and the benefits governments can achieve is beginning to, and has already, attract governments attention in many countries (Batubara F. R., et al., 2018, Hyvärinen H., et al., 2017). Several nations have already announced that they will invest in initiatives and research to explore the Blockchain technology´s possibilities (Batubara F. R., et al., 2018, White M., et al., 2017). As mentioned earlier in the research project, only 20% of the total research within the Blockchain technology is enlightening other Blockchain applications than bitcoin (Yli-Huumo J, et al, 2016). This show, that governments have to invest a lot more in the Blockchain technology and the technologies related to it in order to enable the Blockchain technology to transform governments. As earlier mentioned, governments can gain benefits within a wide range of areas and the Blockchain technology can especially be beneficial for countries which are suffering from a high percentage of corruption, fraud and lack of trust ("EY 14th global fraud survey", 2016). The need for more research in the Blockchain technology is enhanced by Ølnes S., et al. (2017), who argue that the potential problems for governments which the Blockchain technology can solve is fraud, inefficiency, corruption and fraud (Batubara F. R., Ølnes S., et al., 2017).

So how can the Blockchain technology solve real-world challenges or optimize processes in governments. The first concept the Blockchain technology can solve is in relation to on-chain dispute resolution. The humanity has invented the law which is one of the most important structures in the society. Even though that the legal system should be extremely secure and unbiased, research has shown that this isn't the case. A research

shows that people who are going to court is more likely to acquitted if the judge just have had his/hers lunchbreak (Danziger S., et al., 2011). The legal systems, courts and processes can be very ineffective and extremely time consuming which is related to huge costs (Lyons T., et al., 2020). The Blockchain technology definitely has the ability to automate legal processes through an algorithm built on the Blockchain technology. While this might be at least a couple of years out in the future, smaller more manageable parts of the law can be beneficial from the Blockchain technology. Disputes happens constantly and is often complex to solve. Through the Blockchain technology, a Blockchain-based dispute resolution system can be created. This system can act as the third party where both parties lock their funds in a multi-signature smart contract and if a dispute occurs at the end of the transaction the smart contract will automatically send the case to arbitration. If both parties are satisfied with the transaction each of them can use their private keys to release their funds. This can ease processes and the advantages are clearly the cost saving, transparency and transparency. Additionally, when a dispute occurs the process of handling it is automatic (Lyons T., et al., 2020).

The second concept which the Blockchain technology can optimize is voting. A Blockchain-based voting system has several advantages which includes ease of processes, transparency, voting turnout and less possibilities for corruption. As the advantages are clear and obvious, the risks have also been raised by many people as being easily abused for fraud. A Blockchain-based voting system could minimize the number of errors in normal physical election processes (Lyons T., et al., 2020). Within the area of Blockchain-based voting, three concepts will be enlightened.

The first concept is e-voting in governments. The votes would be recorded on a distributed ledger which would induce a tamper-proof solution and provide the voters with a confirmation that their vote has been counted. Furthermore, advantages can be reach by moving the voting system to a decentralized Blockchain network. Votes could be validated by different and many validators by having different political parties and commissions to run the nodes and ensure the vote has been counted. The voting system could be built on open-source software which would enable transparency to the source code as well as ease audits. At last, the voting system could be moved from demanding physical

attendance to enable voting through your smartphone (Lyons T., et al., 2020). Included in the transformation from a physical election to an online election, or at least having both options, a huge benefit can be achieved regarding sustainability. A lot of processes will be cut off by having an online election. Additionally, it is expected that the voter turnout would raise because more young people are expected to participate (Petitpas A., et al., 2020).

All the above-mentioned advantages are indisputable, but as previous in the research project comes with challenges and risks which further research hopefully can eliminate. The top risk is the change for coercion if voting is done on smartphones without physical presence at a polling place. Another risks could be the risk for cyberattacks. Even though distributed networks are robust, the chance for cyberattacks is presence if the process of cracking the cryptography should be discovered (Lyons T., et al., 2020).

The next concept within Blockchain-based voting is smart participation which is about individuals participating in decision making on a lower level than the e-voting. This could be used in local projects where decisions need to be made and at normal questionaries. The smart participation is having the same advantages as the e-voting, but the risks being much smaller as this wouldn't be as bad as in a political election. The smart participation is therefore a great experimentation on the way to e-voting (Lyons T., et al., 2020).

The third concept within Blockchain-based voting is liquid democracy which is a combination of representative democracy and direct democracy. The liquid democracy gives the individuals the choice of distributing their vote to another individual or voting them self. This can also be filtered to, e.g., an individual wants to distribute its vote regarding the environment to a politician who is ambitious regarding this topic and its vote regarding immigration policy to another politician who wants more open borders. The distribution of a vote to another individual can be revoked at any time until the voting takes place (Lyons T., et al., 2020). In this scenario the risk regarding coercion is present.

The fourth, and last, concept within Blockchain-based voting is quadratic voting and finance which covers a new point of origin regarding voting. The voting is with the quadratic

voting and finance able to track how much the voters care about the specific voting option. The process is as follows, all voters receive the same number of voting credits, if you really/only care about one subject you place all you voting credits there and the number of voting credits you have placed there goes up quadratically. This will first of all show what you vote for, but also how much you rate this specific subject in relation to all the others (Lyons T., et al., 2020).

The third concept, and the last, this research project will enlighten in this section is the Blockchain technology´s ability to enable decentralized organizations. Decentralized Autonomous Organizations (DAO) is understood as an organization governed by code which means it is governed transparent, untamperable and without human involvement. Most DAOs could in extension manage any organization by encoding corporate governance, bylaws, work processes and bank accounts into smart contracts which in the end could disrupt the management functions in governments (Lyons T., et al., 2020). As the DAOs has been thoroughly enlightened in section 9.2, it will not be further distinguished in this section.

9.4 The Blockchain technology to foster sustainability

As the section before analyzed how to transform governments, the Blockchain technology´s current state in governments and where and how the Blockchain technology can transform governments, this section will have its only focus on how the Blockchain technology can be a key driver for sustainability. This section will be split up in four parts, the first three parts will each be analyzing a specific concept which the Blockchain technology can foster sustainability through, and the last part will be trying to sum the three concept and analyze if they can be used to foster sustainability in a social-ecological system. This section will cover the environmental factor from the PESTEL framework.

9.4.1 Smart grids

The first part of the Blockchain technology in a sustainability context will focus on the production and distribution of electricity and the use of smart grids.

It is not wrong to say that electricity is very close to be driving the whole world. The invention of the electricity is actually from back in the 18th century (Agung A. A. G., et al., 2020), and since its invention it has grown rapidly and the demand for it has as well. In 1980 the net consumption in billion kilowatt hours were 7.323 and in 2015 that number had increased to 21.153 (Agung A. A. G., et al., 2020). With the huge amount of produced and consumed electricity a normal estimation of the price would be that it was close to steady all over the world. But in 2021 the price in Denmark was 0,36 U.S. dollars per kilowatt hour, in Iran it was 0,01 U.S. dollars and in USA it was 0,16 U.S. dollars per kilowatt hours ("Statista: Household electricity prices worldwide in September 2021", 2022). The advancement in the technology has changed the process of electricity generation and distribution which has led to mass production and therefore cheaper power generators. Additionally, inventions have enabled new ways of generating electricity from the sun, wind, waves and other alternative sources (Agung A. A. G., et al., 2020). These inventions have not only made it available for the energy companies to generate electricity through the aforementioned sources, but also enabled the average citizen to invest in solar power cells and windmills. Additionally, the citizens who generate their own energy and generate more than they use, can sell it to other citizens which make them an alternative power source. As earlier describe in the research project, smart grids can transform the energy generation by creating decentralized generators, enhance renewable power sources and direct transactions between energy generators and consumers (Agung A. A. G., et al., 2020, Hermann M., et al., 2016). Furthermore, the smart grids boost security regarding electricity supply, but the smart grids also add complexity in the transactional processes. Multiple generators and consumers will be making transactions between them without knowing if the generators will deliver the electricity the consumer just paid for. The generator and the consumer will also need to create trust between each other or validate the transaction through other possibilities (Agung A. A. G., et al., 2020). As the research project has emphasized multiple times, the Blockchain technology can apply the trust to the process without having to use an intermediary to secure the transaction. By implementing the Blockchain technology into the smart grid, it will allow the users to run transactions without an intermediary due to the Blockchain technology´s consensus process.

9.4.2 Supply chains

The second part of the Blockchain technology in a sustainability context is in relation to supply chains.

As the planet´s environmental state constantly is a top global addressed challenge and issue, and no government, organization og company can neglect the fact that it is a world-wide problem. Therefore, a lot of research regarding the development of a sustainable supply chain management has been made which goal is to transform supply chain processes to operate and at the same time don't harm the environment (Manupati V. K., et al., 2020, Panigrahi S. S., et al., 2019). A tool to achieve this is the governments around the world who has implemented regulation regarding companies´ and organizations´ carbon footprint (Panigrahi S. S., et al., 2019). Research show that supply chains are responsible for 90% of the total impact on natural resources and furthermore 80% of the carbon emission of a consumer product is directly coming from the supply chain (Carter C., et al., 2020). This emphasizes that companies and organizations have to analyze, monitor and control their supply chain because they are responsible for the carbon emission impact it has (Manupati V. K., et al., 2020, Panigrahi S. S., et al., 2019). As the challenge for many companies is to track their sourcing materials, the Blockchain technology can enhance this (Kamble S., et al., 2020). What has to be created is a certified sustainable information system where all data regarding the supply chain is stored. This would create a fully transparent supply chain where all data regarding carbon emission would be stored (Kamble S., et al., 2020, Kouhizadeh M., et al., 2021). By implementing this certified sustainable information system, transparency and immutable information will be available for inspection. Supply chains can then accomplish the demand from governments and other organizations and provide complete supply chain traceability and transparency, which include product quality and authentication. By inviting the consumers inside the supply chain will furthermore strengthen the trust and relation to the product (Francisco K., Swanson D., 2018, Venkatesh V. G., et al., 2020). As analyzed the most relevant benefits supply chains can gain from the Blockchain technology is traceability and transparency, which is why these two benefits will be further analyzed.

The first benefits which will be further analyzed is transparency. Transparency can be defined as a concept where data and information are freely accessible and can be enabled by smart contracts (Gardner T. A., et al., 2019). Through smart contracts, rules, penalties, terms and conditions can be determined to deal with environmental challenges and issues. Monitoring of the supply chains environmental impact will be monitored and if the rules, conditions or terms are being violated, the responsible will be given the agreed penalty (Venkatesh V. G., et al., 2020, Bai C., Sarkis J., 2020). By implementing this system, containing rules and penalties, supply chains will intensives the process of being as environmentally friendly as possible (Bai C., Sarkis J., 2020).

The second benefit which will be analyzed is the traceability. Traceability can be defined as the ability to track information and data related to anything (Astill J., et al., 2019). The purpose of traceability in supply chains is the ability to track information and data regarding the supply chain´s activities (Venkatesh V. G., et al., 2020). This will in the supply chain´s case be by following a products´ journey and identifying its CO2 emission and where the product´s material is originated (Ko T., et al., 2018). By being able to track the supply chain´s CO2 emission, the rules and penalties will become much easier to enforce (Venkatesh V. G., et al., 2020). Additionally, the traceability can foster even lower CO2 emission, because the consumer will demand that the product has a low CO2 emission. This will create competition between the companies where the companies with the lowest CO2 emission will have an advantage (Bai C., Sarkis J., 2020).

As previous experienced in the research project, the adoption and implementation of the Blockchain technology is still demanding more research in order to achieve its full potential and lower the risks and challenges that lie ahead (Saberi S., et al., 2018). Within the sustainable supply chain some of the barriers are lack of sustainability awareness, lack of general knowledge about the Blockchain technology, lack of prioritization and lack of resources (Saberi S., et al., 2018, Kouhizadeh M., et al., 2021, Rane S. B., et al., 2020).

These barriers are all inter-organizational and to deal with these barriers, awareness, knowledge and information has to spread (Saberi S., et al., 2018, Kouhizadeh M., et al.,

2021, Rane S. B., et al., 2020). To do this, governments can support more initiatives regarding the Blockchain technology with a sustainable purpose. This would be an external initiative started by the government to foster inter-organizational change.

9.4.3 Smart cities

The third concept, and last, which will be enlightened in this section is smart cities, and especially smart cities in relation to shared economics. As earlier mentioned in the research project, the consumption and space in the cities will be challenged during the next 25 years. More and more people are expected to live in the cities which is why a solution needs to be made in order to share the resources we have available best as possible. This solution is expected to be the emerging of smart cities (Sundararajan A., 2014). The key characteristics within smart cities are smart governance, smart living, smart mobility, smart citizens, smart use of resources and smart economy, all mixed together, but the most important characteristics of smart cities are sharing (Gori P., et al., 2015, Mclaren D., Agyeman J., 2015). This section will analyze the sharing economy within the smart cities and how it can foster sustainability.

The sharing economy is defined as an economical model where under-utilized assets, resources, etc., where demand and supply are interacting for the supply side to directly provide assets, resources etc. The purpose of the sharing economy concept is to improve the use of under-utilized assets, resources, etc., and reduce transaction costs (Gori P., et al., 2015). In the sharing economy the citizens in the smart city can shift between two roles. The first role is the supplier, this role supply and offer other citizens all kind of assets. The other role is the consumer, who demands the assets the suppliers are offering. The consumer benefit from buying or renting the offered assets by the supplier by saving money on transactions cost or renting the assets (Collins P., 2021). The shared economy concept has enabled the smart cities to improve asset utilization, lower transaction costs, save energy and avoid congestion (Tedjasaputra A., Sari E., 2016). Several applications have over the past decades been created to foster shared economies, e.g., Airbnb and Uber as two of the most successful. The power of these applications is that they supply the two types of users with a platform where they can interact and rent out their assets on their

own terms (Eisenmann T., et al., 2006). These platforms are online constantly, and data is being processed immediately. This enables real-time information and knowledge which can enhance the exploitation of inefficient use of under-utilized assets and through that foster smart cities (Tedjasaputra A., Sari E., 2016).

Through the implementation of the Blockchain technology it can enable suppliers and consumers of the smart city to perform transactions between each other without an intermediary and without having to fear about being cheated. As earlier described in the research project the Blockchain technology can provide secure transactions without the need for an intermediary. This would enhance lower transactions fees and increase the efficiency in the shared economy. The automation of the shared economy through the applicability of the Blockchain technology is an essential feature in creating the smart cities. As the Blockchain technology adds elements like distributed, shared, secure and untamperable in the smart cities through shared economy the foundation for smart cities which are democratic, automatic, traceable, transparent and sustainable.

The three above mentioned concepts have the ability to transform the world into a more sustainable place. In order to enable this, the social-ecological systems can enhance the process and structuralize it. The different complex social-ecological systems which are cooperating and have an interest in the same resources, are relatively separated and have to be restructured so they aren't that. This social-ecological system contains of the resource system, resource units, users, governance systems and rules which has to be transformed so they are being monitored and enforced better. Complex social-ecological systems have suffered from not being able to monitor and enforce the commons. To do this the Blockchain technology can be applied. The Blockchain technology can, as analyzed earlier, be used for setting up rules through smart contracts, which can execute rules that the system provides it with. To monitor if the rules aren't being obeyed to the Blockchain technology will be implemented so transparency is available and the transparent data can´t be tampered due to the digital signatures which verifies the authenticity of the data. This can enhance sustainability as the complex social-ecological system will be managed (Ostrom E., 2009).

10. Discussion

After the analysis it can be concluded that there certainly are opportunities for the Blockchain technology to transform organizations, governments, etc., with a sustainable purpose. As the analysis exemplify, the relationship between the Blockchain technology, governance, Ostrom´s eight design principles, sustainability and socio-ecological systems are demonstrated. This section will enlighten several points throughout the research project which have been questioning the outcome of the analysis. Furthermore, the questioned points have created room and curiosity for further research in order to achieve a complete understanding of the Blockchain technology and its full potential.

This section will deep dive into the identified benefits and findings and discuss the challenges regarding, Gartner´s hype cycle, tokenization, self-enforcement and formalization of rules, autonomous automatization, decentralization of power over infrastructure, transparency, codification of trust, governments ability to transform, voting, sustainability and social-ecological systems.

As the Blockchain technology´s journey on Gartner´s hype cycle started from being present as the cryptocurrencies in 2015 to having its completely own hype cycle with underlying technologies in 2019 is a great illustration of its journey. As Gartner´s hype cycle illustrates the Blockchain technology, and all the underlying technologies, still have at least a couple of years in front of them before the general public are feeling the predicted transformation and impact. As the Blockchain technology being mentioned as the most epoch-making technology since the internet, the expectations are extremely high. The research project has investigated, researched and analyzed the Blockchain technology´s potential within governments in relation to sustainability and the potential is indisputable, but there is still some way to go. In recent years, the Blockchain technology has managed to move out of the cryptocurrencies shadow and begun its own journey towards plateau of productivity. This has made the world acknowledge that the Blockchain technology does not necessarily have to be solely related to cryptocurrencies which has enabled

more research to be initiated with its core focus on the Blockchain technology and the underlying technologies´ benefits. This is exactly what is needed for the Blockchain technology to move forward and reach the plateau of productivity in the future.

The first benefit which will be discussed is tokenization. If tokenization follows the techno-deterministic discourse it can foster extreme quantification. Extreme quantification can lead tokenization to use too much or solely quantitative data which can´t measure the human aspect. This can complicate the process of structuring rights to perform actions in the system. Furthermore, tokenization can lead to data fetishism, which can course damage to the company or organization if all decisions are solely based on data. Even though data is all around us and data is one of the most valuable assets right now. Everything people do deliver data to a database which can and will be used to something. As data can determine a lot of and predict future actions, it is dangerous to rely solely on data. It is necessary to keep in mind that there are human beings behind the data and that the data they provide isn't that useful all the time. The key is to combine the knowledge of your costumer, consumer etc., and combine it with the data to treat, predict and target them best at possible (Drexler O., 2022).

The next benefit which is up for discussion is self-enforcement and formalization of rules. As the embedded smart contracts, which are being used to enhance the rules in the system, only rely on forecasts and not on actual results, it presents the challenge regarding extreme quantification. Additionally, the incorporated rules are automatically enforced due to previously negotiated agreements by the company or organization, which entails the difficulty to make exceptions ((Di Filippi P., Hassan S., 2016, Rozas D., et al., 2021). Last for the self-enforcement and formalization of rules, the risk for extreme formalization can occur because the individuals who are coding the rules possess the power which also can entail biases (Harcourt W., et al., 2022).

The third benefit which´s risks will be enlightened is autonomous automatization. As the DAOs are acting on the behalf of the company or organization no one is directly responsible for the DAOs´ actions. This can lead to frustration for the one being penalized and

extra frustration because they can´t get directly feedback from the one who performs the penalty (Frost R., Postman N., 1993, Rozas D., et al., 2021). A solution to this can be that when the DAOs penalize a person who has the responsibility for the DAOs or at least knowledge regarding it can respond to the penalized person if they contact them. This is again an example which imply that everything can´t be digitalized and automated.

The fourth benefit which will be discussed is the decentralization of power over infrastructure. The first risk regarding this benefit is through the techno-deterministic approach where a decentralized infrastructure is very hard to govern. This is of course a risk which gets bigger and bigger correlated with the company´s or organization´s size. The key related to this risk is to manage to loosen control by decentralizing but without losing control and more and more decentralization will raise the change for losing the control. The second risk is that even though decentralization can minimize the single point of conflicts and high tensions by decentralizing, there will always be a main point where conflicts and high tensions are located and has a higher chance of occurring. Again, this is not something that companies or organizations can decentralize them away from. Another risk is, as seen with some of the previous benefits, the power the coding people possess. As this risk has been discussed earlier no further additions will be made in this section.

The fifth, and second to last, benefit is transparency. If transparency, follow the techno-deterministic approach, everything will be transparent. This will of course not be a good idea, as full transparency perhaps will reveal sensitive data on costumers or special recipes. As transparency is a thoroughly great thing to achieve, it shall be analyzed and evaluated what and how to use transparency.

The sixth, and last benefit within the governance benefits, is codification of trust. A risk related to this benefit is the power the people who code it possess. Once again, no further additions will be made in this section.

This section will discuss the findings regarding governments, this will include governments ability to transform, voting, cryptocurrencies´ transaction per second and volatility.

The first finding is governments´ ability to transform which really need to change in order for them to change and with that implement the Blockchain technology. This is something which each government has to take very serious and act from. As governments are working in a high paced environment where rapid changes occur more often than ever before, it is crucial to be able to respond on these changes. This should be on every governments´ to-do list in the future, as their ability to make use of and implement new emerging technologies and innovation lacks.

Second is government´s potential regarding Blockchain-based voting. As Blockchain-based voting could be very beneficial in a lot of matters regarding sustainability and voter turnout. But as mentioned earlier, there is risks related to the Blockchain-based voting in elections which needs to be eliminated before governments will look further into the solution. To initiate research related to the Blockchain-based voting the previous enlightened smart participation could be a prototype for governments to investigate.

The last section in the discussion will enlighten sustainability. In this section sustainability awareness, lack of knowledge regarding the Blockchain technology, lack of prioritization and lack of resources will be discussed.

The first finding is the sustainability awareness. As the data showing that the climate is getting worse every year, the awareness regarding sustainability is rising (Pope R., 2021). This is an essential reason for initiatives which can solve the environmental crisis and create a more sustainable world. As research regarding sustainability are rising ("A 'natural' rise in sustainability" 2019), the research within the Blockchain technology will be made and the findings will be published. As this is happening, the knowledge regarding the Blockchain technology will rise, which is covering the next finding, lack of knowledge about the Blockchain technology and its potential. Additionally, findings regarding lack of prioritization and resources have been discovered, which will be resolved parallel with the abovementioned findings. For the Blockchain technology to succeed and find its plateau of productivity, research, knowledge and initiatives have to be performed.

The last finding regarding the social-ecological systems (SES) is that they can be very hard to monitor. The monitoring aspect are correlated with the size of the SES as well as what it has to monitor. The challenge of monitoring the SES can be helped by the implementation of the Blockchain technology.

11. Conclusion

The purpose of the conclusion is to answer the research questions and will furthermore present the findings which has been analyzed and discussed in the previous sections. The conclusion will additionally sum up recommendations from the research project to the R:ekobyn project to achieve optimized governance and foster sustainability. As the R:ekobyn project has been used as a theoretical case for the research project, other similar projects to the R:ekobyn case can apply the recommendations and benefit from them as well.

11.1 Recommendations to optimize governance

The first section will draw recommendation from the research project regarding the optimized governance which can be achieved through the Blockchain technology.

The benefits within Ostrom´s eight design principles and the Blockchain technology can profoundly be concluded to exist which several points through the research project have enlightened. This section will conclude on the findings regarding how the Blockchain technology can optimize and enhance governance through Ostrom´s eight design principles. This will act as recommendations to the R:ekobyn project and conclude how and in which area the Blockchain technology can be applied to foster a better governance.

The first recommendation to the R:ekobyn project is related to Ostrom´s first design principle, clearly defined boundaries. This design principle can benefit from one of the identified Blockchain technology benefits, tokenization. Tokenization can be used to define clear boundaries by managing rights through distribution of tokens to the participating users.

The second recommendation to the R:ekobyn project is related to Ostrom´s second design principles, congruence between appropriation and provision rules and local conditions. This principles can benefit from several of the Blockchain technology´s benefits, tokenization, self-enforcement and formalization of rules, and decentralization of power over infrastructure. These three Blockchain technology benefits can improve the monitoring of common pool resources and penalize those who do not obey to the rules automatically. The smart contracts enable the automatic penalization which free up time, resources and save costs. The decentralization of power over infrastructure can reduce technical costs and decentralize decision rights so few actors don't have too much power which can foster corruption and fraud (Fisman R., Gatti R., 1999).

The next recommendation to the R:ekobyn project is related to the third of Ostrom´s design principles, collective-choice arrangements. This principle can benefit from two of the Blockchain technology´s benefits, tokenization and decentralization of power over infrastructure. Tokenization can simplify the structure of how rules are being created and modified which will formalize the process regarding rules which will ease the governance of them. As the collective-choice arrangements decentralize the rules to be created on a local basis it will entail and ensure they fit the system and situation on a local level.

The fourth recommendation to the R:ekobyn project is associated to the fourth of Ostrom´s design principles, monitoring. This principle can benefit from several of the Blockchain technology´s benefits, self-enforcement and formalization of rules, autonomous automatization, decentralization of power over infrastructure and increasing transparency. These benefits can help allocate, monitor and enforce common pool resources through smart contracts, which can strengthen the governance of common pool resources in the R:ekobyn project.

The fifth recommendation which will be recommended to the R:ekobyn project is associated to Ostrom´s fifth design principle, graduated sanctions. This principle can benefit from two of the Blockchain technology´s benefits, self-enforcement and formalization of rules, and autonomous automatization. The R:ekobyn project can benefit from these

Blockchain technologies through effective rules and the process of enforcing and modifying them and additionally automating them.

The next recommendation to the R:ekobyn project is related to the sixth of Ostrom´s design principles, conflict-resolution mechanism. This principle can benefit from two of the Blockchain technology benefits, autonomous automatization and increasing transparency. By implementing the Blockchain technology this principle can be automized through smart contracts and DAOs which can resolve conflicts automatically. By increasing transparency, the resolution mechanism can be optimized because transparent data can create a thorough picture of the resolution and reason behind. The R:ekobyn project can apply this in their community, which can optimize conflict resolution and transparency.

The seventh of Ostrom´s design principles which can be optimized through the Blockchain technology and will be recommended the R:ekobyn project to research further and implement is the minimal recognition of rights to organize. This principle can benefit from three of the Blockchain technology benefits, self-enforcement and formalization of rules, decentralization of power over infrastructure and codification of trust. The decentralization enables local autonomy to create, modify and organize their own rules as long as the rules obey to the overall rules. As the rules are local, they can still communicate with the overall rules due to the trust between the systems which foster interoperability. The decentralization can furthermore foster innovation which enable for research which can be beneficial when something relevant and applicable are discovered. The R:ekobyn project can benefit from the abovementioned especially by having focus on decentralization of rights which foster continuous innovation. This is essential so the innovation in the R:ekobyn project don't stop. As the Blockchain technology still is an emerging technology the research within it isn't complete and several new benefits are expecting to emerge over the next decade which the R:ekobyn project will be able to respond to by decentralizing decision rights.

The last recommendation regarding Ostrom´s design principles is the eighth, nested enterprises. This principle can benefit from two of the Blockchain technology benefits, autonomous automatization and codification of trust. The R:ekobyn project can through the

DAOs enhance the creation of nested entities through higher degrees of automatization. This is achieved through the codification of trust which are fostering the capacity to scale up (Rozas D., et al., 2021).

11.2 Recommendations to optimize the ability to transform

This section will give recommendations on how governments can achieve the ability to transform in order to enable the implementation of the Blockchain technology. Additionally, as distinguished in section 8.2.1 and 8.2.2, governments have a lot of pain points which the Blockchain technology can optimize and make more efficient, these will be highlighted as well.

To achieve the benefits mentioned in the previous section, the ability to transform is essential. As the research project has identified, governments are lacking this ability, which can have severe consequences for the implementation of the Blockchain technology (Bollyky B., et al., 2021). Below, governments and the R:ekobyn project will find recommendations to achieve the enabling of transformation.

The first recommendation is to invest time and energy to communicate with the employees and make the purpose clear regarding the transformation. As the purpose is clear the achievable benefits should be stated in order to strengthen the purpose. The next essential part is to achieve the right resources to initiate the transformation and manage to get it completed. During the transformation it is essential to keep the momentum by constantly having the employees actively involved to make sure that they are following the transformation and still believe that the end of the transformation will be beneficial for them. When the transformation is done it is important to keep being attentive for new updates and features so the transformation keeps being fully utilized (Bollyky B., et al., 2021, Hemerling J., et al., 2018).

The second recommendation is to make the processes much more transparent. As the citizens have a negative perception of the governments´ processes, transparency could

solve this pain point. The next recommendation is to decentralize decision rights in order to achieve a higher ability to transform and be more innovative (Thierer D. A., 2016).

11.3 Recommendations to achieve sustainability

This section will highlight the recommendations to achieve sustainability through the Blockchain technology.

The first recommendation is the use of smart grids. Through smart grids, a more sustainable electricity distribution can be achieved, as the smart grids entail advanced data processing which enables a more efficient, decentralized, reliable, secure and flexible electricity distribution. Smart grids are using advanced information and communication systems to link consumers, distribution stations and power generators. Besides the above-mentioned advantages, smart grids let consumers who also generates their own energy sell extra energy which they don't use to other consumers nearby. This will enhance the sharing economy, which will be concluded on later in the conclusion in relation to smart cities. To enable the full potential of the smart grids the Blockchain technology will has to be incorporate to enable transactions between consumers through smart contracts which enable transactions without the use of an intermediary (Agung A. A. G., et al., 2020, Hermann M., et al., 2016, Imbault et al., 2017).

The next recommendation is the supply chains which through traceability can foster sustainability. As it is still very hard to identify a product´s original environmentally footprint due to tampering of data, transparency of the supply chain and the Blockchain technology could solve this. The recommendation is to implement traceability and transparency through the Blockchain technology which entail that data can be made untamperable through the proof-of-work consensus mechanism. This would let the R:ekobyn project monitor and enhance the use of resources easily and automatic (Geroni D, 2021, Wright L., 2022, Giungato P., et al., 2017, Manupati V. K., et al., 2020, Panigrahi S. S., et al., 2019).

The next recommendation for the R:ekobyn project is to research within the smart city concept. The smart city concept is emerging around the globe and the Blockchain

technology can enhance the shared economic services by securing transactions between people. As the idea behind shared economic services is to sell excess resources to other consumers to exploit resources so nothing is wasted (Kewell B., et al., 2017, Giungato P., et al., 2017). As concluded previously the smart grids can foster the shared economic service.

The last recommendation within the sustainable concepts includes all the above-mentioned recommendations which can be applied and incorporated in a social-ecological system. The SES can help structuralize and create the skeleton for a community where sustainability is prioritized. The SES has the ideas and concepts to create a sustainable community, but lacks the security, transparency, traceability and monitoring which the Blockchain technology excels in (Ostrom E., 2009). The recommendation to the R:ekobyn project is to use and investigate the social-ecological systems framework to foster sustainability in the structure of the community.

12. From now on

This section will short evaluate the research project in the author´s perspective and enlighten what the next steps for the author could be.

As the research project has been a several month-long process where the perspective has changed through several iterations which has led to the final composure. For the author, this has been a process with a steep learning curve where a lot of new knowledge has been achieved. As this is a characteristic for a research project it can be considered successful. Furthermore, the research project has opened up the author´s aspect, as the conduction of the research project has been very interesting. After the research project the author will definitely keep his knowledge up to date with the newest technologies, concepts, ideas etc., within the topic, which might could turn into further research. As the research project concludes, the Blockchain technology hasn't even started its real impact yet, which the next five to ten years will be extremely interesting to follow. Additionally, the author´s purpose with this research project has been to encourage governments, the R:ekobyn project and other similar organization and projects to conduct research within

the applicability of the Blockchain technology in order to create a better world at last. The author really hope that this is the occasion when the reader has reached this last section of the research project.

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14. Appendix

14.1 The R:ekobyn project idea (Utkast projektskiss)

Projektnamn	
Blockkedjan och Social-Ekologiska System i Öresundsregionen (BK-SES-ÖR)	
Lead Partner	
Länsstyrelsen Skåne, Malmö	
Övriga partner	
Department of Digitalization vid Copenhagen Business School, Köpenhamn	
Kontaktperson	*E-postadress*
Jörgen Dehlin	jorgen.dehlin@lansstyrelsen.se
Telefonnummer	*Mobil*
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Att tänka på när du planerar projekt

- Du kan hitta information om hur du planerar och genomför ett projekt inom Interreg Öresund-Kattegat-Skagerrak på programmets hemsida www.interreg-oks.eu
- Få en överblick över programmets insatsområden, investeringsprioriteringar, specifika mål samt aktivitetsindikatorer

1. Beskriv projektidéen (Bakgrund, aktiviteter, målgrupp och syfte)

De rådande klimatförändringarna gör att många projekt väljer att sätta upp mål och visioner för hur gemensamma resurser ska styras och förvaltas för att säkerställa att de används på ett hållbart sätt. Dessa mål och visioner kan vara av mer övergripande karaktär som FN:s 17 globala utvecklingsmål, Agenda 2030, eller av mer specifika karaktär som tex särskilda hållbarhetsmål inom en kommun eller ett projekt. Ett exempel på ett projekt med tydliga hållbarhetsvisioner är det innovativa bostadsprojektet R:ekobyn i Röstånga, som tillsammans vill skapa förutsättningar för ekologiskt, socialt och ekonomiskt boende. Den ideella föreningen som driver R:ekobyn vill hitta klimatmässigt hållbara tekniska lösningar för de gemensamma utmaningar som finns kring uppvärmning, energi och byggteknik. Men de vill även skapa gemensamma utrymmen och aktiviteter, exempelvis en gemensam verkstad, för ett mer effektivt resursutnyttjande. Det saknas däremot ramverk, baserat på evidensbaserad forskning, för hur projekt likt R:ekobyn ska styras när mål, visioner och resurser är gemensamma och involverar flera olika parter som framtida invånare samt offentliga och privata aktörer.

En möjlig lösning är att skapa ett nätverk, baserat på blockkedjeteknik, med syfte att ta fram konkreta lösningar på de utmaningar och problem som uppstår i samband med att visioner och resurser är gemensamma. Nätverket ska utgå från Elinor Ostroms, Nobel pristagaren i ekonomi, Social-Ekologiska System (SES). Detta system bygger på åtta principer som ökar sannolikheten för

att människor tillsammans ska kunna styra och förvalta gemensamma resurser på ett långsiktigt och hållbara sätt. Principerna är följande:

1. Det ska finnas tydligt definierade gränser för de gemensamma resurserna och vilka som har rätt att ta del av dem.
2. Användarreglerna för de gemensamma resurserna är välanpassade till de lokala behoven och förhållandena.
3. Individerna som berörs av användarreglerna ska kunna vara med och förändra dem.
4. Det är medlemmarnas egna ansvar att se till att respektera och leva upp till användarreglerna.
5. Medlemmarnas rätt att styra över sina gemensamma resurser är respekterad av andra externa auktoriteter.
6. Det ska finnas proportionella sanktioner som medlemmar kan bestraffas med ifall de bryter mot användarreglerna.
7. Medlemmarna har tillgång till snabba och billiga metoder att lösa potentiella konflikter.
8. I vissa fall så tillhör/påverkar de gemensamma resurserna inte enbart medlemmarna, då kan medlemmarna behöva styra de gemensamma resurserna tillsammans med andra aktörer.

Användarreglerna som nämns ovan består av sju olika regler, som medlemmarna i nätverket behöver komma överens om och vars syfte är att påverka medlemmarnas initiativ att agera på ett sätt som gynnar de gemensamma resurserna. Den första regeln *Boundary rules* bestämmer villkoren för hur medlemmar går med och ur nätverket. Den andra regeln *Position rules* syftar till att bestämma vilka positioner som behövs i nätverket och vilket ansvar som kommer med varje position. Den tredje regeln *Choice rules* handlar om att förutbestämma hur medlemmar vid de olika positionerna i nätverket ska agera eller icke-agera vid olika omständigheter. Den fjärde regeln *Aggregation rules* bestämmer hur många och vilka medlemmar som behöver delta vid olika beslut. Den femte regeln *Information rules* bestämmer vilken information som nödvändig eller icke-nödvändig vid olika situationer. Den sjätte regeln *Payoff rules* bestämmer hur medlemmar ska belönas eller bestraffas baserat på deras handlingar eller resultat. Den sjunde och sista regeln *Scope rules* är till för att avgränsa vilka sakområden och därmed vilka frågor som nätverkets medlemmar är tillåtna, förpliktigade och förbjudna att arbeta med.

Nätverkets medlemmar kan komma och variera beroende på vilken fas bostads-projektet i R:ekobyn befinner sig i men tänkbara medlemmar är följande: framtida invånare, offentlig sektor, företag, universitet, icke-statliga organisationer och engagerade medborgare.

För att skapa transparens och öka delaktigheten i nätverket, ska kommunikationen ske i en blockkedja. Fördelen med blockkedjetekniken är att bara de som är inbjudna kan delta samt att innehåll som skickas i en blockkedja har en unik signatur och går således inte att kopiera eller göra till sin egen. Vill någon lägga till texten eller bilden så blir det ett nytt block i kedjan med den personens unika digitala avtryck. Det är alltså ett system med hög säkerhetsstruktur och tillförlitlighet. I R:ekobyn skulle tekniken underlätta kommunikationen internt genom att fungera som en loggbok för alla kommunikation som sker internt så väl som externt. Det skulle även bidra till att medlemmarna i R:ekobyn enklare skulle kunna skaffa sig en överblick över tidigare bestämmelser och pågående arbete.

- Ett nätverk underlättar för projekt att kunna nå de gemensamma hållbarhetsmålen och -visionerna som är uppsatta. På så sätt ser man till att mål inte förblir mål utan också realiseras i verkligheten.
- Ett nätverk kan främja att de gemensamma resurserna används på ett hållbart sätt, vilket minskar sannolikheten att möta de problem som ofta uppstår när resurser är gemensamma så som konkurrens om användning, överanvändning och ”free riding”.
- Ett nätverk där samtliga parter kommunicerar via en blockkedja gör kommunikationen säker och spårbar, vilket underlättar ansvarsutkrävandet.

Denna idéskiss gäller en förstudie i R:ekobyn, som ämnar skapa ett nätverk baserat på Ostroms SES-ramverk och blockkedjetekniken. Tanken är att förstudien leder fram till ett genomförandeprohejt, där de lärdomar som nätverket uppmärksammat genomförs. Ett genomförandeprojekt skulle baseras på en relativt ny teknik, blockkedjetekniken, och dels på ett teoretiskt ramverk som kan vara svårförståeligt till en början. Ett genomförandeprojekt kan även vara till nytta för att dra lärdomar inför framtida likande nätverk i andra projekt i Öresund-Kattegatt-Skagerak regionen. Nätverken kan på sikt samarbeta och lära av varandra.

2. Vilket av programmets mål kan ni vara med till att uppfylla?

Programmet har fyra insatsområden: **Innovation**, **Grön ekonomi**, **Transport** samt **Sysselsättning**. Till varje insatsområde hör två eller tre specifika mål. Välj vilket mål projektet kan vara med till att uppfylla, och motivera kort valet nedanför. Välj bara ett mål.

Innovation:

X ☐ Öka antalet forskare som är verksamma gränsregionalt/internationellt, samverkar med näringslivet och arbetar inom ÖKS styrkeområden

X ☐ Öka tillämpad forskning och innovationsinriktad aktivitet inom ÖKS-området

Grön ekonomi:

☐ Ökat antal samarbeten för utveckling av ny teknik, nya styrinstrument och metoder för att främja ökad produktion av förnybar energi

☐ Öka andelen användning av förnybar energi (i förhållande till total energianvändning)

☐ Minskad energiförbrukning i offentlig verksamhet

Transport

☐ Förbättra tillgängligheten till och igenom ÖKS-regionen

☐ Minska transporttiden med miljövänliga transportformer för personer och gods till närmsta knutpunkt i TEN-T (Miljövänliga transporter: Kollektivtrafik för persontransport (buss, tåg och båt), samt sjö- och järnvägstransport för godstransport)

☐ Öka det miljövänliga transportarbetet i utvalda korridorer, inklusive i kärnnätverket TEN-T samt i och omkring tätorter

Sysselsättning:

☐ Främja ökad sysselsättning i egenföretag, mikroföretag och nystartade företag

☐ Öka antalet gränspendlare

Motivering (hur kan ni vara med till att uppfylla målet?):

Genom att applicera Ostroms teoribildning samt den digitala blockkedjetekniken, bidrar projektet till att öka tillämpad forskning och innovationsinriktad aktivitet inom ÖKS-regionen.

Projektet kopplar även på ett naturligt sätt samman medborgare, akademi, näringsliv och offentlig sektor.

Projektet kan bidra med värdefullt underlag när det gäller arbetet för att främja skapandet och förvaltandet av gemensamma resurser, vilket är en viktig del i omställningen till en cirkulär ekonomi.

3. Beskriv varför ni behöver samarbeta över nationsgränser för att uppnå projektmålet

De projekt som finansieras av Interreg Öresund-Kattegat-Skagerrak ska ha ett tydligt gränsregionalt mervärde. Ambitionen är att projekten ska ge resultat inom ett eller flera av nedanstående områden:

- förbättrade administrativa och institutionella strukturer
- lärande genom överföring av metoder, modeller, data, kunskap samt idéer och visioner

- lösningar på gemensamma problem
- kritisk massa – sammanslagning av resurser för att skapa en större gemensam potential än vad som finns inom den enskilda regionen eller landet

Beskriv projektets gränsregionala mervärde (varför kan ni inte uppnå projektets mål utan at samarbeta över gränser?):

Länsstyrelsen Skåne har som offentlig myndighet under de senaste åren byggt upp en viss basal kompetens inom området blockkedjeteknik och ser en stor potential i teknikens förmåga att skapa samhällsnytta och bidra till hållbarhet i enlighet med de globala hållbarhetsmålen; främst då mål 11 (hållbara städer och samhällen) och mål 16 (fredliga och inkluderande samhällen). Länsstyrelsen har även en väletablerade kontakt med den ideella organisationen som driver R:ekobyn i Röstånga.

Department of Digitalization vid Copenhagen Business School har en väldokumenterad forskningskompetens inom området för blockkedjeteknik och besitter även en god kunskap om Ostroms teoribildning och SES-ramverk.

Genom projektet sammanlänkas kunskap och erfarenheter från offentlig sektor, akademi och allmänheten i Öresund-Skagerak-Kattegatt regionen.

Klimatförändringarna gör att människan måste börja använda jordens resurser på ett mer hållbart sätt. Att försöka hitta ett fungerande ramverk för att styra och förvalta gemensamma resurser kan därmed ses som en lösning på ett gemensamt problem. Projektet ska ses en förstudie som på sikt går att skala upp och applicera på fler projekt inom ÖKS-regionen.

4. Beskriv de aktiviteter (övergripande) som förväntas ingå i projektet

Vad förväntas ingå i projektet som vi vill skapa?

Projektet kan beskrivas som en förstudie bestående av två delar, dels ett nätverk i R:ekobyn och dels en styrgrupp som har det övergripande ansvaret för projektet.

Nätverket i R:ekobyn har följande uppgifter:

- Undersöka och diskutera hur nätverket bäst arbetar för att nå R:ekobyns mål och visioner. Finns det sammanhang där nätverket är bättre lämpat för? Hur väljs nätverkets medlemmar och hur ska nätverket finansieras?
- Sätta sig in i Ostroms SES-ramverk och diskutera hur de åtta principerna kan användas som en utgångspunkt för hur de gemensamma visionerna och resurserna i R:ekobyn kollektivt ska styras.
- De åtta principerna bygger på att det existerar ett antal användarreglar och nätverket behöver därför komma överens om vilka användarregler som ska finnas i just R:ekobyn. Användarregler som är väl förankrade i R:ekobyns lokala kontext, ökar incitamenten för deltagarna i nätverket att försöka nå de gemensamma målen och använda de gemensamma resurserna på ett hållbart sätt.
- Sätta sig in i hur nätverket använder och kommunicerar i en blockkedja.

Projektet består även av en styrgrupp som har ett mer övergripande ansvar för projektet. Styrgruppens främsta uppgift är att hitta deltagare till nätverket, se till att nätverket förstår Ostroms SES-ramverk, hitta ett sätt att utveckla och implementera blockkedjetekniken i nätverket samt skriva ansökan till ÖKS brobryggar-projekt. Av dessa uppgifter är den största utmaningen att hitta ett prisvärt sätt att utveckla blockkedjan, då detta är en teknik som är kontextspecifik och måste utvecklas från grunden för det enskilda ändamålet.

Förstudien ska svara på följande frågor:

- Ifall Ostroms SES-ramverk med kontextspecifika användarregler i kombination med blockkedjetekniken är användbart för att nå gemensamma hålbarhetsmål och visioner?
- Undersöka ifall det är några särskilda frågor som nätverket är bättre lämpat för?
- Ifall detta är ett användningsområde där blockkedjetekniken är användbar?

Målet är att förstudien ska leda fram till ett underlag för ett fullskaligt genomförande-projekt, som på sikt ska kunna applicera på fler projekt inom ÖKS-regionen.

Du kan maila det ifyllda projektidéformuläret till sekretariatet i Göteborg eller Köpenhamn.

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