Setting Up a Decentralized Autonomous Organization

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Abstract

In recent years a new type of organization has emerged, the Decentralized Autonomous Organization. Enabled by blockchain technology and smart contracts this kind of organization runs itself through programmable code uncontrolled by any form of central authority. However, the practice of setting up a DAO is complex due to security issues, unclear legal status, technical limitations and a lack of accepted formalization and standards. Various open source software frameworks have emerged to provide infrastructure and services for users to create and manage decentralized organizations. In this research paper it is explored how a DAO can be created in the context of the SecureSECO project. By the use of document analysis, case study and expert interviews a blueprint is established for implementation of SecureSECO DAO. Five steps were identified during the process of setting up a DAO being requirements engineering, voting mechanism selection, DAO platform selection, DAO modeling and token design. Conclusion is that the SecureSECO DAO should implement a reputation-based voting mechanism with a lazy consensus and multisignature mechanism. The best fitting framework for DAO creation Aragon because of high level of maturity and high customization ability.

Keywords: Decentralized Autonomous Organization, Requirements engineering, Voting mechanism, DAO framework, Token design

1 Introduction

Traditional organizations as we know them today are more often structured in a top-down manner meaning they consist of many management layers. Each layer passes on goals and tasks to lower layers by using bureaucratic coordination. This hierarchical and centralized way of organization leads to the age-old principal-agent dilemma which occurs when an agent in the organization has the power to make decisions on behalf of another person or entity within the organization (Voshmgir, 2020). Think of the CEO acting on behalf of the shareholders or the government acting on behalf of its citizens. In such situations there is a chance of a moral hazard occurring when the actor takes more risk than usual because the agent isn't directly affected by the outcome or acts in his own interest because the principal has no control over the agent (Voshmgir, 2020). The majority of our organizational theory was created on the assumption that there is a need for centralized network positions in organizations to ensure trust. While this assumption has been valid in the past, the emergence of distributed trust systems such as blockchain technology fundamentally challenges the core principles of our organizational theory (Seidel, 2018). A blockchain is an immutable ledger of transactions which is not controlled by a central authority. Any kind of ledger being a record of economic exchange, a reputation rating or a certificate of authenticity no longer requires to be validated by a trusted third party. This heavily questions our previous assumptions about the legitimacy and power of centralized network positions and forces us to rethink the way how we fundamentally shape our organizations (Seidel, 2018).

With the use of blockchain technology and smart contracts (self-executing computer programmes on a blockchain) a new type of organization was invented. This organization is the Decentralized Autonomous Organization or DAO. As of today there is still no broadly accepted definition of DAO. Various researchers have tried to formulate a definition or abstained from using one (Norta et al., 2015). Ethereum founder Vitalik Buterin defined the early concept as "a virtual entity that has a certain set of members or shareholders [...] which have the right to spend the entity's funds and modify its code" (Buterin, 2013). More recent academic definitions of DAO are "organizations in which participants maintain direct real-time control of contributed funds and governance rules are formalized, automated and enforced using software" (Jentzsch, 2016), "an organization that is run through rules encoded as computer programs called smart contracts" (Chohan, 2017) and the most recent being "A DAO is a blockchain-based system that enables people to coordinate and govern themselves mediated by a set of self-executing rules deployed on a public blockchain, and whose governance is decentralized (i.e., independent from central control)" (Hasan & De Filippi, 2021).

The absence of a universal definition of DAO makes it difficult to identify its origins. To some within the blockchain space Bitcoin is considered as the first establishment of a DAO since the code is validated through the nodes of the network where everyone who owns bitcoins essentially becomes a stakeholder of the organization, despite the fact that the governance of the bitcoin network is not completely automated by smart contracts (i.e., "off-chain governance") as the modern definitions of DAO describe (Kypriotaki et al., 2015; Ehrsam, 2017). For others it was the emergence of "The DAO" which was built on the Ethereum blockchain in 2016. The project's team consisted of prominent pioneers in the field including Vitalik Buterin and envisioned that "by encoding the rules of governance for organizations and governments in a set of "smart contracts" running on an immutable, decentralized, and potentially unstoppable and public blockchain, new forms of social interactions and order would emerge". These forms would be "transparent, efficient, fair, and democratic" (DuPont, 2017). The experiment was short-lived as the code of the protocol was exploited by malicious actors

shortly after the project had launched and a large part of the organization's collective funds amounting to $50 million were stolen (Dhillon et al., 2017). Despite the tragedy The DAO had opened doors for further exploration of decentralized governance issues.

In recent years various ways to create a DAO have emerged. This has led to the fact that currently over a thousand DAOs are living on a variety of blockchain networks across the globe with some containing thousands of active members [11] . Most of these DAOs have issued their own tokens with the goal of creating an incentive compatible environment for its participants. Tokens represent a participant's stake in the organization and therefore their voting power within the organization which they can use for voting on open proposals or to initiate a proposal themselves. This way the initial team behind a project tries to decentralize its governance by gradually handing over control of the project to its users (Wang et al., 2019). The goal of a DAO is not solely to provide a form of decentralized governance, it can provide services and resources to external parties, hire people for a job or to perform specific tasks or transact with individuals to grant access to its services or reward them for their contributions to the network (Valiente Blázquez et al., 2022). The practice of creating a DAO from scratch is complex and even for experienced engineers in the industry it is highly challenging to grasp all the issues related to it. Think of security issues, unclear legal status, technical limitations, a lack of accepted formalization and standards and absence of actual use cases throughout the blockchain space. As a response to this complexity various open source software frameworks have emerged to provide infrastructure and services for users to create and manage decentralized organizations such as Aragon, Colony and DAOstack. Although these frameworks may ease the process it is still difficult to find comprehensive material to understand the architecture and many aspects of these frameworks needed to build a DAO (Valiente Blázquez et al., 2022; Wang et al., 2019).

In this research paper the complex process of DAO creation and implementation is studied and specifically executed on the basis of a SecureSECO distributed ledger case study. The structure of this research is as follows: In the next section the main research question, sub-questions and project context are given. On top of that the research methods of this study are explained. Section 3 provides an in-depth overview of the core concepts that shape the decentralized world such as blockchain networks, smart contracts and decentralized applications (dApps). Section 4 provides an overview of different blockchain networks and their corresponding DAO platforms with industry case studies. Section 5 provides an insight in the process of DAO platform selection and voting mechanism selection. In section 6 is described how the model of a DAO is created and in section 7 is described how the token of the SecureSECO DAO is implemented in the SecureSECO distributed ledger. In the next section a conclusion is drawn from the answers of the main and sub-questions and lastly this conclusion is discussed.

2 Research Approach

Research is the process of collecting, analyzing, and interpreting data in order to understand a phenomenon originating with a question or problem and requires clear articulation of a goal (Leedy & Ormrod, 2005). The research process is systematic in the sense that objective definition, data management and communication of findings take place within established frameworks and following existing guidelines. The frameworks and guidelines give the researchers an indication of what should be included in the study, how the study should be conducted, and what kinds of conclusions are likely based on the data collected (Williams, 2007).

Problem Statement

The problem stated in this research paper addresses how one can establish a form of decentralized governance in order to manage a decentralized project.

Most research problems are too large or too complicated to be solved without breaking them down (Leedy & Omrod, 2005). Almost any problem can be broken down into smaller units. From a research perspective, these units are easier to address and solve. The subunits of the main problem are called subproblems, which are briefly discussed in the first chapter. By viewing the main problem in terms of the subproblems, the researcher often gets a better idea of how to approach the entire study (Leedy & Omrod, 2005). Therefore, a main research question and several sub-research questions are formulated. By finding answers to the sub-research questions and combining them into the bigger picture, the main research question can then be answered.

Research Questions

Main research question: How can a Decentralized Autonomous Organization be created?

Sub research question 1: How are the requirements of a Decentralized Autonomous Organization identified?

Sub research question 2: How is a voting mechanism for a Decentralized Autonomous Organization selected?

Sub research question 3: How is a technical platform for Decentralized Autonomous Organization creation selected?

Sub research question 4: How is the business model of a Decentralized Autonomous Organization created?

Sub research question 5: How is the token of a Decentralized Autonomous Organization implemented?

Research Objectives

In this research paper the concept of DAO is explored using the above research questions and ultimately a technological artifact, the DAO, is created on the basis of the findings. In order to achieve this the constructive research approach is used. The constructive research approach is a research framework that can be used when inventing innovative artifacts with the intention to solve real world problems and at the same time to contribute to the theory in the field in which it is practiced. The central concept that characterizes this research approach, constructive, is an abstract concept with an unlimited amount of practical implementations. Think of all human artifacts like models, diagrams, plans, organization structures, commercial products, information system designs and even mathematical algorithms (Lukka, 2003). From this perspective the creation of a DAO perfectly fits the definition of a construction since it aims to create a decentralized organizational structure. A constructive study is experimental by nature in the sense that the constructed artifact isn't solely a practical implementation but also an attempt to illustrate, test, refine or develop an entirely new theory. Characteristic of the constructive study is that its results are an explicit and strong empirical intervention. By providing an in depth analysis of what works and doesn't work in practice a significant contribution to the existing theory can be made. The ideal result of a constructive research project is that a real-world problem is solved by constructing an artifact, which has both great practical and theoretical implications.This kind of result would be in the best interest of all the different stakeholders involved in the research project. However, even when the project fails at the practical level it can still provide a significant theoretical contribution (Lukka, 2003).

Figure 1. provides the key elements of the constructive research approach according to Lukka, 2003.

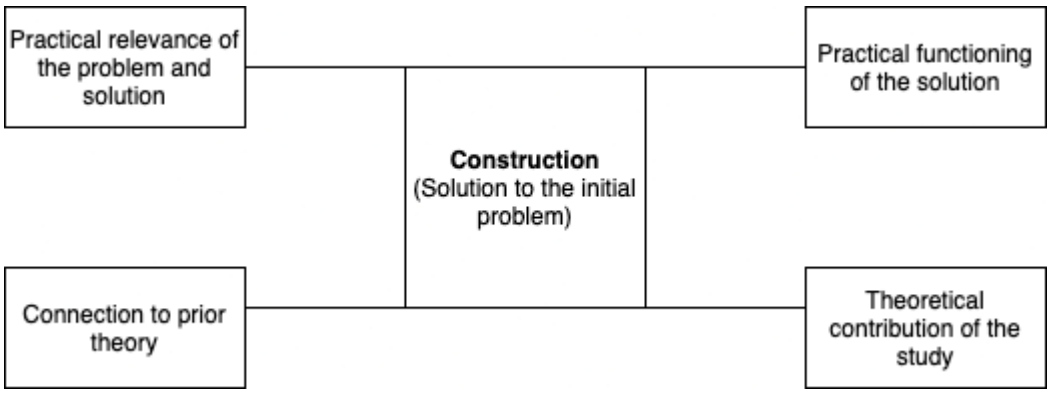

Figure 1. Key elements of the constructive research approach

Starting with the practical relevance of the problem and solution. The SecureSECO project needs to be governed in a decentralized manner by the community (problem) which can be achieved by the creation of a Decentralized Autonomous Organization (solution). In order to gain insight in the problem and to develop a solution a connection to prior theory is made. This is done by performing document analysis, case studies and expert interviews. With the knowledge gained from these actions an artifact is constructed that provides a real-world solution, the SecureSECO DAO. As a practical functioning of the solution the DAO is implemented for the SecureSECO distributed project. The solution can then be tested to see if the solution provides legitimate practical implications. As a theoretical contribution of the study this research provides a framework that can be used by other researchers in the future during the process of DAO creation.

Furthermore Lukka (2003) divides the constructive research approach process in different steps which are:

1. Find a practically relevant problem which also has potential for theoretical contribution.
2. Examine the potential for long-term research cooperation with the target organisation(s).
3. Obtain deep understanding of the topic area both practically and theoretically
4. Innovate a solution idea and develop a problem solving construction, which also has potential for theoretical contribution
5. Implement the solution and test how it works
6. Ponder the scope of applicability of the solution
7. Identify and analyse the theoretical contribution

These steps are somewhat ambiguous and can be interpreted in various ways. However, throughout the research paper these steps are used like general guidelines in order to give structure to the research.

2.1 Project Context: SecureSECO

In this research the SecureSECO project is studied. SecureSECO is a distributed ledger with a trust calculation component aiming to create an open and trustless ecosystem for the worldwide software supply chain (Hou et al., 2021). The ledger collects trust facts from all different kinds of stakeholders that are connected to the ecosystem consisting of software end-users, providers, engineers and organizations. All trust fact data is validated by every single node within the blockchain network on the basis of the same consensus mechanism. A blockchain is a tamper-resistant, decentralized database of transactions consistent across a base of decentralized nodes. A consensus mechanism ensures database consistency when new transactions on the network are validated, often by economically incentivizing the network's node operators. Two common consensus mechanisms are proof-of-work and proof-of-stake where in proof-of-work nodes are required to solve complex mathematical puzzles and in proof-of-stake nodes are required to contain a staked amount of cryptocurrencies (Rossi et al., 2019). After the project's academic lifespan it should be maintained by the community in the future. In order to realize this form of decentralized governance the creation of a Decentralized Autonomous Organization is needed.

During the research different sources to gain insights and knowledge on the topic are consulted. The three main sources are going to be document analysis, case study and expert interviews.

2.2 Document analysis

Document analysis is a qualitative research method that involves skimming, reading and interpretation of all sorts of documents. This process is iterative and combines elements of both content analysis and thematic analysis. Content analysis is the process of organizing information in different categories on the basis of the formulated research questions. Thematic analysis is a form of pattern recognition from the analyzed data. From these patterns that are found categories are formed. This kind of analysis requires more extensive reading of data. The goal of document analysis is to provide background and context to the research, raise additional questions, supplement data, give a means of tracking change

and development, and verification of findings, even when an event can no longer be observed or witnesses have forgotten details (Bowen, 2009).
Most of the documents used for analysis in this research paper are academic literature articles found through the Google Scholar search engine. However, since the industry of blockchain and specifically Decentralized Autonomous Organizations is relatively young and ever evolving at a rapid pace there is not a sufficient amount of scientific literature available yet to successfully perform a research study on DAOs, therefore a supplementary amount of gray literature is added to fulfill the need of documental resources. Documents that belong to gray literature are unpublished studies and studies that are not commercially published which are therefore not indexed in respective databases such as Google Scholar. Think of documents such as conference abstracts, dissertations, policy documents and book chapters (Schmucker et al., 2013). Pieces of gray literature used in this research are on-chain data, metrics and analytics, github repositories, platform whitepapers, platform libraries and unreviewed articles.

2.3 Case study

A case study is a detailed examination of a single person, organization, or event. The case study method allows for in-depth, multi-faceted examinations of complicated subjects in their contexts. Case studies are useful in many domains, including psychology, medicine, education, anthropology, political science, and social work (Crowe et al., 2011). In the authoritative work of Yin four types of case study designs are identified based on holistic versus embedded and single versus multiple (Yin, 2012). This research uses holistic multiple case designs to examine different existing DAO platforms as multiple cases within their environment in order to comprehend one specific unit of analysis and evaluate the SecureSECO DAO platform selection problem.

Objective: Deciding on which decentralized autonomous organization framework fits the SecureSECO DAO best on the basis of their identified requirements.

Study design: Multiple case design of publically available Decentralized Autonomous Organization frameworks

The cases: Based on the top three results of the SecureSECO case study in the authoritative work of Banimeneh et al. The three analysis units are decentralized autonomous organization frameworks Aragon, Colony and DAOstack.

Methods: We conducted multiple gray documents and scientific works regarding the three frameworks Aragon, Colony and DAOstack to gain a deep understanding of their key features and main differences.

Analysis: Evaluating the findings on the basis of the SecureSECO DAO requirements.

2.4 Expert interviews

The qualitative interview is used in qualitative research of all kinds, whether positivist, interpretive or critical. It is used in case studies, in action research, in grounded theory studies, and in ethnographies. The qualitative interview is the most common and one of the most important data gathering tools in

qualitative research. A series of qualitative semi-structured interviews based on Myers' and Newman's guidelines has been conducted to explore tacit knowledge of domain experts regarding SecureSECO and especially the SecureSECO DAO (Myers & Newman, 2007). In this study expert interviews were used during the requirements discovery process. The discovery process is the first stage in the requirements engineering process. It's the process of obtaining data about the necessary system and current systems and distilling user and system requirements from that data. For the requirements discovery process, experts from the SecureSECO project are interviewed according to predefined questions created by a researcher from the SecureSECO team (appendix A). The predefined questions formed the fundament of the interview leaving space for open discussions. From the interview with the SecureSECO expert a list of requirements are identified.

3 Background: The Decentralized World

Before diving deeper into all the concepts that the decentralized world is made of, it is essential to understand what decentralization actually means in this particular context. To start off its crucial to be aware that there are three different axes of centralization/decentralization namely architectural, political and logical. The degree of architectural (de)centralization of an organization or system is determined by how many different components it consists of and how many of these components it can tolerate shutting down at a given time to keep running. For example traditional organizations are architecturally centralized since they are controlled by one head office, breaking down this component will cause the organization to stop functioning. The degree of political (de)centralization is determined by how actors within the organization or system can ultimately control it or make changes to it. In traditional organizations the CEO or the Steering Committee is in control of the organization making it politically centralized. Logical (de)centralization is determined by whether the infrastructure of an organization or system can be split in half and still function. Decentralized organizations and systems have some advantages since it makes them fault tolerant, attack resistant and collusion resistant. Fault tolerant because decentralized systems are less likely to fail since they rely on multiple independent components, attack resistant because its harder and more expensive to attack multiple components instead of a single central point and collusion resistant because its more difficult for participants to collude in ways which benefit them at expense of other participants (Buterin, 2017). To get a better understanding of the concepts of centralization and decentralization it can be helpful to put the two into perspective through some real world examples. Starting with centralization, Central Bank Digital Currencies or CBDCs are digital currencies issued by central banks around the world that will be introduced by 2023 (Auer & Böhme, 2021). These currencies, including the network they are deployed on, are controlled by a single central authority, the central bank. This means that the central bank is in full control over the monetary policy, rights of the users and future changes to the network. This network will not be verified by blockchain technology meaning that the operations by the central authority on the network are not visible or known to the public, however actions done by users on the network are available to the central authority if desired (Auer & Böhme, 2021). This means that the network is architecturally and politically centralized and thus less transparent. Then there are cryptocurrencies, which are deployed on blockchain networks and controlled by Decentralized Autonomous Organizations that control the monetary policy, rights of the users and future changes to the network. Actions done by all participants within the network including the DAO itself are written to the distributed ledger and visible to the public making the network highly transparent (Härdle et al., 2020). Blockchain networks are politically decentralized since no central authority controls them and architecturally decentralized since there is no infrastructural central point of failure, but they are logically centralized since there is a commonly agreed state and the systems behave like a single computer (Buterin, 2017)

Not every blockchain network has the same degree of decentralization with the reason for this lying in the blockchain trilemma. Vitalik Buterin defined the trilemma as “developing a blockchain technology that offers security, decentralization, and scalability without compromising any one of them”. It is known that currently, a blockchain technology can only offer two of the three variables” (Im, 2018). Bitcoin and Ethereum are examples of blockchain networks that achieve decentralization and security, meaning that they sacrifice scalability. In order to get a better understanding of the three components, or values as some like to call them, within this trilemma the different consensus algorithms of blockchain networks need to be compared.

Proof of Work was the first ever consensus algorithm to be invented and was first used by the Bitcoin network and is currently still the most prevalent consensus algorithm used by blockchains. Proof of Work harnesses the security component through its simple design and the requirement that the network nodes have to generate pieces of data that meet a universal standard of rules which are computationally difficult to produce and easy to verify. Proof of Work or PoW algorithms implement this by creating complex mathematical puzzles that can be solved by brute computer force (Altarawneh et al., 2020). This process requires hardware, infrastructure and energy facilitation from the so called "miners" and therefore they are rewarded by the network for their effort in the form of cryptocurrencies. It may take years to build large scale new energy sources making it impossible to just buy hashrate dominance instantly. PoW sympathizers claim that because of this networks will become secure, decentralized and censorship resistant, harnessing the security and decentralization components of the blockchain trilemma [12] . On the other hand this means that PoW has to sacrifice on the scalability component. This especially comes to light when looking at key metrics such as maximum throughput, latency, bootstrap time and cost per confirmed transaction of PoW networks. For example Bitcoin's highest transaction throughput is 7 transactions per second while Visa can reach roughly 4000. These performance metrics have a significant impact on the user's quality of experience. One could simply argue that by shortening the block interval or block size the transaction per second metric would be enhanced, however this would lessen the security of the network since it increases the chance of a fork occuring (Zhou et al., 2019).

Another consensus mechanism that is often used in the blockchain space is Proof of Stake or PoS and emerged as one of the main alternatives to PoW. PoS sympathizers criticize the PoW model because it sacrifices on the security and decentralization component since 70% of all miners are located in the same country (China) making the network vulnerable to single government regulation, and that the majority of mining hardware is made by the same company giving opportunity for the implementation of malicious backdoors that can harm the network (Buterin, 2017). Throughout the early years of blockchain pioneering it became obvious that for some use cases the scalability limitations and energy usage were simply too large (Altarawneh et al., 2020). In PoS the nodes with the most cryptocurrencies staked in them are most likely to be chosen to validate the next block. This eliminates the need for having nodes competing with each other by solving complex puzzles resulting in more scalability and less energy usage. It can be stated that PoS nodes compete with each other economically instead of computationally threatening both the security and decentralisation values of the trilemma (Altarawneh et al., 2020). This is because rich node holders are chosen more frequently to validate the next block and thus are rewarded more often. Therefore, in the long run PoS-based networks tend to become more centralized in the favor of a few large node holders (Saad et al., 2021). Subsequently this increasing concentration of staked cryptocurrencies in fewer network nodes gives opportunity for security vulnerabilities to develop. In order to strengthen these two values many different PoS protocols have emerged that try to implement a random function to generate the next block producer to make the selection process more fair. Examples of these protocols are Ouroboros that uses a coin-flipping mechanism and Snow-white that exploits a random oracle to select the next leader (Zhou et al., 2019).

During recent years also various solutions to be able to strengthen the scalability component while still guaranteeing decentralization and security have emerged. Commonly used scaling solutions are sharding, rollups, state channels and sidechains. A separation can be made between on-chain and off-chain scaling or layer 1 and layer 2 scaling. Layer 1 scaling focusses on upgrading the base layer of the network while layer 2 scaling focuses on offloading the work to another layer, off-chain [7] . A leading layer 1 scaling solution currently used to solve the blockchain trilemma is sharding. Sharding

is the process of splitting databases horizontally in order to spread the load. The idea behind this concept is to split the network into different fragments, called shards. Each shard is working on a different set of transactions meaning that each node in the network is no longer required to be working on the entirety of all transactions across the network. This allows the network to scale with the numbers of shards, resulting in the throughput and the storage to achieve higher efficiency [7] . However, this leaves a chance of weakening the security of the network because of the possibility of a single-shard takeover attack. Popular blockchain networks that currently use sharding technology are Zilliqa and Harmony (Hafid et al., 2020). Layer 2 solutions invent mechanisms that are implemented outside of the native blockchain, while maintaining its security from the base layer [8] . Currently invented layer 2 solutions are rollups, state channels and sidechains. Rollups are currently being experimented with by the Ethereum community and perform transaction execution outside layer 1 and then the data is posted back to layer 1 after which consensus is reached. As the transaction data is on layer 1 this means that the rollups are secured by the native blockchain network. This way of inheriting security properties of layer 1 while executing transactions off-chain is a defining characteristic of rollup technology and layer 2 solutions in general [8] . A state channel is a temporary private off-chain connection between two parties that have agreed to establish their own transaction channel that is still secured by the native blockchain. Transferring a portion of the network transactions to these private state channels helps to reduce the workload of the main network resulting in an improved transaction throughput of the whole system. Two examples of well-known state channels are Bitcoin's Lightning Network and Ethereum's Raiden Network (Im, 2018; Zhou et al., 2020). Sidechains look similar to state channels but it uses a separate blockchain to improve scalability. This seperate blockchain runs in parallel to the mainchain and operates independently meaning that transactions don't have to be constantly communicated to the mainchain. The concept of using multiple chains looks similar to blockchain sharding; however, side chains are more dependent to a main blockchain like state channels as they are designed to eventually communicate their end state to the mainchain. The sharded chains, on the other hand, are fragments of a main blockchain divided into a different category. Two well-known sidechains are Bitcoin RootStock and Ethereum Plasma (Im, 2018; Hafid et al., 2020).

All these different kinds of scaling solutions are welcomed with wide arms by the blockchain communities since using multiple solutions can help reduce the overall congestion on any one part of the network, and moreover prevents single points of failure. The vision is that the whole is greater than the sum of the parts and that different solutions can work in harmony creating a positive exponential effect on the future of transaction speed and throughput [7] . Some pioneers in the field even claim to have solved the Blockchain Trilemma such as the foundation behind the Alogrand protocol (Conti et al., 2019). The protocol tries to achieve this by using "cryptographic sortition" which securely and randomly selects a set of voters from the network periodically. These voters are responsible for reaching consensus through a highly efficient Byzantine Agreement Protocol in order to guarantee the network's transaction cost linearity and a block generation time of nearly a minute laying the infrastructure for mass scalability. However, critics argue that this network still sacrifices on the security component (Conti et al., 2019). Others choose to sacrifice on the decentralization component purposely such as the VeChain Foundation (VeChain Foundation, 2018). This platform focuses on building a public blockchain that is designed for mass adoption through enterprise onboarding and envisions that current available consensus models are not suitable for achieving this. Therefore, the Proof of Authority consensus algorithm was introduced where only the 101 Authority Masternodes (AM) are allowed to produce blocks after going through a strict Know Your Customer procedure to satisfy the foundation's minimum requirements. The protocol ensures that every AM has an equal chance of being selected to be the next block producer. The underlying design philosophy of

VeChain's Proof of Authority consensus model is that: "Neither a total centralization nor a total decentralization would be the correct answer, but a compromise and balance of both would." (VeChain Foundation, 2018). Designing the consensus algorithm of a blockchain is an important decision to make because it determines which components of the blockchain trilemma are being harnessed or sacrificed. Blockchain networks lie on a spectrum between centralization and decentralization and its up to the foundation to determine the sweet spot based on the particular use cases their platform wants to fulfil.

In previous sections various blockchains have already been named such as Bitcoin, Ethereum, Algorand and VeChain. "A blockchain can best be described as a data structure of blocks that are chained together to form a collection of records, called a ledger, with cryptography being a key ingredient in the process. A blockchain doesn't have a storage mechanism; instead, it has a set of protocols that govern the way in which information is forged" (Raj, 2019). The term blockchain actually entails a number of concepts, including P2P network, consensus mechanism, and more, it goes beyond the technology of blockchain that links data blocks into an immutable chain. The above-mentioned are examples of public or permissionless blockchains meaning that they are open for any person to join and read records, make transactions or become a miner. This makes these blockchains highly transparent, and they are often governed by a decentralized autonomous organization (Raj, 2019). This open nature of permissionless blockchains can lead to privacy concerns especially for data sensitive business applications such as the storage of medical records. There are also permissionless blockchains with private blockchains having the strictest system participation control meaning that all reading, transacting, and mining privileges are strictly controlled within a single organization by the network owner (Cai et al., 2018). Other types of permissioned blockchains are the consortium blockchain which is controlled by multiple organizations, and the hybrid blockchain which overlaps between permissionless and permissioned areas. The fact that permissioned blockchains are not governed by a decentralized autonomous organization can lead to unwanted collusion between network participants at the expense of others (Cai et al., 2018). Examples of permissioned blockchains are MultiChain (Private), Hyperledger Fabric (Consortium) and XinFin (Hybrid).

Bitcoin was the first application of blockchain technology and really opened the door for future blockchain applications. Bitcoin itself is only a public decentralized ledger without any subject matter other than the development of a P2P network and the computational cost of nodes through PoW mining. Apart from strengthening the robustness of the system this application of blockchain technology doesn't provide any value (Cai et al., 2018). Some experts in the field like to call this application of blockchain technology blockchain 1.0. In order to add more value to blockchain applications the idea of smart contracts was first introduced by the Ethereum Foundation. A smart contract is a set of programs which are self-verifying, self-executing and immutable. By integrating smart contracts with blockchain technology the system is capable of performing certain tasks in real time with a high degree of efficiency and security (Mohanta et al., 2018). This application of blockchain technology is widely known as blockchain 2.0 and since then several blockchain platforms have emerged with the intention to become ecosystems that build decentralized applications or dApps. A decentralized application is an application built on a decentralized network that combines a smart contract and a frontend user interface. Decentralized applications are used in many industries such as logistics, finance and gaming (Mohanta et al., 2018). This led to the emergence of new decentralized industries such as Decentralized Finance and Play-to-Earn gaming which are currently in their infancy stages. There are significant advantages to decentralized applications compared to centralized applications being zero downtime, more privacy, censorship resistance and data integrity. Some of

these benefits come from the fact that decentralized applications are governed by decentralized autonomous organizations. Being governed by such an organization means that after deployment a dApp needs no further maintenance and governance from the original developers (Cai et al., 2018; Raj, 2019).

As mentioned before, a decentralized autonomous organization (DAO) is a blockchain-based system that allows people to coordinate and govern themselves using a set of self-executing rules published on a public blockchain, and whose governance is decentralized (Hassan & De Filippi, 2021). A DAO can be used to do a variety of different tasks. For example, to construct a virtual entity that functions as a crowd-funding platform, ride-sharing platform, fully automated firm, or fully automated decision-making system. It's important to recognize that a DAO is not a specific business model or organization, but rather a term that can apply to a wide range of things (Hassan & De Filippi, 2021). In practice DAOs refer to blockchain-based groups of like minded individuals that share a common goal which often involves pooling of capital to invest in accordance to specific projects that add to this goal. These DAOs are setting a precedent for a revolutionary governance model that will potentially replace all forms of businesses, governments and human organizations [15] . Potential use cases for DAOs are countless and ever evolving. The DAO landscape ranges over not only economic issues, but political, humanitarian, social and scientific domains. Due to this high variety of use cases and the rapid pace at which the DAO ecosystem is emerging, many in the field of blockchain still struggle to make sense of what DAOs truly are and what they are capable of. To get a better understanding of the concept we have to look closely at the terms it consists of. Simply said a DAO is an organization that is both decentralized and autonomous. Autonomous because these kinds of organizations are automatically run by smart contracts. These smart contracts have been established by the initial developers of the DAO and will in the future be managed by the community. Often through a process called progressive decentralization in which the control of the organization is gradually handed over to the community by the foundation overtime (Walden, 2020). This eventually makes the organization self-sustainable when it comes to hiring, distributing rewards, and other bureaucratic or important questions which are typically found in organizations [15]. Decentralized because there is no central entity that owns or controls it, and decisions are made collectively by the whole organization instead of the executive board. Members with a certain number of representative tokens or reputation can effectively vote or make proposals on changes to smart contracts, project initiatives, or investment plans. In terms of entry modalities, economic rights, and governance rights, many different governance structures exist [15] .

Previous chapter has provided an overview of the decentralized world and specifically its emergence, advantages and limitations. This background information is essential in order to be able to grasp the in-depth analysis of the concept of decentralized autonomous organizations in the next chapters and fulfills step three of the constructive research approach.

4 Requirements Engineering

Step four of the constructive research approach is to innovate a solution idea and develop a problem solving construction. This is done through Requirements Engineering (RE) which is the process of defining, documenting, and maintaining requirements in the engineering design process. Requirements are the descriptions of qualities, attributes, services, functions, and behaviors that a product must have in order to achieve the system's goals and purposes (Arayici et al., 2006). It's a common function in systems engineering and software engineering, and it's responsible for the goals, desirable characteristics, and restrictions of complex systems involving software, organizations, and people. It also looks at the relationship between requirements and business processes, soft problems, work redesign, system and software architecture, and testing. This process is considered one of the most important aspects of building an information system because it is during this process that decisions are made about what is to be built (Carr, 2000).

This section will focus on answering sub research question 1:

How are the requirements of a Decentralized Autonomous Organization identified?

The steps involved in requirements engineering vary widely depending on the type of system being designed and the organization's specific procedures (Sommerville, 2011). These may include:

1. Requirements discovery or elicitation
2. Requirements analysis and negotiation
3. System modelling
4. Requirements specification
5. Requirements validation
6. Requirements management

Although these tasks are frequently depicted as sequential steps, in actuality, there is considerable interleaving of these activities.

The discovery or elicitation of needs is the first stage in the requirements engineering process (Sommerville, 2011). It's the process of obtaining data about the necessary system and current systems and distilling user and system requirements from that data. The first sub-research question is answered through this approach. Documentation, system stakeholders, and specifications of similar systems are all sources of knowledge during the requirements discovery phase. End-users of a system, managers, and external stakeholders such as regulators who confirm the system's acceptability are all examples of stakeholders. Each of these requirements sources can be represented as a system viewpoint, with each viewpoint displaying a subset of the system's requirements. Different perspectives on a situation see the issue differently. Their perspectives, however, are not fully autonomous and frequently overlap, resulting in similar requirements. Different viewpoints on a problem see the problem in different ways. Their perspectives, however, are not fully independent and frequently overlap, resulting in similar requirements (Sommerville, 2011).

There are various techniques for requirements discovery. In this research paper the interviewing technique, the user stories technique and the use cases technique are used.

Requirements engineering procedures often include interviews with system stakeholders. During these interviews, the requirements engineer asks stakeholders questions about their current system and the system that is constructed. The answers to these questions are used to create requirements. According to Sommerville interviews may be of two types:

1. Closed interviews, where the stakeholder answers a predefined set of questions.

2. Open interviews, in which there is no predefined agenda. The requirements engineering team works with system stakeholders to explore a variety of topics and gain a deeper knowledge of their demands.

In practice, interviews with stakeholders are normally a mixture of both of these. Interviews are useful for gaining a broader understanding of what stakeholders do, how they might engage with the new system, and the challenges they have with present systems (Sommerville, 2011). For the requirements discovery process an expert from the SecureSECO project was interviewed according to predefined questions created by a researcher from the SecureSECO team (appendix A). The predefined questions formed the fundament of the interview leaving space for open discussions.

From the interview with the SecureSECO expert the following list of requirements were identified:

- The team doesn't want to implement an independent DAO operating apart from the state.
- There needs to be a legal Foundation with five board members that are not allowed to have any stakes in the organization.
- The Foundation is ultimately responsible for the treasury of the DAO. Larger transactions need to be reviewed by the Foundation.
- The Foundation has to be able to receive grants and donations.
- An Emergency Commission consisting of ten independent SE and Cybersecurity professors needs to be able to use the kill-switch in emergency cases. (Example: Curve Finance Emergency DAO)
- Apart from the Foundation and the DAO, there's also going to be a Start-up that's going to collect data for the DAO and resell the data.
- The Start-up will be rewarded by the DAO in euros or tokens.
- Income streams are on the account of the Foundation.
- Ownership and control is going to lie with the Foundation.
- Decisions will be made on-chain through a vote.
- The DAO can be joined through verifying with a GitHub account.
- If a participant has no verifiable github account, DAO will vote on the admission proposal.
- The DAO needs to be able to set out bounties for projects through proposals. There could be a collaboration with Gitcoin.
- Only DAO members that have completed a KYC process will be able to create proposals. These members will be viewed as Whitelisted.
- All DAO members will be able to vote anonymously.
- There needs to be a committee of experts that actively monitors the quality of open proposals by asking creators critical questions regarding their idea. Committee members get rewarded for judging proposal quality and providing substantial feedback.
- Proposals that do not meet up to the minimal required standard need to be able to get rejected by the committee of experts.
- The committee of experts will be formed by DAO members that have the highest reputation.

- There will be a two-token model; reputation tokens are paid to DAO members, economic tokens are paid to the Start-up or other companies.
- There is no formalized hierarchy and influence and power are reflected through voting power.
- Voting power can only be acquired through reputation tokens.
- Reputation tokens cannot be sold to other DAO members.
- All DAO members start with zero reputation tokens.
- DAO members are rewarded for database hosting with a combination of reputation tokens and financial tokens (fiat or crypto).
- DAO members are rewarded for data mining with a combination of reputation tokens and financial tokens.
- Outcomes of proposals will not be enforced on-chain, a committee of experts needs to check if the task was sufficiently completed.
- If a task is accepted the projected bounty is locked up.
- If a pull request is accepted the bounty for the task should be released after approval of the committee.
- Proposals and voting starts after a total of ten DAO members have joined.
- Voting power of a single stakeholder can never be over 10%.
- There needs to be a leveling of power overtime through token inflation.
- Voting power can not be delegated to other DAO members..
- Implementation of a form of governance where voting is not needed unless objection for more efficient decision making is an option.
- Implementation of an off-chain voting mechanism such as Snapshot for cheaper voting is needed.
- There needs to be stake based voting through reputation tokens, staked tokens are burned after the proposal has closed.
- There needs to be a voting fee to reduce the chances of sybil attacks.
- DAO members can choose how much reputation they want to stake on a particular proposal.
- All proposals need to have a cap of usable voting power set by the proposer.
- The DAO is going to manage the treasury while the Foundation is ultimately responsible.
- Data resellers must provide part of their revenues to the DAO.
- Mining should be rewarded with a couple of euros or tokens per 100mb of methods.
- After 50% github coverage mining rewards should be gradually reduced.
- If github indexing reaches a certain threshold the DAO can temporarily stop rewarding data contributors.
- If the treasury runs dry the DAO can temporarily stop rewarding data contributors.
- Organizations that want to run their code against the database should pay a couple of euros or tokens per project. Or a subscription fee.
- Researchers that want to download from the database should be able to pay by mining with a particular ratio method mined/methods downloaded.
- Both the Foundation and the DAO will be able to hire new employees.
- There will be no on-chain mechanisms for punishing DAO members.
- Software releases will be formally decided on on-chain.
- The DAO needs to be upgradeable through the change request policy.

4.1 User Stories

User stories are especially helpful for fleshing out an outline requirement description. It's a description of a hypothetical interaction session. Each story usually focuses on one or a small number of possible interactions. Different types of stories are created, each of which provides different types of information about the system at various levels of detail. Working with stakeholders to identify tales and gather details to add in these stories is what story-based elicitation entails (Sommerville, 2011). Before user stories can be written all the different stakeholders that are part of the system have to be identified first. Based on the SearchSECO expert interview and the TrustSECO research paper which is a component of the the SearchSECO platform the following stakeholders in this organization were identified (Hou et al., 2021):

Organization Stakeholders

The Foundation
Companies
The DAO
The Emergency Commission
The Committee of Experts

Types of DAO Members

Empirical Software Engineers (ESERs)
Software producing organizations (SPOs)
End User Organizations (EUOs), i.e., organizations that aim to use software safely.
End users (EUs), i.e., private people at home
Package Manager Organizations (PMOs)
SecureSECO node managers (SNMs)

User stories may follow different formats or templates. In this research paper the format Three Rs or the Connextra format (Lucassen et al., 2016) is used. Overview of user stories can be found in appendix B.

5 Voting Mechanism Selection

In many situations of everyday life we find ourselves faced with the problem of mending with the different views of others. These issues are usually solved by resorting to some opinion assembling procedures, like voting. Throughout the existence of mankind, voting has always been regarded as a primary means of individuals to express their preferences on controversial issues and discussions. It's a process that is at the heart of a democratic society and allows people to voice themselves on ballot questions, candidate elections, political parties and other problems (Khoury et al., 2018).

This section will focus on answering sub research question 2:

How is a voting mechanism for a Decentralized Autonomous Organization selected?

Answering this question contributes to step four of the constructive research approach.

We take multiple documents as a starting point for selecting voting mechanisms for the DAO. First is an authoritative work by Kurniawan, 2021 providing a framework for the DAO selection problem. Second is a collection of gray literature pieces regarding DAO voting mechanisms. Despite the fact that these are not scientific, they are rather actual than available peer reviewed works and thus very insightful.

5.1 Voting systems

Voting systems have progressed from counting hands in the early days to paper, punch cards, mechanical levers, and optical-scan machines. Recent democratic elections employing voting machines have revealed that victory margins can be as small as the voting system's error margins, making election a risky task. Electronic voting has the ability to reduce or eliminate undesirable human errors. It can also handle multiple modalities, such as voice assistance for handicapped, and provides better scalability for large elections. E-Voting is also a mechanism that doesn't require voters to be in close proximity making it very efficient (Sampigethaya & Poovendran, 2006). However, the current E-voting systems as we know them are often built on centralized infrastructures which are governed by third parties. The fact that a central party is responsible for guaranteeing voting data integrity raises issues of trust. Since voting is heavily reliant on trust, the results of voting events have always been questioned and perceived differently by voters. Technically speaking these E-voting systems have drawbacks in the form of data integrity, security, single point of failure and centralized control (Khoury et al., 2018).

Over the years various engineers and researchers have tried to invent decentralized voting systems aiming at resolving the trust concerns raised by conventional E-voting systems. Researchers analyzed the architecture of the existing E-voting systems and integrated blockchain and smart contracts into the application. Whichafter was found that it could enhance data verifiability and lower the cost while maintaining the openness and transparency of the voting system (Khoury et al., 2018). Other findings were that anonymities of voters, the security of ballot transmission and the verifiability of votes during the billing phase are the most fundamental requirements for a decentralized voting system. It's argued that these decentralized voting systems have strong data integrity, secure validation through consensus mechanisms, transparent runtime and high availability (Hsiao, 2017).

In their most basic form, voting systems or voting mechanisms are a mapping from a set of votes to an ordering of the options that best expresses the group's preferences (Elkind & Lipmaa). Manipulation, or when a strategic voter lies about his choices to get a better result, is a fundamental difficulty that all voting techniques encounter. When it is profitable for rational agents to manipulate, it is realistic to expect the voting mechanism's output to dramatically mislead the agents' actual preferences and be destructive to the system as a whole. While there is no information theoretic solution to this problem, it is claimed that making manipulation more difficult will help discourage manipulators (Elkind & Lipmaa). It was found that different voting procedures are different in a very basic sense, resulting in the same voting body making different collective conclusions when different voting procedures were used. Nonetheless, voting systems promise to achieve the same goal, eliciting agreement on the best candidate or alternative (Nurmi, 2012). These findings show the importance of implementing an extensively thought out voting system when trying to solve governance issues.

Classical voting systems such as plurality voting and majority voting are often used in decision making for political problems (Niemi & Riker, 1976). Plurality voting seems to be the most intuitive voting system, where the option with the most first-preference votes wins, regardless of whether it receives a majority of votes overall. In ballots for a single proposition, this is known as ‘First-Past-the-Post’, or ‘Block-Voting’ for multiple propositions. Because of its simplicity and tendency to elevate stable parties with broad appeal, Plurality voting is the preferred electoral system for many countries. Unfortunately for those who are subject to it, Plurality voting is a poor technique of accurately capturing sentiment, and its dynamics tend to drive civilizations to political polarization and long-term two-party domination (Niemi & Riker, 1976).
Majority voting systems require the winning option to receive a majority of the total vote count, rather than just the most votes [13] . This is accomplished by having voters rank or score the options, which greatly expands the input space. Despite being vastly more indicative of voter sentiment than Plurality voting, a 'tyranny of the majority' can occur when there is a significant minority of voters who are firmly opposed to a proposition, but it passes because the majority is weakly supportive [13] .

There are two main processes to reach a group decision in decentralized networks. The first is consensus, where all members must consent before the decision is accepted. Second is voting where the decision is accepted when a majority of the participants agrees. A reason to choose for voting instead of consensus is that the decision-making process is faster, and is more controllable when the scale of the organization is large (Kurniawan, 2021).

A voting-based DAO's governance can be broken down into six steps: proposal, review, voting, execution, disagreement, and arbitration [14] . Members initiate proposals for community improvements, financing applications, or asset changes. Before a proposal can be enacted, it must pass through the voting stage. Under normal conditions, the proposal is now complete, albeit some members may be unhappy with the voting results or consider that the voting process was corrupted. The situation has now been rectified. If the disagreement is accepted, it will go to arbitration. The decentralized court steps in here. Members who are dissatisfied with the outcome can request arbitration from the decentralized court, and the decentralized court will make a decision.
Each governance mechanism has its own unique shortcomings. The issues in DAO governance can be divided into internal governance issues and external governance issues. Internal governance problems are problems caused by the defects of the governance mechanism itself, such as the cost of proposals, the value of voting and the influence of voting, plutocracy and vote buying. External governance problems are those caused by the external environment, such as sybil attacks, fee related issues, last minute voting and voter apathy [14].

DAO governance is a democratic process requiring participation from its stakeholders or community members. Although there are diverse DAO manifestations, they all seek to achieve trustless joint management with the use of blockchain technology in order to achieve the main goals of these organisations. The means to achieve these goals is the organisation's voting mechanism. A voting mechanism determines on the basis of which encoded rules the organization is governed. DAO voting mechanisms are deployed in blockchain protocols via smart contracts to offer higher levels of transparency at the same time minimizing bureaucracy with automatically executing codes. Different DAO voting mechanisms do exist such as relative majority, conviction and token based quorum voting. Relative majority voting mechanisms compare the total number of votes of those supporting and those against to arrive at a decision, conviction voting is a DAO voting mechanism whereby individuals stake their powers to vote on proposals and gather enough votes to pass over time and token-based quorum voting mechanisms require a particular voters' threshold for a proposal to pass, often being set at more than 50% quorum. The DAOs voting mechanism plays a vital role in the success of projects in the long-term by stimulating members to make the best decisions (Kiarie, 2021).

5.2 Decision Criteria

During recent years various researchers have developed frameworks and tools that can make the process of decision making in software less complex. One of these research papers provides a Decision Criteria Framework and a Voting Mechanism Decision Model (Kurniawan, 2021). The Decision Criteria Framework raises questions to clearly define which topics of the decision process need to be addressed. The decision criteria have been clearly ordered in a table by the researcher:

Table 1: Decision Criteria Framework

General	**Network status**	Permission		Permissionless	
	On vs Off-chain voting	On-chain voting		Off-chain voting	
	Proposing rights	Everyone		Core developers	
	Democracy	Direct	Representative	Liquid	
Voting mechanism	**Voting weight**	One vote		Token-weighted	
	Number of winners	Single-winner		Multi-winner	
	Alternatives	Two		More than two	
	Vote accumulation	Buying		Earning	
	Ballot type	Single	Multi	Ranked	Range
	Majority quorum	Any percentage between 51-100			
	Majority subset	Participants	Community	Token supply	
	Participation quorum	Any percentage			
	Participation subset	Community		Token supply	
	Voting fee	Yes		No	
	Participant motivation	Self-interest	Social incentive	Economic incentive	
	Dispute Resolution	Mechanism	Jurisdiction	Sell	Hard fork

There are general DAO criteria and specific voting mechanism criteria, some of these voting mechanism criteria are later on used in the Voting Mechanism Decision Model. The decision criteria will be processed on the DAO requirements identified from the expert interview in the previous section. First a brief explanation of the different criteria according to Kurniawan will be given, second the criteria questions will be answered for the SecureSECO DAO.

Network status

Network status describes if the organization requires permission to join i.e. permissioned or is open for anyone to join i.e. permissionless. Permissionless or public organizations tend to have more members than permissioned or private organizations (Kurniawan, 2018).

On vs Off-chain voting

On-chain voting formalizes decision-making processes by capturing the proposals and voting into blockchains making the process more transparent and more audible. Off-chain voting makes use of meetings, forums, or face-to-face interaction to make a collective decision which allows dominant actors to gain more influence and exclude other members (Kurniawan, 2018).

Proposing rights

An important aspect of decision making is determining who is eligible to participate in the decision making. One option is to make each member in the community eligible to propose so one would be able to offer its input. Another option is to only limit the right to propose to developers to guarantee the quality of the proposals. It can be argued that creating proposals often require a minimum amount of technical and organizational knowledge and should only be done by certain experts or developers. However, the second option has the pitfall of creating a technocracy because it could put too much power in the hands of a few (Kurniawan, 2018).

Democracy

Democracy is a governance system where people who are affected by collective decisions of a group are able to participate in the decision. There exist three methods which differ in how individuals are able to contribute to the decision. First is direct democracy in which people make decisions directly, and thus treat each voter equally. On a large scale this democracy requires high total transaction costs of the voting process for the whole organization, and participants that are required to inform themselves on each issue which makes it a time-consuming decision. Second is representative democracy, where representatives are elected to make decisions on behalf of the participants. Contrary to direct democracy, only representatives are required to delve into the issues, and subsequently does not require a high transaction cost. Third is liquid democracy, which is a hybrid of direct democracy and representative democracy. In this democracy, each participant can either vote directly or delegate their vote to another participant. These delegated votes could be further delegated to others. Due to this option, the quality of the collective decision increases as participants that are motivated to inform themselves can decide for themselves, while participants who do not want to, delegate their vote to others (Kurniwan, 2018).

Voting weight

There are two main ways to distribute the voting weight. The first is one-vote-one-user where each user only has one vote. The other one is token weighted voting where the voting weight can be dependent on the ownership of tokens. This means that the voting power is in proportion to the number of tokens a participant owns in the organization. The latter one can result in becoming a plutocracy in the long term where the more wealthy members are able to gather more votes and thus have the most power within the organization (Kurniawan, 2021).

Number of winners

This criteria depends on the use case of the voting mechanism. If a participant desires to implement a proposal, it is recommended to only consider one proposal at a time. This prevents members from being overwhelmed by the amount of proposals to choose between (Kurniawan, 2018). On the other hand, a use case to choose multiple-winners is in a crowdfunding system. Where multiple options in the system can be funded at the same time of being.

Alternatives

Alternatives describe the options a voter can choose from. Two alternatives means voters have to choose solely between “Yes” or “No”. Multiple alternatives mean that there is a set of given answers to choose from.

Vote accumulation
in token-weighted voting users are able to accumulate more votes. There are two main ways in which a participant can gain tokens in an organization. One is to buy economic tokens from other participants to gain more power in the organization, the other is to contribute value to the organization to receive more reputation tokens and thus influence.

Ballot type
The voting mechanisms can be classified further based on how voters can express their preferences. Each participant can only vote once on the single ballot. Following that, a multi-ballot system allows participants to vote on many options at the same time. Then there's the ranked ballot, where the voter rates the options in order of preference. Finally, there is a score ballot, which requires voters to assess each alternative on a scale.

Majority quorum
Some mechanisms require a majority and/or participation quorum. The majority quorum could be set between 51% and 100%, but 100% support is less common as the community could use consensus instead. The majority spectrum ranges from 51%, to a super-majority which is typically 75-90%. Without these quorums the outcomes of decisions may not represent the opinion of the whole organization (Kurniawan, 2018).

Majority subset
The majority subset determines to which proportion of the organization the majority quorum is applied to. The majority can be applied to the total number of the entire community or to the present voters. When it applies to the organization, the members that did not vote are counted towards disapproving. This means that the actual voters need to gain the majority quorum for the whole organization before a proposal can pass. In token weighted voting it’s possible to use a token quorum, which means that a proposal should be supported by a minimum of the token supply before it can be implemented. Risk of token weighted voting is that wealthy members can collude to gain strong influence over the organization (Kurniawan, 2018).

Participation quorum
Participation quorum ensures that a minimal number of organization members were involved in the decision process, preventing proposals from being implemented by a few powerful individuals (Kurniawan, 2018).

Participation subset
Similar to the majority subset, the participation subset can be in proportion to the entire community or total of the token supply.

Voting fee
The voting mechanism can reward members for voting, or the mechanism can require members to pay for a vote. Risks here are that members can be discouraged in active participation when having to pay for a vote, on the other hand free voting raises chances for sybil attacks and uninformed decision making (Kurniawan, 2018)

Participant motivation
Organizations can only be long term successful when members are encouraged to participate in a valuable way (Kurniawan, 2018). There are various types of incentives that can stimulate positive behavior in participants; self-interested, economic and social incentives. A member could participate for self-interest, because the project seems interesting to participate in. Economic motivation could play a role as members are rewarded for their work. Furthermore, the member may be motivated to take part as a member of a like-minded community or social recognition for their contributions and influence.

Dispute resolution
A dispute resolution is a necessity in any decentralized organization to solve disagreements during the decision making process.

5.3 SecureSECO Voting Mechanism Selection

On the basis of a second interview with one of the experts at SecureSECO the voting mechanism selection process will be conducted. First the decision criteria will be answered on the basis of the identified requirements from the previous section, then the Voting Mechanism Decision Model is consulted.

Decision Criteria:

- The network status will be **permissioned** since new participants need to have an active GitHub account. This needs to be verified before access to the DAO is granted.
- The DAO will make decisions **on-chain** through a vote.
- **Everyone** who is whitelisted is able to create proposals, proposing is not limited to core developers.
- Voting power can not be delegated to other DAO members, which means that the environment is going to be an illiquid **democracy**.
- DAO participants use reputation tokens for voting, which means that the voting power is **token-weighted**.
- Number of winners is determined at a later stage of the DAO.
- Alternatives are determined at a later stage of the DAO.
- Voting power is acquired through **earning**.
- Ballot types are determined at a later stage of the DAO.
- The community wants to be as open and flexible as possible, therefore a majority quorum and subset of **51%** is chosen.
- As the tokens in reputation-based voting can decay over time, a participation quorum and subset of **30%** is chosen.
- In order to reduce chances of sybil attacks, there will be a **voting fee**.
- A member could join the community for **self-interested**, **economic** and social motivations
- Members are able to force a **hard fork** to solve disputes in the community.

The decision model was developed by combining the decision criteria with the voting mechanisms (Kurniawan, 2021). The model makes a distinction in the distribution of the voting power. These are one-vote-one-user and token-weighted voting. The left makes a contrast between the various voting

methods. These are then divided into groups based on the amount of options available to the participants. If there are only two options, a simple majority of votes is enough to make a choice. When there are more than two options, voting systems are based on how many of them are able to win the vote. Multi-winner systems are not covered, hence the result is generalized to multi-winner systems. The last one distinguishes between ballot types. The right branch distinguishes token-weighted voting systems with the help of specific DAO related questions. Reputation-based voting systems differ from other voting systems in the sense that members have to earn voting power through valuable contribution instead of buying. Token Curated Registry requires more specific categorization as this voting mechanism can only be applied to maintaining a list, hence the question.

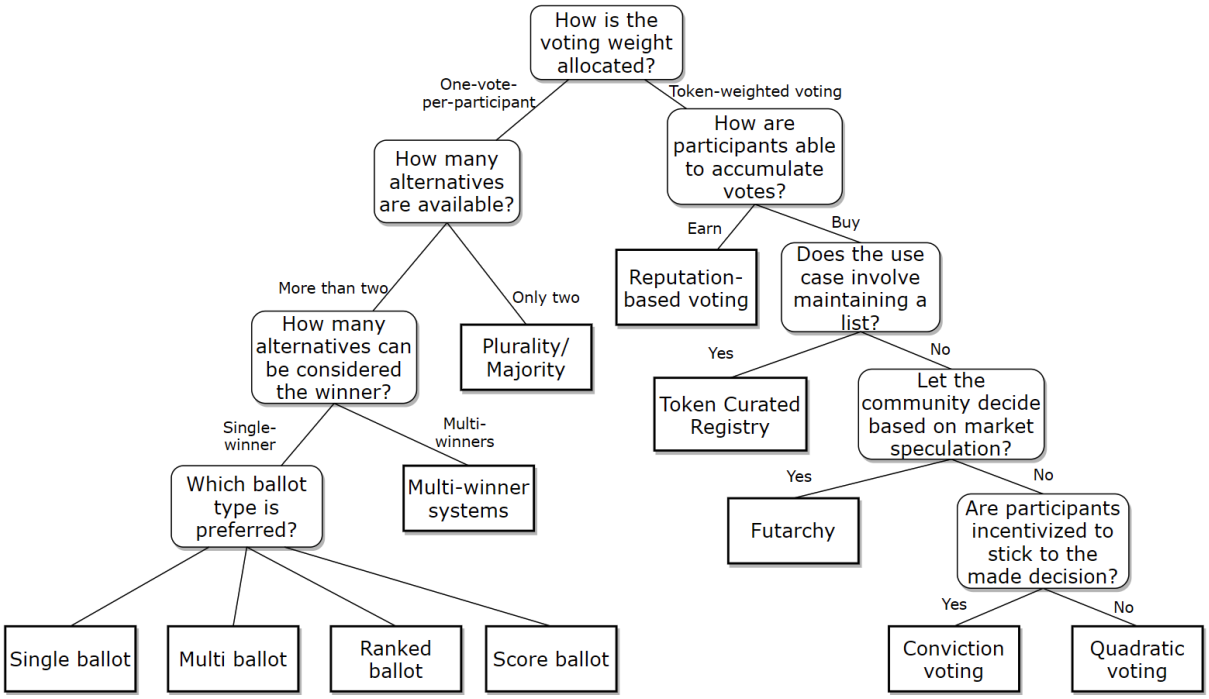

Figure 3. Decision Model

When the Decision Model is applied on the SearchSECO use case an answer is found rather shortly. The SearchSECO experts made clear that they want token-weighted voting instead of one-vote-per-participant, hence their two-token model. In addition, participants should accumulate voting power through valuable contributions in the form of reputation tokens. According to the above model the SecureSECO DAO should implement a **reputation-based voting system**.

5.4 DAO Mechanisms

With the recent rise of DAOs a large number of new unique DAO voting mechanisms have emerged. It can be difficult for blockchain engineers to keep track of these different mechanisms and their corresponding strengths and weaknesses. Based on a collection of gray literature pieces that were more actual, an overview of DAO voting mechanisms was created (Arsenault, 2020; Ehrsam, 2017; Kiarie, 2021) [14] . The following different DAO voting mechanisms were identified from these pieces:

Table 2: DAO Voting Mechanisms.

Mechanism	**Strenghts**	**Weaknesses**	**Example DAO**
Token-based quorum voting	Simple UX Battle tested	Quorum is hard to determine Requires high participation Vulnerable to whale attacks	Curve DAO Kleros Compound
Holographic consensus	Protects from nefarious proposals Proposals are handled quickly	More confusing UX Staking on proposals is not always desired	DXdao NecDAO PrimeDAO
Permissioned relative majority voting	Simple UX Less actions by participants	Proposals are easier to pass which can pose risk Slower by design	MetaCartel Ventures Raid Guild DAOhaus
Multisignature mechanism	Efficiency Cheap voting through off-chain voting tool like Snapshot	Multi-signature wallet increases risk	Rarible Perpetual Protocol BitDAO

For SecureSECO we have decided upon the Optimistic governance or Lazy consensus and Multisignature key.

This is because the SecureSECO experts indicated during the interviews that they are interested in a form of governance where there is no need to vote on any small decision, because of efficiency reasons. A solution to this requirement would be the implementation of an optimistic governance or lazy consensus. On top of that they signaled to be concerned about excessive voting costs. For these reasons the multisignature mechanism might be a solution to them. In this voting mechanism, token holders signal on proposals, which are then executed by a more centralized committee who usually control a Gnosis Safe. Usually with Snapshot for off-chain signaling resulting in cheaper voting procedures. The multisignature mechanism allows DAOs for faster decision making by a more centralized party. The multisignature wallet can be implemented on top of the DAO's regular voting system (Arsenault, 2020, Voting Options in DAOs). Based on the requirements of SecureSECO the team is advised to implement an **optimistic governance mechanism** and a **multisignature mechanism** in their DAO.

6 DAO Platform Selection

During recent years, DAOs have gained increasing attention in the blockchain industry. They have been discussed in Economics, Law, Organization Theory or Computer Science as a means to support non-hierarchical organizations that are concerned with ensuring sharing, security, transparency, and auditability, enabling global business models without a central authority or middle-man controlling them (Valiente Blázquez et al., 2022). Creating a DAO from scratch requires highly specialized knowledge about blockchain engineering. As a result, these DAOs frequently support blockchain-based businesses and blockchain engineering projects (El Faqir et al., 2020). An example of such DAO is the Curve DAO, which started in January 2020. This DAO governs the Curve Protocol which is currently the largest Decentralized Finance application on Ethereum in terms of Total Value Locked ($23 billion) [6] . Curve DAO aims to bring “extremely efficient stablecoin trading, and low risk supplemental fee income for liquidity providers” to the Decentralized Financial sector [3] .

To make DAO implementation less complex, some open-source software frameworks or independent DAO platforms have emerged. Independent DAO platforms are toolkits that make it easier to create organizations on public blockchains by providing opinionated decision-making and market processes while also leaving everything up to the developer (Baninemeh et al., 2021). Some community and team members have suggested that integrating the frameworks could be beneficial, as some methods pioneered by one framework team could be implemented by another or a developer creating a module on top. These platforms that offer DAO deployment as a service allow customers with limited blockchain understanding to construct a DAO using a template that can typically be changed. Popular platforms are Aragon, Colony and DAOstack. They don't require coding and give tools for coordinating community resource distribution without the necessity for a single point of contact or a high level of technical knowledge (Valiente Blázquez et al., 2022).

Baninemeh et al. (2021) have developed a decision model as a Multi-Criteria Decision Making problem for the DAO selection problem to systematically capture knowledge about such platforms and concepts. Decision-makers using the decision model have to prioritize their DAO feature requirements based on the MoSCoW prioritization technique. According to the researchers: “DAO feature requirements with Must-Have or Won’t-Have priorities act as hard constraints and DAO feature requirements with Should-Have and Could-Have priorities act as soft constraints. So that the DSS excludes all infeasible DAO platforms which do not support DAO features with Must-Have and support DAO features with Won’t-Have priorities. Then, it assigns non-negative scores to feasible DAO platforms according to the number of DAO features with Should-Have and Could-Have prioritizes” (Baninemeh et al., 2021). Furthermore these researchers conducted three industry case studies with SecureSECO being one of them. The results for SecureSECO were that the top three most feasible DAO platforms fitting their feature requirements were respectively **Colony** (94% match), **Aragon** (88% match) and **DAOstack** (86% match). A case study will be conducted on these three best fitting platforms in order to make the right DAO platform selection for the SecureSECO DAO.

6.1 Aragon

Aragon is by far the largest DAO platform, with currently 1700 DAOs handling $900 million in total (Faqir-Rhazoui et al., 2021). It is a community driven platform that provides a framework for

developing DAOs on the Ethereum blockchain, with the goal of creating highly adjustable governance structures. Aragon is a decentralized application that defines itself as “a framework that enables anyone to create and manage decentralized organizations such as clubs, companies, gaming guilds, cooperatives, nonprofits, open source projects, and any other type of organization you can imagine" [1] . Currently Aragon supports creating organizations on the main Ethereum network and the Rinkeby test network. A DAO, in Aragon's eyes, is a collection of smart contracts (i.e. software programs) known as 'Aragon apps,' each of which is linked to a web user interface built using React components [2] . Aragon provides numerous pre-configured DAO templates, which are pre-configured smart contracts for various sorts of organizations for DAO construction. Currently the following categories or governance models are offered: Dandelio, Company, Fundraising, Open Enterprise, Membership, and Reputation. Adding to that, Aragon has created aragonSDK, a set of libraries, tools, and guidelines to assist businesses in implementing their customized DAOs [2] . Elements in this SDK are aragonOS, aragonCLI, aragonUI, aragonDS, aragonAPI and aragonPM. The Aragon smart contract system is based on the aragonOS module. Only authorized EOAs and contract accounts have permission to do certain activities in a DAO, thanks to this technology [2] . That is, the rights and liabilities of those accounts in an Aragon DAO are defined by the aragonOS smart contracts. A DAO in the Aragon domain is viewed from this perspective as a collection of aragonOS smart contracts (Valiente et al., 2017). Aragon-based DAOs can use pre-installed Aragon apps to increase their capabilities which are available in an App Center. There are four of these applications: Tokens, Voting, Agent and Finance [2] . The Token app is used to manage membership and voting power in a DAO, with the ability to mint new tokens, assign existing tokens, and create vestings. Token minting is the process of creating new tokens on the blockchain. Token vesting is the process of locking and releasing tokens after a given time, usually done for team members, advisors, partners and other early contributors. The Voting app allows token holders to create votes that execute operations on their behalf, as well as view all open and closed votes, start a new vote, and poll token holders in a DAO on a specific topic. The Finance app is used to manage a DAO's assets, budget spending, and record final transactions in order to keep track of previous transfers and make new transfers via this module. Lastly, The Agent app allows Aragon organizations to interact directly with any other smart contract on the Ethereum blockchain. Previously, an organization had to appoint a trusted party to act on its behalf when interacting with an Ethereum smart contract (Valiente et al., 2017). Another key feature that Aragon introduces are permissions, which is an access control system intended to safely connect apps and entities together. The DAO creator has the permissions to control it at first, but most of the time, the creator gives those permissions to the voting app, and the DAO is managed by voting. As a result, a more democratic decentralized government is possible (El Faqir et al., 2020). Lastly, Aragon offers Optimistic Governance or lazy consensus which assumes that all actions are legitimate unless proven otherwise. In practice, this means that governance becomes a perpetual-motion machine of proposals that are scheduled as on-chain transactions to execute by default unless they are specifically challenged in Aragon Court during a Dispute Time Delay set by the DAO [2] .

6.2 Colony

Colony is a DAO framework based on a reputation system. Its goal is to assist enterprises in forming their own DAOs, called "colonies," which will provide financial management, ownership, structure, and authority. The Colony network is made up of a collection of smart contracts that run on the Ethereum blockchain. Organizations cannot customize colonies with smart contract modules to adopt their specific governance model at present time, despite the fact that it is expected to be incorporated in the near future (Valiente Blázquez et al., 2022). According to Colony, A DAO is a programmable

governable incentive engine, with rules set in code, that can operate as an investment fund, a central financial repository where money travels from one address to another, or a multi-signature wallet (Valiente Blázquez et al., 2022). The structure of a colony is based on domains and the permissions that accounts may have in each domain. Each domain is like a folder in a shared file system, but instead of files and folders it contains subdomains, funding and expenses. Domains can also be used to represent different concepts such as projects, teams and departments. In terms of permissions, a colony's access control is based on Ethereum accounts, which are divided into six categories:

1. Recovery: gives you access to the colony's 'recovery' feature in an emergency.
2. Root: gives access to high-level administrative activities in the colony, such as upgrading the colony.
3. Arbitration: gives the ability to to change the state of a domain.
4. Architecture: gives a colony the ability to build new domains and assign rights to those domains.
5. Funding: gives access to financial management.
6. Administration: gives the ability to create and manage expenses

A given colony must implement permissioned functions, which define some arguments that may be assessed on-chain in real time to see if an account is authorized to invoke a privileged function (Rea et al., 2020). Additionally, because each colony has its own ERC20-compatible 'internal token,' organizations can use their own tokens. When these tokens are earned as an expenditure payout, the recipient address will gain reputation. Internal tokens are divided into three categories by Colony. First are tokens as early rewards, which can be used to pay for effort before the organization has any real revenue or funding to rely on. Second, tokens representing hours worked, used for guaranteeing that users who accomplish the same amount of labor obtain the same amount of reputation. Lastly, tokens as a performance-based bonus which allows you to strike a balance between predictable compensation and performance-based incentives (Rea et al., 2020). Units of works or functionalities in Colony are represented by Tasks. These tasks are assigned to one of three roles. There is a manager who is responsible for the coordination of the delivery of a task, a worker who executes the task, and an evaluator who validates the finished tasks (Valiente et al., 2017). Unlike Aragon and DAOstack, which are vote-driven because voting mechanisms are used to allocate resources, Colony is a meritocracy because the only way to gain a member's influence is to work for the organization. One should note that Colony DAOs break with the typical proposal-driven schema of functioning, where each action of the DAO must be voted on (El Faqir et al., 2020). Unlike Aragon and DAOstack, which make their focus the enabling of vote-driven management of an organization, in Colony, DAOs are task-driven, which means tasks are published, and members accept them for a payout. This means that Colony DAOs come with a lazy consensus-like governance mechanism. Through these task-driven mechanics Colony also addresses the issue of scalability. First, by dividing DAOs into domains that are potentially self-contained and can work without interfering with one another in a stigmergic fashion. Second, by skipping voting, all decisions are automatically authorized unless someone objects, in which case the objection is explored and resolved through voting (Faqir-Rhazoui et al., 2021).

6.3 DAOstack

DAOstack attempts to ease the facilitation of DAOs by providing a library with a collection of tools and user interfaces. From DAOstack's perspective, a DAO is a network of stakeholders who make

non-hierarchical decisions about a collection of shared tools (Valiente Blázquez et al., 2022). They do this based on rules defined in the blockchain without oversight from a central authority. In DAOstack, decisions are started with a proposal. DAOstack categorizes DAOs into two different modes. The assembly mode, where a large number of software agents are involved in decision making within a single organization through a smart contract that ensures voting power is fairly distributed. And a fractal federal-governance mode, where a few software agents are part of a particular organization and each of these software agents is itself an organization made up of other agents. The structure of a DAO is seen as a combination of these two modes. A nested mesh network of organizations that communicates with other DAOs via shared organizations. A DAOstack consists of a number of different modules and layers (Valiente Blázquez et al., 2022) [4] .

The Infra module serves as the foundation for general decentralized decision-making, such as DAOstack's voting and reputation systems (Valiente et al., 2017). The Ethereum blockchain is used to implement these technologies as smart contracts. The layer that provides registration of DAO building blocks and standard components for developing any type of DAO is the Arc module, which is also based on Ethereum. The Arc also contains the master contracts that coordinate all the various pieces of DAOs together, as well as any number of flexible “schemes” that enable other DAO functions, for example defining the types of proposals users can submit (Weller, 2021). For DApp interoperability, the ArcHives module is the layer that provides curated registries of DAOs, governance modules, and identities on the blockchain. The ArcGraph module serves as an application caching layer, providing developers with a decentralized database that gets, saves, and organizes data from the blockchain, allowing DAOstack apps to load quickly (Weller, 2021). Then there is the DApps module which provides the user interface layer for decentralized applications that create and interact with DAOs. Lastly, the DAO module acts as the community layer, which is made up of decentralized organizations designed to work together (Valiente et al., 2017).

Users of DAOstack will simply interact through the DApps layer that uses Infra, Arc, and ArcGraph for their backends. This reduces the technological barrier for creating DAOs on DAOstack significantly. Developers aren’t required to have experience in concepts such as Solidity or blockchain. Unlike Aragon, DAOstack doesn’t support extensive customization (El Faqir et al., 2020). The framework provides pre-installed modules that cannot be customized through smart contracts. This reduced complexity can be attractive to some developers, however problematic to others. For example, they only offer the implementation of one governance mechanism, being Holographic Consensus. As mentioned in the previous section, an organization using holographic consensus can scale to arbitrary numbers of proposals and arbitrary numbers of participants without sacrificing either decision-making speed or quality. As of current state this means that only developers specifically interested in the Holographic Consensus mechanism can consult DAOstack for their DAO solutions (El Faqir et al., 2020).

6.4 Comparison

In a research conducted by Valiente Blázquez et al. (2022) a comparison between Aragon, Colony and DAOstack was given. These researchers found that an optimally functioning DAO must meet a number of requirements. These requirements are:

1. Financial management
2. A voting system

3. Tokens for membership and voting power
4. Ability to create new governance models relying on smart contracts
5. Templates of organization models
6. Permissions

Based on these required mechanisms, the researchers provided a comparison for the three DAO frameworks Aragon, Colony and DAOstack. The results of this comparison are visible in Table 3.

Mechanism	Aragon	Colony	DAOstack
Token	✓	✓	✓
Reputation	✓	✓	✓
Funding	✓	✓	✓
Permissions	✓	✓	✗
Voting system	✓	✓	✓
Organization templates	✓	✗	✗
New governance models	✓	✗	✗

Table 3: Comparison of Aragon, Colony and DAOstack

As can be seen in Table 3, among these three frameworks, only Aragon offers prototypes of DAOs (organization templates), which can be configured, and provide mechanisms to add smart contracts that enable the definition of new governance models. On the other hand, DAOstack does not support the definition of permissions and roles. Therefore, Aragon is more flexible as it satisfies all the above requirements for DAO development (Valiente Blázquez et al., 2022). The lack of the possibility to customize smart contracts at Colony and DAOstack is therefore regarded by these researchers as sub optimal.

Furthermore, the Aragon community seems to be most active in the field of DAOs. This framework is the most developed and most widely adopted among developers. On the date of June 5th of 2020. Aragon is by far the biggest platform with 1459 DAOs, followed by DAOstack with 22 DAOs, while in the case of Colony, which has been released very recently, there is no information on its current number of DAOs (El Faqir et al., 2020).

6.5 Advice SecureSECO

SecureSECO has indicated that it wants to use a reputation system with token-weighted voting. Research in the previous section showed that a reputation-based voting system would be the best fit for SecureSECO. DAOstack DAOs automatically come with a Holographic Consensus voting mechanism and this cannot be changed. This is problematic for SecureSECO as the research has shown that the Holographic Consensus model does not fit their needs. In addition, it is common that a DAO sometimes changes governance models, as is apparent from this article in which a number of

DAO experts were interviewed (Arsenault, 2021). With DAOstack this will not be possible at the moment and may cause problems at a later stage of the SecureSECO DAO if the DAO decides to want to switch. Based on these arguments, DAOstack is rejected as a suitable candidate for building the SecureSECO DAO.

At first glance, Colony appears to be a very suitable candidate to help develop the SecureSECO DAO. It was concluded from a discussion with a number of SecureSECO experts that, based on the characteristic aspects of the SecureSECO DAO, it can best be described as a meritocracy. Colony's meritocratic vision with the associated reputation system and work-driven mechanisms would therefore perfectly match the vision of SecureSECO. However, as seen from the comparison table, there are a number of key features that are missing from the Colony framework that could be problematic when developing the SecureSECO DAO. As with DAOstack, Colony does not allow developers to make adjustments to the smart contracts to create new organization templates or governance models to meet the needs of the organization. Colony DAOs come with a built-in governance model that is very similar to the lazy consensus mechanism. Although the Secure ECO experts have indicated that a lazy consensus or optimistic governance feature could be an option, Colony's work-driven system may deviate too much from the regular vote-driven system with proposals and voting.

An alternative that might be more in line with SecureSECO could be Aragon Optimistic Governance. Due to the high flexibility that Aragon offers, it is also possible to add Aragon Voice to this optimistic governance model. This then makes it possible with Aragon Voice to still make free proposals and vote as a signaling mechanism for the organization, and use the voting results as a justification for actions on Aragon Govern. This example shows that the possibility of customization for organizations via Aragon makes it easier to create a DAO that is more to one's liking. In addition, it seems that Colony's product is still in its infancy. It remains to be seen in the future whether the work-driven model offers a realistic solution for the decentralized decision-making issues of organizations. Based on the fact that Aragon is the first and by far the most widely used platform to date, and that unlike Colony and DAOstack, Aragon offers the possibility to customize governance models and templates which ensures that the chances are high that developers can realize all their requirements. Is our advice to SecureSECO to consult Aragon for developing their DAO.

7 DAO business model

A common way to model a traditional organization is by using the business model canvas (BMC). Osterwalder, Pigneur and Clark (2010) introduced this model with the aim of making business issues more transparent. Their motivation for developing the BMC was as follows: “We need a business model concept that everybody understands: one that facilitates descriptions and discussion. We need to start from the same point and talk about the same thing. The challenge is that the concept must be simple, relevant and intuitively understandable, while not oversimplifying the complexities of how enterprises function.” (Hong, & Fauvel, 2013). The Business Model Canvas is a strategic management template used for developing new business models and documenting existing ones. It offers a visual chart with elements describing a firm's or product's value proposition, infrastructure, customers, and finances, assisting businesses to align their activities by illustrating potential trade-offs. BMC consists of nine basic components of a business model. Instead of simply having them in a row, they are put on a canvas so the visualization of the different issues’ relation is improved. That helps the user to map, discuss, design and invent new business models (Hong & Fauvel, 2013).

While it is possible to use traditional BMC to model Decentralized Autonomous Organizations, there are some shortcomings. A possible solution to this is making use of a specific DAO canvas. Felipe Duarte, a blockchain developer currently working at DAOstack is the creator of the original DAO Design Canvas. The DAO Design Canvas, according to DAOstack, is a direct, co-created product of members of the Genesis DAO's collaborative work [5] . The tool is used to lead organizations through the process of visualizing their DAO's most important decisions, such as soft and hard governance, on-chain logic, and off-chain group dynamics. The process of using the canvas to define and explore your DAO's structure and purpose will refine your use case, create a strong educational experience, and spark high-quality team debate that leads to action. DAO Design Canvas has been used to design the CuraDAO, the dHack, and other projects in the space. Despite the fact that the DAO Design Canvas originated from DAOstack’s technology, the framework is universally applicable on DAOs [5] .

In the next part of this section the DAO Design Canvas is going to be created for the SecureSECO DAO based on the findings from the previous sections. In this research paper the DAO design canvas is considered as the problem solving construction, or design artifact.

During the process of creating the DAO Design Canvas an answer is given to sub research question four:

How is a Distributed Autonomous Organization modeled?

7.1 Canvas

The creation of the DAO Design Canvas will contribute to step four of the constructive research approach; “Innovate a solution idea and develop a problem solving construction, which also has potential for theoretical contribution”.

The DAO Design Canvas consists of five parts that each focus on different crucial aspects of a DAO. These five parts are controller, community, governance elements, stakeholder analysis and actors.

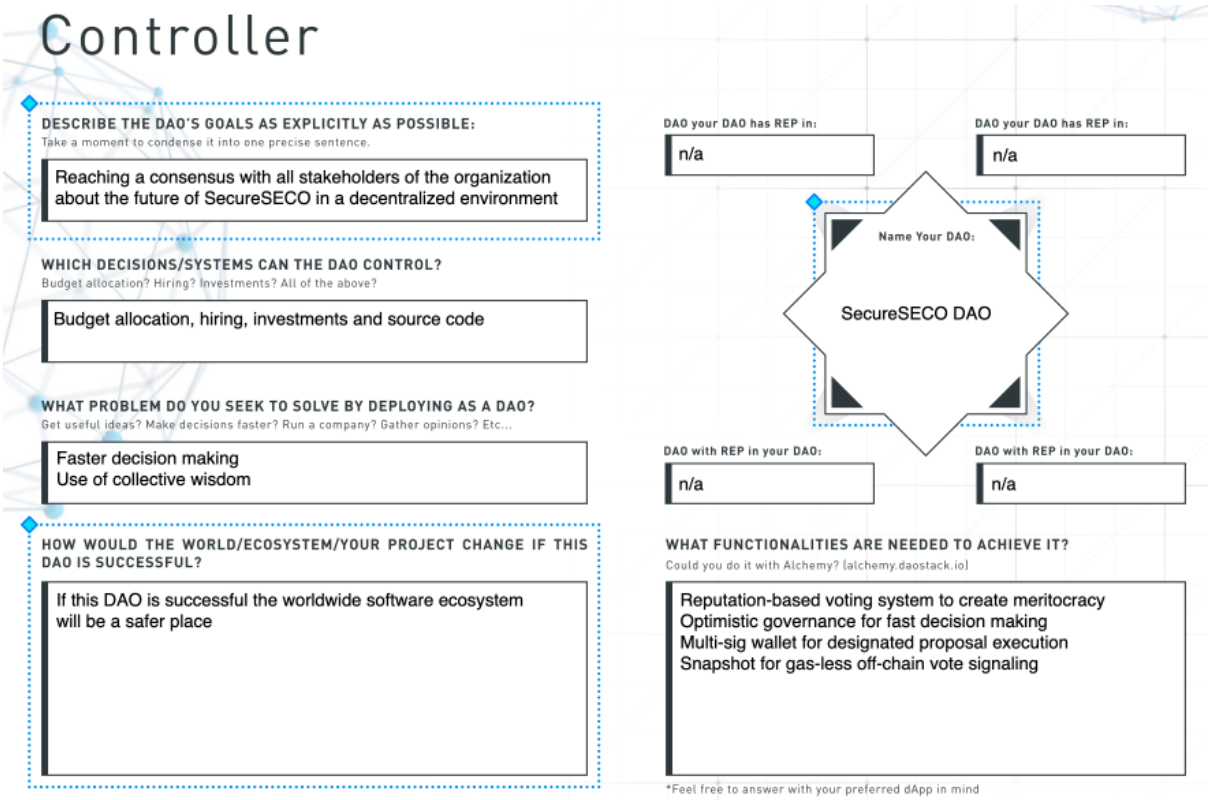

Figure 4. DAO Design Canvas controller

Figure 5. DAO Design Canvas community

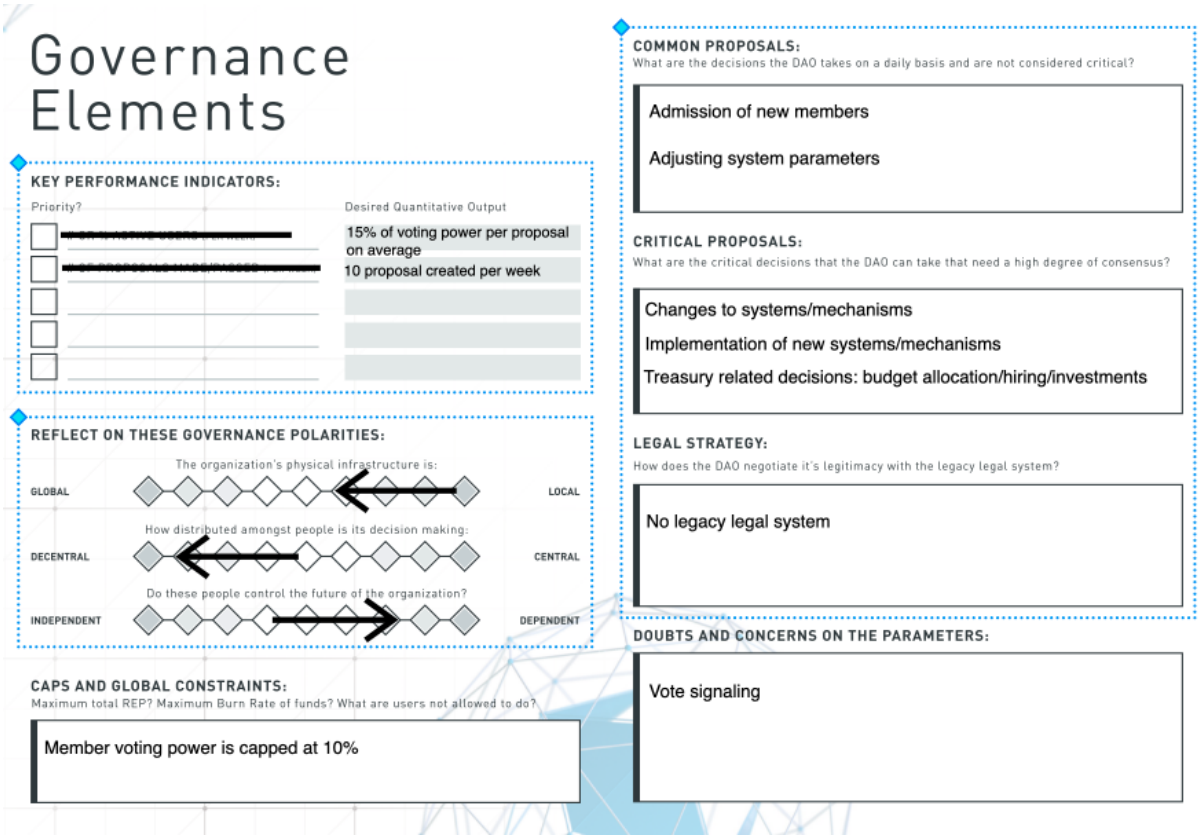

Figure 6. DAO Design Canvas governance elements

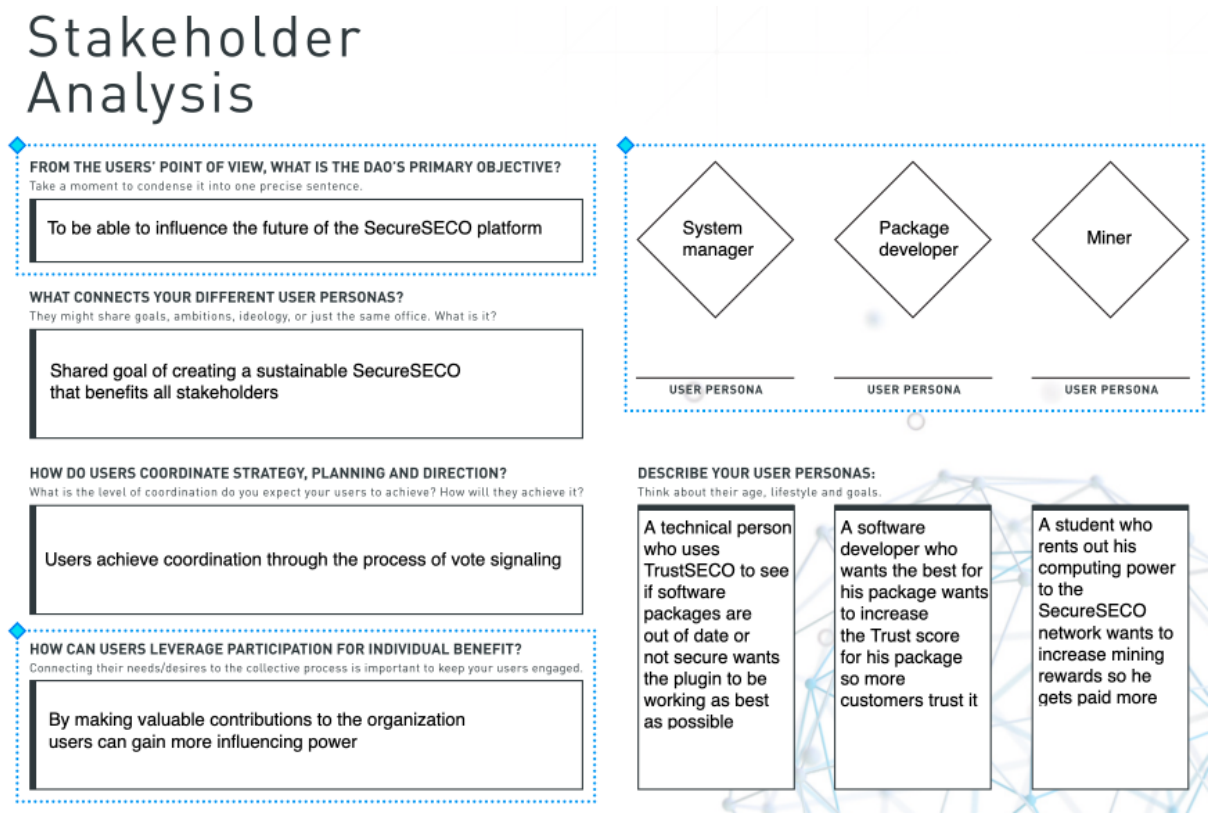

Figure 7. DAO Design Canvas stakeholder analysis

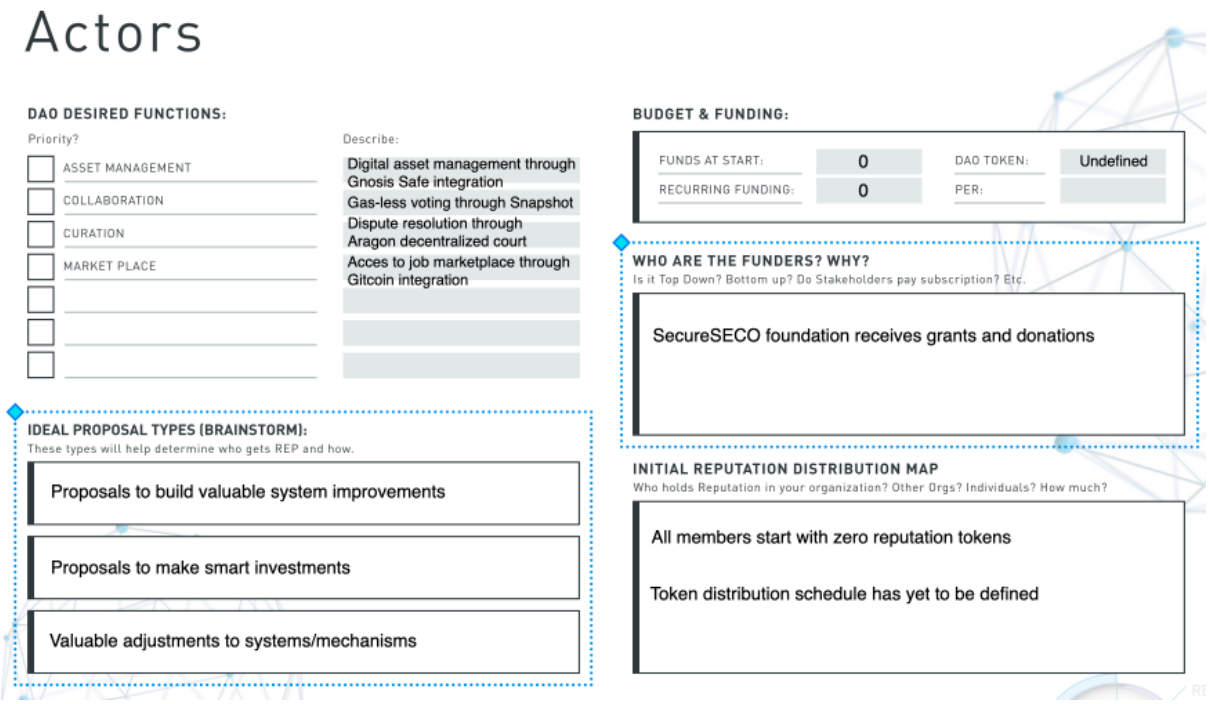

Figure 8. DAO Design Canvas actors

7.2 Canvas explanation

An explanation regarding the DAO Design Canvas is given. The first part of the DAO canvas is the controller part and aims to provide an overview of who is in control of the DAO and what the DAO's main goals and visions are. The main goal of the DAO will be to reach a consensus between all stakeholders on what's best for the future of the DAO. Ideally these decisions should try to benefit all participants within the organization as best as possible. The DAO can control the treasury if desired, however the foundation will always be ultimately responsible. The treasury can be used to hire new employees, place bounties for new tasks that need to be done or to venture into new investment opportunities (Valiente Blázquez et al., 2022). The DAO is created to solve the issues of decentralized governance. The decision process is aimed to be rather fast and based on the collective wisdom of the whole organization. In order to achieve these goals there need to be some functionalities to the DAO. The first required functionalities is a reputation based voting system in order to create a meritocratic environment. Members are rewarded for valuable contributions to the organization in the form of reputation tokens. These tokens will give valuable DAO members more influencing power in the governance process. Second is a form of optimist governance or lazy consensus that allows for faster decision making. There are different ways to enable this form of governance. It can be through the use of a multi-sig wallet assigned to a chosen group of members that have a high reputation count (Arsenault, 2020). This group can execute decisions without the need of a consensus from the DAO. Another option is to implement an Aragon Optimistic client [2] . When choosing to integrate this client the DAO doesn't require proposals to be voted on before passing. Proposals are passed instantly until other community members decide to disagree on it. Lastly, in order to stimulate voting participation the DAO should implement a gas-less decentralized voting mechanism such as Snapshot [11] . When integrating this mechanism members signal their votes off-chain through the mechanisms for free.

Second is the community part of the DAO canvas. The community is an essential part of every decentralized autonomous organization and therefore it's important that the community is managed in proper ways. Community members can reach out to other community members and the project itself through a Forum, Discord or via twitter. These social media platforms will be moderated by high reputation ranked community members who have shown to have excellent social skills in the past. The community should be updated about future updates or other news through blog posts, this can be done through medium articles. Another way to interact with the community and hear their thoughts is through hosting Ask Me Anything sessions. These sessions can be managed by high ranked members or hired community managers. During the lifespan of the project community members should be incentivized with economic rewards such as bounties (Tan, 2019). These bounties can be placed on Gitcoin which is a decentralized freelancing marketplace for the web 3.0. The bounties can be paid in either fiat or in the form of cryptocurrencies.

Next is the governance elements part of the DAO canvas. It's important to have sufficient voting participation in order for the governance process to represent the community's preferences. Therefore the DAO should strive to have at least 15% of voting power used per proposal on average. One should be aware that not all proposals matter to every organization participant and therefore voting activity in DAOs can be low (Chitra, 2021). Quality proposals is what gets the DAO further, therefore the DAO should aim to have at least ten accepted proposals per week. Member voting power should be capped at 10%. This should prevent large players from getting an unfair advantage over smaller or newer players. Common proposals are proposals that can't do significant harm to the protocol. These kinds of proposals will most likely concern admission of new members and adjusting system parameters. Critical proposals are proposals that can do significant harm to the project or community. These proposals should be reviewed and voted on by a large part of the community in order to ensure a safe outcome. These proposals concern any form of treasury related decisions, changes to systems and mechanisms and the implementation of new systems and mechanisms.

The stakeholder analysis provides better insights into who the potential users of the SecureSECO DAO can be. The primary objective of potential DAO users is best described as the ability to influence the future of the SecureSECO project. The shared goal of the DAO members should be to create a sustainable future for SecureSECO while benefiting all stakeholders within the organization. Users will try to achieve this goal through vote signaling. Which is the process of the community members clarifying their preferences to the rest of the community through creating proposals and letting others vote on it. Users can leverage their participation by providing valuable contributions to the organization to gain more influencing power. User personas can be system managers, software developers or miners (Sommerville, 2011). The system manager is a technical person who uses TrustSECO to see if software packages are out of date or not secure enough. This person wants the plugin to be working as best as possible to ensure safety. A software developer who wants the best for his package wants to increase the Trust score for his package so more customers trust it. This high degree of trust can result in more product sales for the developer. A student who rents out his computing power to the SecureSECO network wants to increase mining rewards so he gets paid more (Hou et al., 2021).

Lastly the actor part explores how actors in the network create and sustain competitive advantage independently. There are a few DAO functions required to fulfill the needs of these actors. These functions are asset management, collaboration, curation and marketplace. There are solutions that can be implemented into the DAO to realize these functions. Asset management can be handled through the use of a multisig wallet. Certain DAO members will be responsible for executing the financial

proposals of the DAO. A leading platform currently providing this service is Gnosis Safe which lets you fully customize how you manage your company crypto assets, with the option to require a predefined number of signatures to confirm transactions [10] . Collaboration can be realized by implementing a decentralized voting mechanism which enables gasless off-chain voting for the community. An example of such a voting mechanism is Snapshot [11] . Curation can be enabled by implementing a decentralized court such as the Aragon Court through the Decentralized Dispute Resolution Protocol [2] . The Aragon Court handles subjective disputes that require the judgment of human guardians. A marketplace could be realized by integrating a decentralized freelancing platform. A prominent player in this space is Gitcoin [9] . Which describes itself as a hub where blockchain developers can connect to build and fund the web 3.0 together. Ideal proposal types would be to build valuable system improvements, to make smart investments or to make valuable adjustments to systems or mechanisms. The SecureSECO foundation receives grants and donations that will be added to the treasury. All DAO members start with zero reputation tokens. The release schedule for these reputation tokens has yet to be defined.

8 Token design

A DAO's principal motivator is a token incentive. Tokens are a form of digital assets that can be traded and used to prove ownership. A token is thought to combine the properties of equity, property, and currency in general. Investors, developers, and other stakeholders share the system's property rights, while tokens are the primary economic incentive for other players (Tan, 2019; Wang et al., 2019). Token Economy is the name given to the new economic model produced by token, which refers to the use of the financial properties of crypto digital assets to map commodities and services to tokens and then accomplish low-cost or even zero-cost transactions (Tan, 2019). Payment tokens, functional tokens, and asset tokens are the most popular forms of tokens today. Each DAO can issue its own token and regulate the circulation, lock-in period, distribution style, and other features of the token architecture, according to the project attributes. The mechanism behind it is the most important aspect of the token model design (Wang et al., 2019). The purpose is to encourage participant incentive compatibility and create a win–win situation. On the one hand, a good token model combines monetary, human, and other capitals, alters the interaction between individuals and organizations, lowers operating expenses, and, in the meantime, meets fund needs in the early stages of a project. On the other hand, because the token serves as a project's anchor, high-quality efforts will drive the token's market value to climb over time, providing an economic incentive for participants (Tan, 2019; Wang et al., 2019).

As stated in the previous sections of this research paper, the reputation-based voting system was advised to SecureSECO. In this section the reputation token design model is created using the DAO Design Canvas as a starting point. For decentralized ecosystems the token plays a vital role in the long-term success of the project. In this research paper the implementation of the token design is considered as the realization of the DAO.

In this section an answer will be formulated to sub-research question 5:

How is the token of a Distributed Autonomous Organization implemented?

This research question will contribute towards step five of the constructive research approach: “Implement the solution and test how it works”.

8.1 Token Economics Framework

In this research paper the token design model is created according to the Token Economics Framework of Tan, 2019. Based on the token’s function, token type, and purpose, the design of the token varies differently. Tan argues that these token design rules should be coded or embedded into the decentralized system, sometimes with a smart contract. As the main incentive for participants to use the network, token design is important to ensure that participants follow the rules of the tokenized economy. Since token economies are decentralized, it is important to establish certain rules of the tokens into the programmable code. The token economics framework consists of various endogenous variables to be considered, when developing the token economics model for the project. For the token design the variables are:

- **Token Policy**
    a. Monetary policy

    b. Valuation
- **Financial Incentives**
    a. Platform activities
    b. Return to investment
- **Architecture**
    a. Property rights
    b. Distribution

According to Tan it should be noted that the variables have differing levels of significance. This depends on the variable's relevance to the specific token ecosystem. Also, the variables are endogenous aspects that define the token ecosystem's performance and worth. Other external influences include interactions with the real-world ecosystem and project-specific factors.

Token Policy
The token policy is based on monetary economics and policy. It aims to create a blueprint for how tokens will be maintained and governed. Open market operations, discount rates, needed reserves, and quantitative easing are examples of traditional monetary policy. To open the market, create another token sale or publish it on exchanges (Tan, 2019). Token policy imposes varying limits on the market depending on the token ecosystem's goals, such as maintaining price stability or extracting rent from token holders. Unlike monetary policy, token policy can be used for purposes other than money. By changing the number of tokens available in the network, token policy also considers expansionary or contractionary policies (Tan, 2019).

Financial Incentives
With financial incentives for participating in the token ecosystem, a market can achieve broad acceptance much more quickly. This can include financial incentives for joining (e.g., airdrops), as well as possible returns on equity owned (Tan, 2019). Financial incentives become an important constraint to achieving network effects in the ecosystem. Valuation of token ecosystems is a compelling incentive for venture capital, investors and buyers to participate in the ecosystem (Tan, 2019).

Architecture
Architecture includes principles from structure of property rights, payoffs based on property rights, identity and design of monetary tokens. Property rights are not the resource itself that is owned, rather the rights to use the resource (Tan, 2019). With clear definitions of property rights come with bargaining power, ownership, identity and property rights. Self-identity is another factor to examine while determining token property rights. Blockchain's role is to enable the property rights that come with the concept of self-identity (Tan, 2019).

8.2 Reputation Token

Tan states that token design is highly variable to the token type and token function (Tan, 2019). Therefore it’s important to note that the SecureSECO DAO is planning to implement a reputation token. A reputation token is significantly different from an economic token on multiple aspects. Reputation tokens have two key advantages over existing decentralized economic voting tokens: it’s non fungible which avoids corruptive elements, and it optimally aligns incentives for DAO members individually and at the same time for the totality of the DAO as an institution (Kaal, 2021). Because a

reputation token is non-fungible and ideally anonymous, it is much harder for DAO members and external participants to try to game the system to improve their own utility exclusively while hurting the common good of the DAO (Kaal, 2021). Researchers have concluded that DAO member reputation should be inflationary in the DAO design. As such, nonuse, e.g. non-staking or non-voting, would lead to value depreciation, which incentivizes action and thus value enhancement (Kaal, 2021).

8.3 Application of the Token Design Framework

In the next section the Token Design Framework is applied on the Reputation token of the SecureSECO DAO, called SecureSECO Reputation (REP). This reputation token is fundamentally different from the financial token. As the SecureSECO experts have not yet figured out their requirements for the financial token, this research paper will solely focus on the reputation token. The DAO Design Canvas will be used as a starting point to implement the token design model, as it acts as the blueprint for the implementation of the SecureSECO DAO. In addition, a specific reputation-based system framework from Esber & Kominers (2021) will be consulted to help formulate token variables. In this framework a reputation system design is outlined based on a dual token model. The framework was slightly adjusted to fit the reputation token better.

8.3.1 Token Structure (Properties of the token) How the token is specifically designed, that can be defined and coded into the token ecosystem.

1. Token policy

(a) Supply of tokens; Expected growth of money supply
The token supply should grow linearly with no maximum supply.

(*b) Saving function of tokens*
There will be no saving function of tokens. On the contrary, saving reputation tokens will be discouraged by the increasing token supply.

(c) Inflation/deflation tokens
In order to keep the DAO voting power leveled, and accessible for new entrants, SecureSECO was advised to implement a token burning mechanism. A percentage of reputation tokens used in the voting process will be burned (sent to a blackhole address).

Burning mechanism parameters can be adjusted by the DAO at will.

(d) Distribution of token allocation
Reputation tokens are distributed to DAO members who perform valuable actions in the organization. The organization considers the following actions as valuable:

- Mining trust facts
- Proposing
- Voting
- Completing bounties
- Social activity
- Time in DAO

The reputation token distribution process should be automated if possible.

Token distribution will still be if a member wallet reaches 10% of total token supply, however excessive voting power cannot be used in governance.

Token distribution mechanism parameters can be adjusted by the DAO at will.

2. Token valuation: variables that can allow tokens to have endogenous value

Since a reputation token is non-fungible and therefore not exchangeable the token valuation variable is not applicable here.

8.3.2 Financial (Reputation) Incentives Rewards for participating in the token economy to further strengthen the incentive-compatible mechanism to achieve the objectives.

1. Platform activities
(a) Rewards for mining
Users can rent their computation power to the SecureSECO network in order to help in the process of mining trust facts. Users will be rewarded both Reputation tokens and economically in the form of euros, dollars or cryptocurrencies to compensate for their effort.

(b) Rewards for completing bounties
Users or freelancers can earn bounties by completing tasks through platforms such as Freelancer or Gitcoin. They will be rewarded economically in the form of euros, dollars or cryptocurrencies. On top of that, bounty hunters who are a member of the SecureSECO DAO are also rewarded Reputation tokens. However, being a member of the SecureSECO DAO is not a requirement for completing tasks for the organization.

(c) Proposing
Users are rewarded in the form of Reputation tokens for creating valuable proposals. There is going to be a distinction between common proposals and critical proposals. Critical proposing is rewarded with more reputation tokens.

(d) Voting
Users are rewarded in the form of Reputation tokens for voting on open proposals. Voting on critical proposals is rewarded with more reputation tokens. This is because critical proposals are more impactful for the future of the DAO and therefore require a high degree of participation.

(e) Social activity
The community plays a vital role in shaping the future of the DAO. Therefore, DAO members who are actively participating in supporting the community through social media platforms like twitter, discord and the forum should be rewarded in the form of Reputation tokens for their efforts.

(f) Time in DAO
Users should be rewarded for their time spent in the Decentralized Autonomous Organization in the form of Reputation tokens. Here we assume that members who have been active for a longer period of

time have more knowledge about SecureSECO and therefore should have more say in decision-making.

2. Return to investments
(a) Potential returns to equity owned
Currently the SecureSECO DAO Reputation token has no exchangeable value. It's purpose is to recognize and reward users who added value in the platform, by giving them more voting power in the organization. According to Esber & Kominers the Reputation token can be seen as social capital which holds its value to the fact that it's not transferable. However, this doesn't necessarily mean it can't generate exchangeable liquidity. In their framework they propose a two-token model, where one token, the non-transferable reputation token, serves as a way to signal reputation. And a second, exchangeable token, that gets rewarded to reputation token holders as some sort of dividend. This model designs a feedback loop where users derive reputation tokens from high-quality contributions to organization. These reputation tokens on their turn generate transferable tokens that can be exchanged for a currency. The demand for these transferable tokens drives the need to acquire reputation tokens, which in turn incentives valuable contributions to the organization. The essence herel is that contributors receive a non-tradable token that spins of tradable tokens (Esber & Kominers, 2021).

SecureSECO indicated that in the current stage of the project there is no need for a two-token model yet. However, this could change in the future as the project grows. The model outlined by Esber & Kominers could be a potential solution for SecureSECO by that time.

(b) Arbitrage on exchange rates of token prices
Since a reputation token is non-fungible and therefore not exchangeable the token valuation variable is not applicable here.

8.3.3 Architecture (Design of token structure) Tokens can help to govern actions through property rights and establish trust through scale economies.

1. Property rights
(a) Token rights
Users do not have the right to transfer reputation tokens to other users.

Users do not have the right to exchange the reputation token for another currency.

(b) Governance rights
Users have the right to create proposals by using tokens.

Users have the right to vote on proposals by using tokens.

Users do not have the right to delegate voting power to other users.

Users have the right to open a dispute resolution in the decentralized court.

(c) Self-identity
Users are required to verify through Github account before joining the DAO

Users are required to complete a KYC process before submitting proposals.

The Token Economics Framework was used to create a Token Design Model for the SecureSECO DAO reputation token. The above model can be used by the SecureSECO developers to embed the token design rules into the decentralized network system with a smart contract.

9 Prototype

This section contributes to step five of the constructive research approach. We have attempted to prototype the SecureSECO DAO. This was done via aragon client on the Rinkeby test network. It was fairly self-explanatory so the process went quite smoothly. Aragon gives the choice of different templates such as company, membership, reputation and enterprise. Since this research showed that a reputation voting system is the best fit for secureseco we chose the reputation template. During the creation of the DAO an Ethereum Name Service domain (ENS) is created. We chose securesecodao.aragonid.eth. With the help of this domain access to the DAO can be obtained if the Ethereum address of a user has at least one token of the SecureSECO DAO. Furthermore, it can be set what the majority quorum and participation quorum should be. These are set to 51% and 30% respectively as concluded in the study. Voting duration is set to seven days as this is the most common in existing DAOs [11] . The name for the reputation token is SecureSECO Reputation under the ticker REP. Currently with a supply of 10 million. To add other SecureSECO members to the test DAO, a proposal is required. In this proposal one can vote to allow an address with a certain number of reputation tokens. The DAO comes with the apps Tokens, Voting, Finance and Agent, which are essentially smart contracts on the Ethereum blockchain. These smart contracts can be configured to the needs of the DAO. Furthermore, there is an App Center where additional apps can be added such as Redemptions, Time Lock and Token Request. It is also possible to add your own built apps to the DAO. Finally, there is a Permissions section where permissions can be assigned to accounts and apps for the various functionalities.
Since SecureSECO clearly stated they wanted to use Optimist Governance it was tried to build this in. To implement optimistic governance with the Aragon Client DAO, having an Aragon Govern DAO is a prerequisite. After creating the Aragon Govern DAO it is needed to Grant the Govern Executor address desired permissions within the Aragon Client DAO. In order to replace the governance mechanism, the Govern Executor needs the same set of permissions that the Voting App currently has. The Voting App's permissions should then be revoked from the permissions panel. Aragon did not recommend changing the Permission Manager from the Voting App as it will make setting up permissions complicated in the future [2] .

Without extensive technical knowledge of blockchain programming it was managed to implement Optimistic Governance in the SecureSECO DAO. A visual overview of the prototype's functionalities can be found in appendix C.

10 Evaluation

For this section the requirements and prototype of this research paper were evaluated by experts of SecureSECO. These experts provided feedback on the decisions made in this research paper based on their own vision. This section contributes to step six of the constructive research approach.
Questions were raised regarding the reputation weighted voting allocation. Specifically how DAO members should decide how much reputation to allocate to a vote. How to react when other DAO members allocate more voting power than initially expected? The vision in this research paper is that DAO members should choose wisely on which proposals they want to allocate their voting power, since voting power is scarce. Changing of voting allocation should not be allowed in order to prevent last minute voting manipulation. This mechanism of blind voting was not fully embraced by the SecureSECO experts. Mainly because predicting if others might make a big decision on something that does not personally interest you much, but is in the personal interest of those others, may not necessarily be in the best interest of the whole DAO. Adding to this the experts were not necessarily on board with the burning mechanism in combination with blind voting. Those who never vote could just gain a whole lot of voting power, while those who are actively voting won't be able to exercise the same voting power. This paper advised the burning mechanism to keep the DAO from getting centralized overtime. As stated in a previous section, this tends to happen regularly. The burning mechanism also helps to keep the DAO accessible for potential new entrants. Considering the concerns of the experts, another inflation mechanism should be implemented to prevent members from hoarding voting power. On top of that, a quiet ending mechanism could be a solution to last minute voting manipulation. Initially this paper decided to allow delegation of voting power in order to stimulate voting participation. However after the experts raised concerns about potential security issues this decision was revised, making the SecureSECO DAO an illiquid democracy.
Some concerns were raised about the Aragon framework by experts of SecureSECO. Does Aragon support all these features? What will we have to build ourselves? Are we limited in our choices by Aragon? At first sight it looks like the aragon template is sufficient to set up a proper working DAO that meets the requirements set by SecureSECO without too many modifications. In our opinion Aragon offers enough built-in functionality to develop a good first version of the SecureSECO DAO with not too many modifications. In the future the DAO might become bigger and more complex. Then SecureSECO might need to bring in an expert with an understanding of blockchain programming to make more complex adjustments. For the time being, this will not be an issue for the first phase of the SecureSECO DAO, in our opinion.

11 Discussion

This contribution involves disciplines of Information Science in how to establish a form of decentralized governance, in the context of the SecureSECO project. During the research a first version of the SecureSECO DAO was created, and with this a guideline for setting up a DAO in a general sense.
Any empirical study needs to do a validity assessment. Construct Validity, Internal Validity, External Validity and Reliability are common topics in validity discussions. In order to mitigate construct validity threats, the constructive research approach of Lukka (2003) was followed during the entire process of developing the SecureSECO DAO. At the start of this research paper a clear problem statement was given supported by a main research question and corresponding sub research questions. Research methods used in this constructive research approach were document analysis, case study and expert interviews. For the expert interviews a framework from a SecureSECO researcher with predefined questions regarding DAO was used. The framework had been validated by other SecureSECO experts. For the case study the validity threats of Yin (2012) were concerned. Before the case study was conducted a clear objective and method was stated to ensure construct validity. A risk to the construct validity of this research are the pieces of unreviewed literature used in document analysis. Regarding internal validity, the requirements of SecureSECO were used as a strict guideline during the entire development process. Close contact with experts from SecureSECO was kept to test development progress against their requirements. The external validity is supported by performing the research in the context of the SecureSECO case. A threat to this validity is that the results are based on only one case, which could indicate that the findings can not be generalized. This case study, on the other hand, is conducted in a real-world, existent situation rather than a theoretical setting, which increases the representativeness of the sample. Finally, the study's reliability is ensured by outlining five distinct steps that were followed to find the results.
This study experienced limitations in resources. As DAO is a new and unexplored concept, peer reviewed literature regarding this subject is scarce. Therefore during the process of document analysis pieces of gray literature had to be used to complement the need for literature. This posed a risk to the construct validity of this research paper.
Due to the SecureSECO project still being in its infancy stages it is possible that some of the requirements identified in this research paper may change overtime. In that case, the results from this research paper might lose usability for SecureSECO. Adding to that, the DAO space is still very young and constantly evolving. This might result in the emergence of fundamentally better DAO frameworks, voting systems or other mechanisms than advised in this research paper.
As mentioned earlier, currently DAO's expectations differ quite a bit from reality. This is mainly due to a lack of participation and a lack of decentralization. Potential future work could address these main problems DAO is currently facing.

Concerning future work in the context of the SecureSECO project, a few steps need to be taken before the SecureSECO DAO can be launched. A roadmap providing the necessary steps leading to the launch of SecureSECO DAO can be found in Appendix D. Adding to that, a timeline with the expected future growth phases of SecureSECO DAO can be found in appendix E.

12 Conclusion

The aim of this research paper is to create a solution to the issues regarding decentralized governance. The problem stated in this research paper addresses how one can establish a form of decentralized governance in order to manage a decentralized project. During this research paper an answer is developed to the main research question with the help of sub research questions. This section contributes to step seven of the constructive research approach.

Main research question: How can a Decentralized Autonomous Organization be created on the basis of requirements in order to be implemented?

The first sub research question was answered through the process of requirements engineering based on expert interviews. The second sub research question was answered through the application of the Voting Mechanism Selection Model and additional document analysis. The third sub research question was answered through case study. Results from a previous study using the DAO Platform Decision Model were used as a starting point. The fourth sub research question was answered through the application of the DAO Design Canvas. The fifth sub research question was answered through the application of the Token Economics Framework.

Sub research question 1: How are the requirements of a Decentralized Autonomous Organization identified?

The requirements of a decentralized autonomous organization can be identified through interviews with experts from the organization. These interviews can be open or closed, however practically this tends to become a mixture of both. To make the requirements more insightful for the organization user stories and use case diagrams can be added.

Sub research question 2: How is a voting mechanism for a Decentralized Autonomous Organization selected?

The voting mechanism for a decentralized autonomous organization can be selected by using the Voting Mechanism Selection Model. The Voting Mechanism Selection Model is used on the basis of the requirements of the organization from research question 1. The Decision Model selects the best fitting voting mechanism for the organization according to the requirements. Additionally the framework provides Decision Criteria that can be used to give the organization a better overall understanding of their governance model. For the SecureSECO use case the reputation-based voting system was selected. On the basis of gray literature documents specific DAO voting mechanisms were identified that the decision model didn't address. Based on a table of these voting mechanisms and their characteristics the optimistic governance and multisignature mechanism were additionally advised to SecureSECO.

Sub research question 3: How is a platform for Decentralized Autonomous Organization creation selected?

The DAO Platform Selection Model can be used for selecting a platform for DAO creation. This is done with the help of the organization's requirements. The decision model will select the three best fitting potential platforms for the organization. The results for the SecureSECO DAO use case were respectively Colony, Aragon and DAOstack. Based on case study research the Aragon platform was selected as the best fitting platform for SecureSECO. This was concluded on the basis of the organization's requirements.

Sub research question 4: How is the business model of a Decentralized Autonomous Organization created?

The model of traditional organizations can be created with the application of the business canvas. The business canvas is not suitable to model a decentralized autonomous organization. A solution to this problem is using the DAO Design Canvas to create the business model of a Decentralized Autonomous Organization. The DAO Design Canvas acts as the blueprint for the implementation of the SecureSECO DAO.

Sub research question 5: How is the token of a Decentralized Autonomous Organization implemented.

The token of a decentralized autonomous organization is implemented by the creation of a token design model. A solution for creating the token design model is through using the Token Economics Framework. The Token Economics Framework can be used with the DAO Design Canvas as a starting point. The token design model can be used by the SecureSECO developers to embed the token design rules into the decentralized network system with a smart contract.

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Appendix

A Expert Interview Questions

DAO Governance model for OSS projects V0.3	
OSS	DAO
Legal foundation	
Under what OSS license is the project released?	What kind of legal structure will represent the DAO?
	Does ownership and control of the project lie with the DAO?
Decision making	
What decisions are made off-chain, without a formal vote through the DAO?	**Proposals:**
Is there a defined process for decisions that are made off-chain?	Which decisions will be made on-chain, through a vote?
How are the various decisions in the project delegated to different roles? Is this a more centralized or decentralized configuration?	Who is allowed to submit proposals?
How is the outcome of a decision enforced?	Is there a cost or other requirement to submitting proposals in order to limit the number and increase the quality of proposals?
	Do submitted proposals require vetting or approval before being voted on? And by whom (specific roles/subcommittee/community support)?
	Are outcomes of proposals also enforced on-chain?
	Voting:
	How is voting power acquired? E.g., a meritocratic process reputation based voting, or a stakeholdership model through tokens.
	Can votes be delegated to a representative?
	Do voters have a single vote, or are they able to cast multiple votes?
	Is there a cost associated to casting votes or does the voter need to stake tokens or reputation in order to vote?
Leadership and role structure	
Are there formal leadership roles?	Is the influence of the leadership directly reflected on-chain? E.g., through voting power or control over proposals.
Is leadership established through democratic or more autocratic designs? E.g., elections of leadership roles/representatives or self-appointed leadership.	Is the role structure reflected in the DAO, or is there no formalized hierarchy and is influence and power reflected through the voting power?
Are there other observable roles? And how are those structured?	
Incentives	
Are developers employed?	Are DAO members rewarded for performing certain activities?
Are developers rewarded through a salary?	Are DAO members rewarded in fungible or non-fungible assets such as tokens or reputation?
Are there other extrinsic or intrinsic incentives for contributors?	Are development activities directly or indirectly funded through the DAO?
Project chartering	
Is there a mission or vision statement to bring the community together under a shared ideology?	Is the DAO involved in the process of determining release plans and development roadmaps?
How are release plans or development roadmaps established?	
Community management	
How can new community members get involved with a low barrier to entry?	Who can contribute towards code?
Is there a process through which new contributors prove their knowledge, technical competences or alignment with the values of the project?	What is the process for members to join the DAO?
Are there any determined sanctions against violations of rules, norms, values or goals of the project?	Are there any barriers to joining the DAO?
	Do DAO members have to verify their identity?
	Are there on-chain mechanisms for punishing members who violate norms and values or behave against the goals of the project, by for example reducing reputation?
Software development processes	
Who decides what is developed?	Is the inclusion of new code decided on on-chain?
What procedures are followed before new code is accepted?	Are software releases formally decided on on-chain?
What are the procedures for a new release?	
How are responsibilities for tasks distributed? Are some tasks lefts open or are they all managed and delegated?	

B User Stories

As the Foundation, I want to receive donations, so I have more funds for future developments.
As a Company, I want to give up less income to the DAO, so I make more profit.
As the DAO, I want to lower mining rewards, so that the treasury becomes more funded.
As the Emergency DAO, I want to be able to use the kill-switch, so that harm to the protocol can be prevented in case of malicious actions.
As the Committee of Experts, I want to be able to reject proposals, so that proposals meet the minimal required standard.

SearchSECO DAO User Stories
As an ESER, I want to add more data to the database, so I can do better research.
As an SPO, I want to change access to the database, so I can better protect the value of SecureSECO.
As an SPO, I want to lower access fees, so I pay less for access to the database.
As an SNM, I want to raise access fees, so I get more fees for hosting data.
As an EU, I want to raise mining rewards, so I get paid more for mining data.

TrustSECO User Stories
As an SPO/PMO, I want to influence the score calculation, so that my package scores better.
As an SPO/PMO, I want to make new proposals for data gathering, so that we get a better score calculation.
As an SPO/PMO, I want to make the data less transparent, so I can protect the privacy of our developers.
As an EUO, I want to add new data to the ledger, so I can make trust calculations better.

C Prototype

Figure 1. Aragon Client DAO Interface.

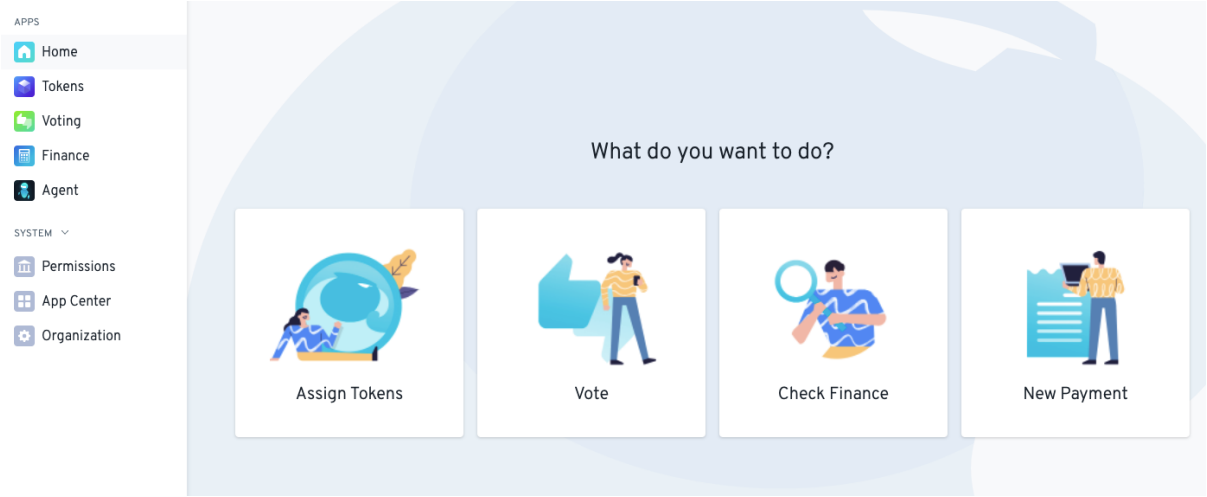


Figure 2. SecureSECO DAO Reputation token (REP)

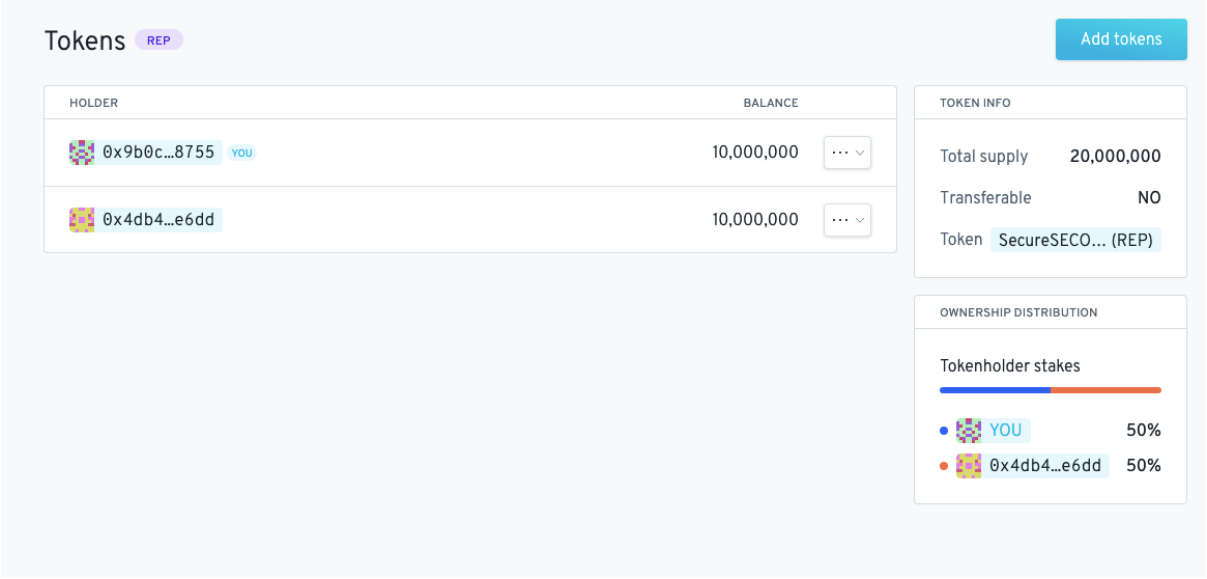


Figure 3. Casting a vote on an open proposal.

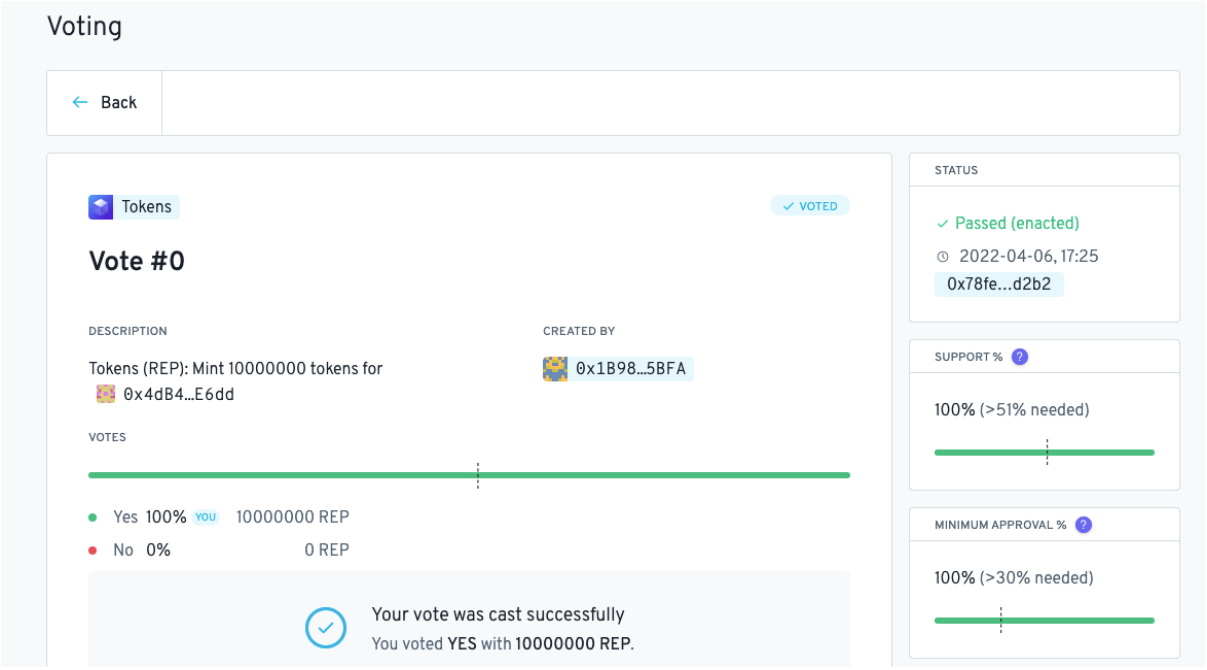


Figure 4. DAO treasury wallet.

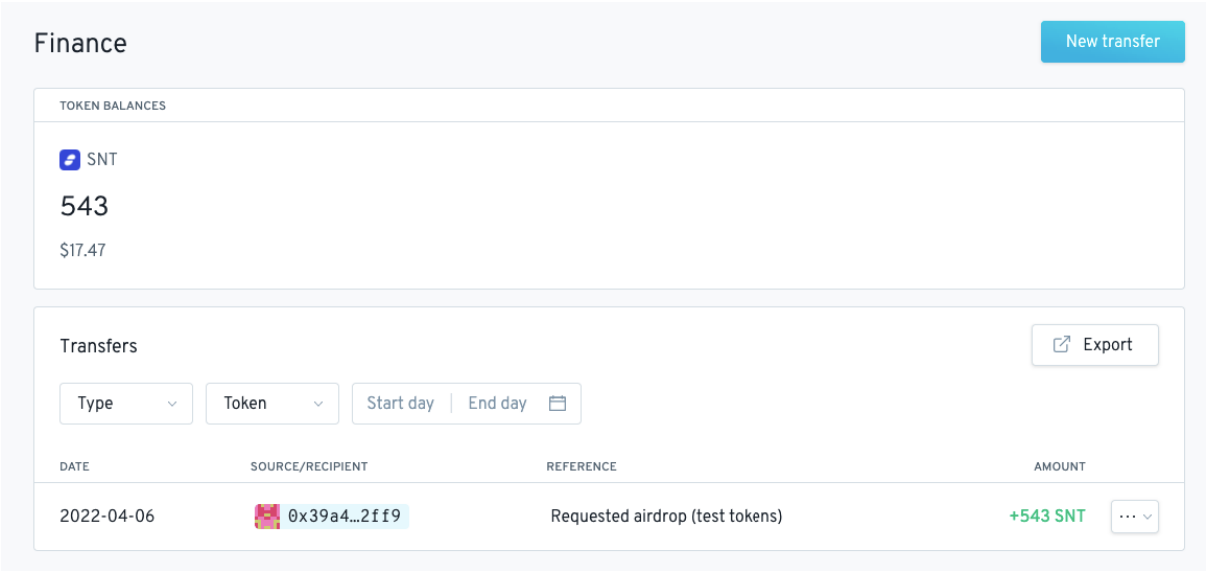


Figure 5. Functionality extensions.

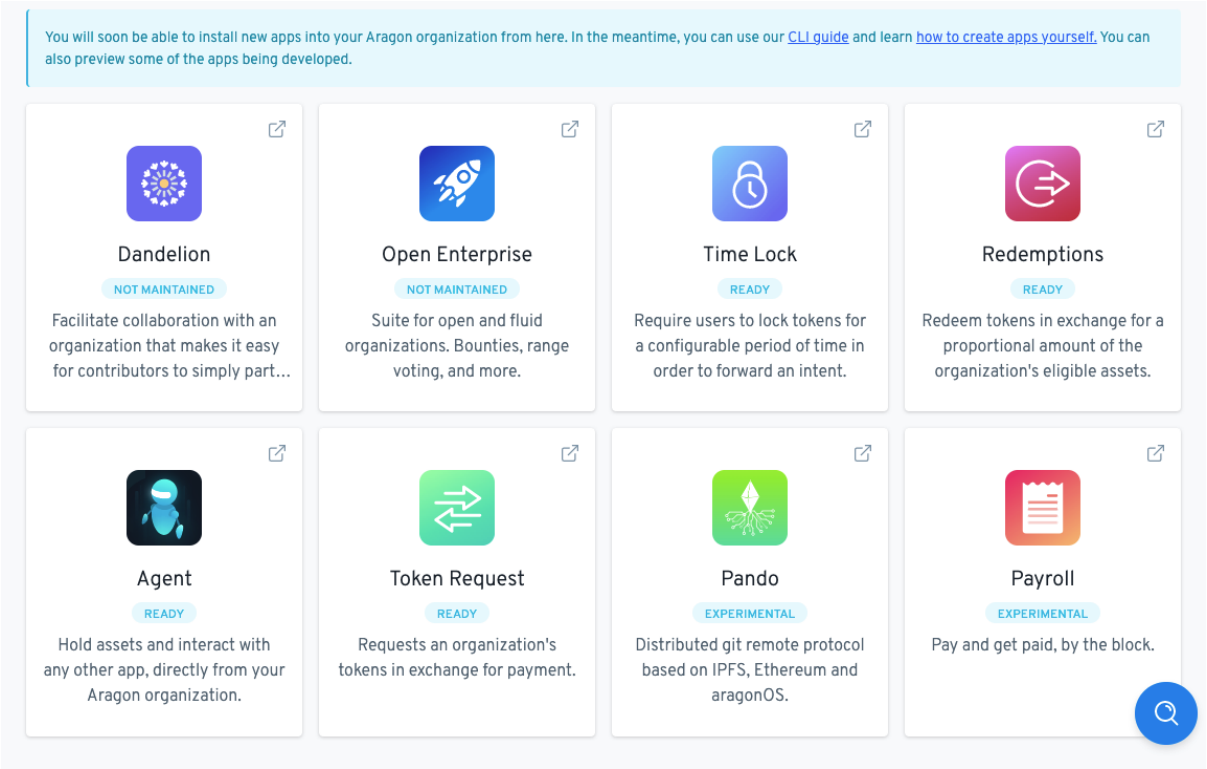
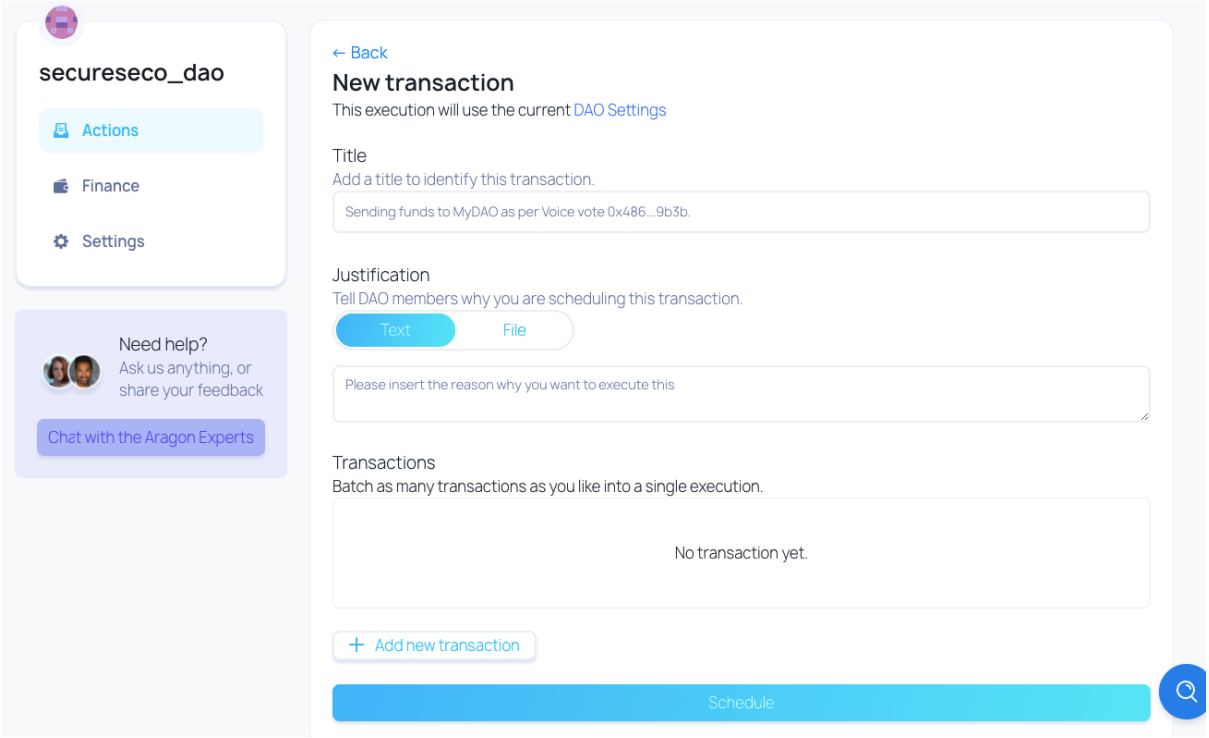
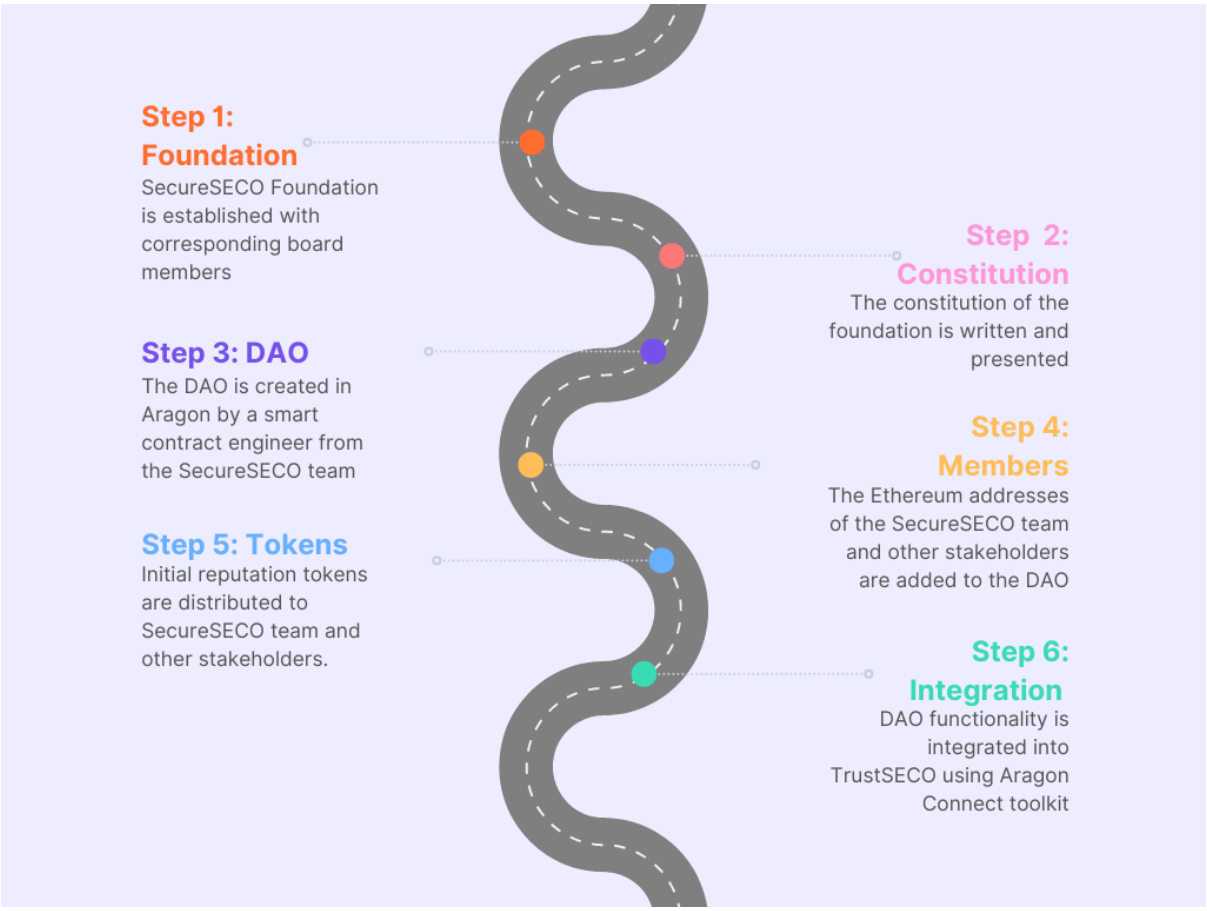


Figure 6. Aragon Govern DAO (Optimistic Governance).



D DAO Launch Roadmap



E DAO Growth Phases