Governance in Decentralized Finance

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***Abstract*—This research paper investigates whether Decentralized Finance cryptocurrencies are mature enough to self-govern. This is done by analyzing some existing cryptocurrencies through the eight principles based on Elinor Ostrom's model for self-goveranance. The results show that blockchain communities have the possibility of self-governing, work anonymously and organize. However, there is a need to centralize some aspects of the network. In addition, the crypto community should have clearly defined boundaries to coordinate activities. Also, they should formalize rules which enforce monitoring and punish the peers who violate the rules should exist and be inspectable, to increase the legitimacy. One should outline explicit and strict organizational processes and roles, as well as clearly define conflict management and maintenance functions.**

***Index Terms*—DeFi, Self-governance, blockchain, decentralization**

I. Introduction

Decentralised Finance (DeFi) is a new way of banking. Instead of regulated and centralised private banks, financial services are offered in a form of a decentralised system. Social lending, social insurance, as well as decentralised banking are some of the typical use cases.

Ethereum is one of the examples of decentralised application infrastructures. Such applications, including DeFi platforms can be designed and deployed on a universal computer provided by the Ethereum network. The important aspect with DeFi is the governance which includes automatically handling decisions about upgrading or details of the operation needed to be made. Blockchain infrastructures such as decentralized finance compete with traditional economic institutions by proposing alternative governance systems [14]. The blockchain systems place the trust in code and the machines at the core of organizational governance, while the humans are at the edges [7].

When it comes to making such critical decisions in an automated way, there are several aspects of finance that need to be handled. In this paper, we try to relate our research with the Ostrom's model on self-governance [26]. Her research on self-governance showed that with a given set of conditions, local communities of peers can manage their resources in a sustainable way. Her findings enable this paper to look at blockchain infrastructures within the decentralized finance domain and evaluate whether these systems is able to function in a self-governing manner. Specifically, we analyze two cryptocurrency coins, Dash and MakerDao in the context of these conditions.

Cryptocurrencies are often associated with the potential of a blockchain's infrastructural capacity and strength. These properties include transparency, immutability, persistency, resilience, and openness [34].

The rest of the paper includes the background of the important aspects of blockchain, providing a brief history of how decentralized finance has evolved over the years. Then, the Ostrom's model is introduced where we try to tie our research with the principles depicted in the model using two cryptocurrencies: Dash and MakerDAO in particular. Finally, we try to find answers to our research questions and discuss the findings.

II. Research questions

In this paper we will look to answer these research questions.

- Can decentralized systems self-govern?
- Is Ostrom's model applicable to governance in blockchain systems?
- How do some of the existing DeFi coins enforce decentralization on their platforms?
- Can people sustainably work anonymously and organize themselves in a cohesive institution through those decentralized technologies?

III. Background

A. Decentralized Finance

The earliest foundation of Decentralized Finance was laid out by the creation of Bitcoin in 2009 by Satoshi Nakamoto. Although the concept of DeFi came a bit later, Bitcoin was the key enabler of the whole cryptocurrenty industry. Bitcoin was introduced as "a purely peer-to-peer version of electronic cash which would allow online payments to be sent directly from one party to another without going through a financial institution" [24].

Bitcoin led to the creation of Ethereum whitepaper in 2013 by Vitalik Buterin, which took this even further and intended to provide "a blockchain with a built-in Turing-complete programming language, allowing anyone to write smart contracts and decentralized applications(dapps) where they can create their own arbitrary rules for ownership, transaction formats and state transition functions" [7]. With a programming language of it's own, Ethereum could allow for the creation of new tokens and provided a quick and easy to use smart contract platform.

MakerDAO, one of the first decentralized autonomous organizations to launch on Ethereum was started. Maker is a protocol that allows for creation of a decentralized stable coin - DAI [22]. With the Ethereum blockchain launching in 2015, two years after the launch of the whitepaper, trustless computing became a reality and creation and release of dapps became more prevalent.

Ethereum has grown stronger and stable ever since giving a platform for more dapps. This led to the creation of Initial Coin Offerings(ICOs) during 2017 where the newly launched cryptocurrencies offer their tokens in exchange for ETH, the token of Ethereum. Although this wave of new ICOs during that time led to multiple failed projects, there were some important projects that would be add value to the DeFi ecosystem of present time. Several kinds of DeFi project including lending and borrowing, liquidity protocols, et. al. were born during this wave.

Decentralization has not been an easy ride for cryptocurrencies. Although it looks easily doable in paper, several actors taking part in the platform make it difficult. There have been several cases over the history which has questioned the very concept of decentralization innate to cryptocurrencies. The ecosystem of a plethora of DeFi coins has provided multiple options to customers and all stakeholders involved. If something is not right in one cryptocurrency, the ones involved can quickly and easily switch to another one, or even create their new coin.

B. Smart contracts

Smart contracts are defined by The chamber of digital commerce as ”Computer code that, upon occurence of a specified condition or conditions, is capable of running automatically according to prespecified functions. The code can be stored and processed on a distributed ledger and would write any resulting change into the distributed ledger” [32].

1) DAO: For the purposes of definition, a DAO, is an organization that is run through rules encoded as 1 computer programs called “smart contracts.” A DAO’s financial transaction record and programmed rules are maintained on a blockchain, which ostensibly increases transparency dramatically at the expense of security. Real-world examples of this business model include Dash governance, The DAO, and Digix.io. Of these, the best-known practitioner example is the former entity of The DAO. Its governance and security issues are worth particular attention because, when it was launched with $150 million in crowdfunding in June 2016, with smart contract implementation through the technology of Ethereum, The DAO was instantaneously hacked and drained of $50 million in cryptocurrency. The hack on the DAO was nullified the subsequent month, and was the product of a decentralized bailout made possible by a majority vote of the blockchain’s hash rate [9], [16]. Some people think it’s against the principles of decentralization because the decision was made by a few people instead of letting the whole community decide. As well as going against the central element of immutability.

2) Legal smart contracts: The concept of smart contracts was created by Nick Szabo in the 1990s. Calling it “a set of promises, specified in digital form, including protocols within which the parties perform on these promises”.

Due to the nature of usual legal contracts, there are some disagreements regarding the use of legal smart contracts. Usual contracts are usually not operating on the same logical basis as a computer program. This has caused some law experts to criticize the Smart legal contracts concept and the push for it to be used as a replacement [1] [10].

3) ERC-20: These categories are quite big, and does not give us much to work with, regarding the different cryptocurrencies and their use of smart contracts. Looking at a research in this conference paper [21] we can see that a huge proportion (close to 90 %) of the smart contracts can be grouped together in 20 sub-groups. The biggest sub-group was tied to ERC-20 (Ethereum request for comment). Further on the other subgroups for smart contracts was mainly focused on gambling contracts, and game and social contracts with an industry orientation.

C. Ostrom’s principles

In Ostroms’ study [26], the focus is situated around how communities manage to govern communal resources in a successful manner. The study extends Hardin’s paper [19], where he found that assets shared by individuals who act based on self interest results in a reduction of the commons. The individuals’ interests friction with the interests of the group, which is based on the fact that they act independently on their short-term interest. The solution is to manage these commons through either private ownership or public administration. The results from the study show that with certain conditions, commons can be managed in a reasonable and sustainable way within communities. From her approach, it is assumed that individuals don’t act in isolation. In addition, the individuals are not only acting on self-interest. Instead, she states that peers interact to build common protocols and rules that strengthen their sustainability. This hypothesis has gained a stronger fundament through the years, as it has been supported by several new studies [11], [27].

In addition, her theory was used as fundament to understand how communities develop and maintain digital commons [18], such as Wikipedia [17] and Free/Libre Open Source Software [29]. As part of the study, she outlined a set of principles to successfully manage the commons:

1) Clearly defined community boundaries: to define who has rights and privileges within the community.
2) Congruence between rules and local conditions: the rules that govern behavior or commons use in a community should be flexible and based on local conditions that may change over time.
3) Collective choice arrangements: to best accomplish congruence (Principle number 2), people who are affected by these rules should be able to participate in their modification, and the costs of alteration should be kept low.

4) Monitoring: some individuals within the community act as monitors of behavior in accordance with the rules derived from collective choice arrangements, and they should be accountable to the rest of the community.
5) Graduated sanctions: community members actively monitor and sanction one another when behavior is found to conflict with community rules.
6) Conflict resolution mechanisms: members of the community should have access to low-cost spaces to resolve conflicts.
7) Local enforcement of local rules: local jurisdiction to create and enforce rules should be recognized by higher authorities.
8) Multiple layers of nested enterprises: by forming multiple nested layers of organization, communities can address issues that affect resource management differently at both broader and local levels.

IV. Literature review

Several studies have been conducted to look at how governance in blockchain systems work. One study argues that the use of blockchain technologies for facilitation of governance processes is attracting the attention of social scientists [28]. Available literature mainly addresses whether blockchain systems can encourage the rise of new forms of blockchain-based governance.

Studies from the topic suggest that there are two standpoints that dominate the blockchain debate. On one side, there are people with techno-deterministic views. [20] suggest that these people inherently look at the idea of market and ignore the complexity of social organization. In addition, they commonly assume that the hierarchies between participants in decision making systems disappear, because of the disintermediation enabled by blockchain infrastructures.

The work of [5] is however critical against these technodeterminist views, and successfully identify and criticize the limitations. The critique is based on the reinforcement of the role of central authorities, resembling traditional responses against unregulated markets. Critiques consider central authorities as necessary to enable democratic governance and hence ignore the potential for communities, such as the decentralized crypto communities, to successfully self-organize. They see the potential to either support the control required by centralized forms of governance [25] or mechanisms to problems like tax fraud [4].

In this article we contribute a view which neither relies on the fundament of markets, as described through the view of the techno-deterministic people, nor on the view presented by the critiques of a tchno-deterministic approach. We base this report on classic studies from organizational studies of commons governance, and research the potential of using blockchain systems in this context. In addition, we analyze two cryptocurrencies to better answer this question.

Some previous research have been conducted on the blockchain governance in context of Elinor Ostrom's principles. [8] looked at how Ostrom's governance principles could be applied to DAOs. While Shackelford [30] examined the applicability of these principles focusing on governance of blockchains. Another study performed by Rozas, et. al. perform an analysis of the affordances of blockchain for decentralized community governance based on these principles [13]. They propose a list of six affordances that blockchain technologies may provide to communities.

V. Method

Using the six principles outlined by Rozas, et. al. [13], we added two principles, namely code deployment and code development. The reason for this is that we wanted to add another aspect to answer the research questions regarding the decision making and governance within the the context of maintaining the codebase of the platform. MakerDAO and Dash were our choice of cryptocurrencies, in which we tried to investigate how these coins perform on these principles. To answer our research questions regarding self-governance, we tie the results of the analysis to Ostrom's principles.

This paper includes the newer generation of blockchain systems, more specifically, the DeFi systems, and the analysis of principles that are supposed to cover the properties of blockchain found in the literature, focusing on the relevance for governance. Those include the organization processes of communities which rely on blockchain infrastructure.

Properties regarding DAOs are relevant to the governance as well, even though it's not a property of blockchain itself. The paper from Roza [13] outlined the following six properties tied to blockchain governance: (a) tokenization, (b) self-enforcement and formalization, (c) autonomous automatization, (d) decentralization of power over infrastructure, (e) increasing transparency, (f) codification of trust, one of the most cited properties of blockchain.

To illustrate the principles, this paper provides two separate cryptocurrency communities, where actors such as node operators, developers, miners, middlemen, exchanges and users interact to create a common governance. These communities naturally bring complex governance where both online and offline communication happen at multiple layers in the organization, from local peers to larger communities.

The section below contains an analysis of MakerDao and Dash based on the above principles.

MakerDAO was created to match normal currency in a bigger way, as currencies such as Ethereum and Bitcoin has a too big volatility [22]. MakerDAO creates and controls DAI, an underlying token used to match 1 US dollar. Dash, on the other hand, formerly known as Xcoin and Darkcoin, was designed to protect the anonymity of its users while also facilitating almost instant transactions. Started as a fork from the Bitcoin codebase, it is working as a Money as a Service Currency, so it has added a few important features, especially in terms of transaction time and privacy to the vanilla Bitcoin platform.

A. Tokenization

An important aspect of blockchain systems is the possibility to use tokens. Tokenization is the process of creating an asset

on the blockchain which can be used to determine the rights a individual have to perform an action on an asset. One example of tokens is in the medical sector, where sector, where tokens is used to provide authorization in line with access to reports.

However, it is important to clarify that the term token can be used interchangeably, as some individuals refer to for example Bitcoin as a token, as an abstraction of the actual coin. Tokens also facilitate the distribution of value and incentives. Banks or other parties such as gateways are not needed to transfer value between individuals. In addition, tokens can be used as representation of equity, decision-making power, property ownership, or labor certificates. These abilities may impact the governance positively.

MakerDao: Coming to the 3 first elements of the Ostrom model [26], MakerDAO meets these. They do have the solution for people to create DAI from any ethereum-based coin staked in a smart-contract. They deliver in having clearly defined boundaries [22]. Since the voting is done through voting with the MKR-token. It is possible to affect MakerDAO through proposals, without having any tokens, but this will not give any power to the individual to get their proposal through.

Dash: DASH, the token of Dash the platform, functions as a general purpose cryptocurrency. Like in Bitcoin, mining rewards the miner with some Dash. But the difference lies in that 45% of the mining reward goes to the miners, 45% to the masternodes and remaining 10% to the general Dash budget.

At present, this model has worked well for Dash. But at the start, there was an incident called Instamine [3], where in the first 24 hours of Dash's launch, approximately 1.9 million DASH coins were issued which represented upto 10 to 15 percent of the total DASH supply. This action clearly benefited the initial developers and founders, questioning the roots of decentralization. However, Dash has been cautious ever since and has handled their token supply well.

B. Self-enforcement and formalization

In this principle, we investigate how much of the rules and normes are formalized into code, and at what level the governance is affected by the formalization.

MakerDao: Looking at the elements from the Ostrom model that forms this principle, 2,4,5, and 7 [13], these are all met, through the use of smart-contracts, and the system designed around proposal voting and executive voting, to make sure that the changes made are in line with the need of the community [22]. When it comes to graduate sanctions towards users there are none. They do however have graduated sanctions to ensure that the goals of the community is met.

Dash: The governance part of Dash is heavily automated. From the system that handles new proposals to involving masternodes in the decision process, they have thought through well to ensure that all contractors of the blockchain including developers, outreach professionals, team leaders, attorneys or even people appointed to do specific tasks can do their work in a decentralized manner. The Dash Forum is the place where proposals generally start as pre-proposals, where feedback and suggestions are added from the general community. The proposal owner then creates the proposal as a governance object on the blockchain. The good thing about proposals is that a fee of 5 DASH is associated with this action to prevent spam and ensure only serious proposals get through. Voting on proposals is updated in real time and is always open and visible to everyone in Dash Nexus.

C. Autonomous automatization

We measure how autonomous the blockchain system is through looking at principles such as how the system interacts with the users, other blockchain systems, which services are availible and whether the system is self-sufficient.

MakerDao: The MakerDAO monitors its communities needs and wants through a two-phased voting system, creating a solution that makes sure that the voices are being heard in a better way [22]. If we look at conflict resolution mechanisms, we can see that they have implemented some mechanisms for different events that can have an impact on the community.

Dash: The automization parts of DASH has mostly been covered in section V-B. It puts more emphasis on the community and let's everyone play their part when it comes to making decisions for the network. It also well with things like adding new features, developers etc. because of the treasury budget that is allocated for every mined dash reward. This means that in case of unprecendented events, for e.g. if there is a case of the core team taken down, funding from the treasury can simply be directed to another team and/or individuals and it would continue to work.

D. Decentralization of power over infrastructure

This principle concerns the process of communalizing the ownership and control of the software employed by the community through the decentralization of the infrastructure they rely on.

MakerDao: MakerDAO is a autonomous organization, fulfilling the decentralization of power over infrastructure. The rules are enforced through the voting rights given to the holders of MKR. This is done by by staking their coins in the voting contract, giving them more decision-making power the more coins are staked. By basing their coin DAI on the US dollar it has decentralized the power, while basing it on a physical asset [22].

Dash: Masternodes add a second layer on top of the miners in Dash. In order to become a masternode, one needs to have a hold of 1000 DASH in collateral. The idea is that if it were free to upgrade to a masternode, anyone come in and create thousands of such nodes and take control over the network. The Dash platform believes that decentralization is more of a continuum and therefore thinks having some control with the masternodes helps maintain the required balance between responsibility and control.

E. Increasing transparency

Increasing transparency concerns the process of opening organizational processes and the related data through depending on the persistency and immutability of blockchain systems.

Enthusiasts of blockchain visualize a blockchain governance as one that takes advantage of the public recordkeeping features of blockchain technology [13].

MakerDao: Through their maintanence and development of MakerDAO the users have the possibility to use Governance Security Module (GSM) to make sure that the changes does not have a malicious impact on the system. The voting is also split into two parts, proposal voting and executive voting, working as a monitoring of the consensus of the community [22], keeping the token transparent.

Dash: Barring the Instamine incident in 2014, the Dash platform has tried to remain transparent in their operations. Anyone can apply to be a masternode given that she holds the required Dash coins. The Dash network is operated by its community users, where anyone can participate by downloading and running the Dash software available as open-source. The network is designed to fund it's own development from the Dash budget. They welcome anyone to submit a proposed project to the network. This increases more integrity among the users and has helped in the growth of the network by constantly adding new features, services, geographies, merchants, and users.

F. Codification of trust

Trust system is one of the key principles of Ostrom's self-governance model. Therefore the codification of trust in blockchain systems is an interesting and important aspect to include in the analysis of the coins.

MakerDao: With the use of MKR token and proposal voting the criteria of codification of trust is met. Both through the element of multiple layers of nested enterprises and local enforcement of local rules. Through smart-contracts tied to voting the rules are enforced, and with MKR, DAI and ethereum-based tokens being tied to MakerDAO it has a layered nested enterprise.

Dash: Dash, on the other hand, believes that right amount of trustlessness and control is required to operate as a digital currency and gain trust from it's users. The Dash Core Group is organized as a regular company which allows them to be organized and co-ordinated as opposed to a lot of other projects. So, it's trustless in the mining layer like bitcoin, with an additional masternodes layer which adds the right amount of control and coordination.

G. Code deployment

In the analysis we will look at how the different crypto communities handle the deployment of new code. Looking into the internal infrastructures, which facilitate for communicating and coordinating.

MakerDao: In MakerDao, code is deployed through the use of a two-step solution, where changes are suggested through governance polling to meet the wants and needs of the community, and then an executive voting to enact on the changes.

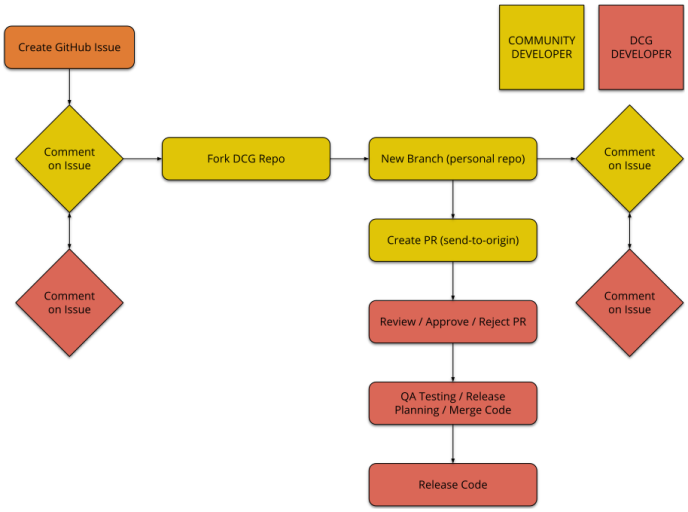

Fig. 1. Dash Code Deployment Process [2]

Dash: Fig 1 shows the process of how code deployment occurs in the Dash codebase. The actors involved are community developers as well as the Dash Community Group(DCG) Developers. Anyone can create a proposal as a new GitHub issue to which the community and DCG developers comment on making it ready for the next steps. The proposal then moves on as a fork of the DCG Repo with a new branch which is able to create pull requests when the feature is developed. The DCG developers will review/approve or reject the PR and do the necessary testing before merging the code to the master repo and releasing the feature. This method is similar to how open source organizations manage their code and roll out new features.

H. Code development

In this section, we will look at licences which the code is published under, where to access the code, how restrictive the community is to outside people working on bugs and contributing.

MakerDao: Code development in Makerdao is based on open-source with a welcoming approach regarding outside people contributing on the system. Their system is licensed under the Apache license.

Dash: The Dash code is published under the permissive free MIT software license, the codebase is easily accessible on GitHub. The Dash Core Group (DCG) is responsible for the protocol repositories, however, any contributor is welcome to work on external bug fixes and features following the contribution guidelines, the work is then reflected in the permanent git commit history.

VI. Results

Dash and MakerDAO were taken as the choice of cryptocurrencies to analyze how they follow the framework built up in section V. While these currencies have their own subtleties in those 8 principles, we could also see that the core principles

that are important in making a currency self-governing don't change much.

Dash has a bit of control with the masternodes to balance the trustlessness with the miners. This affects most of the principles from V. Token supply and circulation is therefore controlled by these two parties whereas other aspects like voting and governance is mostly controlled by the masternodes. MakerDAO has created a unique voting system with failsafes at both the governance polling to make sure that it is the voice of the community that is heard, and with GSM after the executive voting to ensure that malicious proposals does not affect the community in a way that works against its goals.

VII. Discussion

Parallels between Hardin's study and today's blockchain debate can be found. The standpoints pointed out by Hardin [19], where he found that the solution to friction between people's interests and commons, is to manage these commons through either private ownership or public administration. In today's debate about blockchain's governance, the two parts envision different forms of governance which either rely on private markets or on traditional forms of public administration.

A. Tokenization

Related to Ostrom's first principle, the boundaries in a blockchain system are reflected in the rules written in the code, which have the purpose to coordinate communal activity in decentralized communities. The code define the permissions to access or modify assets or community rules. This is seen in the coins analyzed in this paper, where MakerDAO and Dash both have encoded rules to handle actions like voting.

Further, the negotiations concerning the boundaries and the reflection in the code, is in line with the second and third principles of Ostrom. This is because the cryptocurrency communities constantly develop and maintain the collective choice arrangements concerning the governance. Rules are outlined based on local conditions, where the goal is to find ways in which all actors affected by the rules can participate in the modification.

The possibility for tokenization in blockchain systems could sort out latent power in the community. Tasks such as conflict management and maintenance may be made visible and acknowledged by the community. Therefore, the process of tokenization opens up for rethinking the existing power dynamics.

Tokenization also provide some risks. One example is the extreme quantification [31]. First, the balance between what should and should not be tokenized is important. Second, the mechanisms which can change the current state of the system should also be carefully limited and balanced. The need to understand the advantages and disadvantages of tokenization is important, as well as understand how self-governed communities can implement it into the software to collaborate.

B. Self-enforcement and formalization

Ostrom's principles can be used in the context of blockchain rules. An example could be the rules which regulate monitoring, which can be found in principle four and five in Ostrom's principles. The community should define rules concerning the allocation of common assets, which can be done through mutualizing, capping, or pooling. The rules are also automatically enforced and is envisioned by Rozas [13].

Another important note on the rules in the blockchain system, is the fact that the rules are written to be understood by machines, which implies that the governance needs to be formalized. This is because they normally are expressed by natural language. This might lead to the community needing to discuss possible rule changes to implement them in the code. The formalization and encoding of rules is important as they may present several limitations and potentials and needs to be discussed. This is highlighted in the analysis of Dash, where the Dash forum is used as a natural language discussion forum before the proposal is added as a proposal object on the blockchain.

The study done by Mateos [23], found that decentralized communities show an increase in the degree of formalization in decision making over time as they grow. The analysis of MakerDAO highlighted that smart contracts in blockchain systems opens the possibility to make the rules more available and open for discussion, which is in line with Ostrom's second principle. In addition, the formalization of rules in combination with self-enforcement is in line with Ostrom's seventh principle, where peers in the community control that the local jurisdiction of rules is acknowledged by higher authorities or peers.

There are however, several issues concerning the self-enforcement and formalization regarding the governance in blockchain systems. Because there are no third parties who monitor the network, the rules need to be enforced automatically in line with the agreements previously negotiated in the community. In theory, this results in the rules being harder to breach, but it also presents problems regarding the difficulty to define exceptions [15] There are examples of Blockchain systems such as DAOStack, where the code is made to be easier to update the rules coded in smart contracts, which is in line with Ostrom's second principle.

In addition, the formalization of rules to translate them into code, require up to date and current technology, as well as a good fundament of technical knowledge. The formalization can make the rules more available and visible for the community, while the people with technical understanding, who are writing the rules in code gain a lot of power.

There is also a risk of formalizing the rules that regulate the actions of peers in the community too much. In Ostrom's study, she pointed out the importance of informal social norms, to successfully self-manage assets. To excessively formalize norms to specific self-enforced rules through code, might result in unbalanced dynamics in the community.

C. Autonomous automatization

Because of DAOs decentralized nature, not based on traditional central servers, the DAO systems is highly difficult to shut down. They might of course, be programmed to shut down at some time. They function as long as there are someone or something which interacts with the system. This autonomous nature makes DAOs difficult to censor. Another feature in the DAO systems, is that peers can hold tokens and assets, or purchase services from other DAOs. The DAO systems can be self-sufficient as they can charge individuals for their own assets and services, to pay for the services they need [15].

As mentioned before, the smart contracts can help monitoring and punish peers who violate the community rules. This is in line with principle four and five in Ostrom's work. DAOs also share this feature, and possibly strength the view, as a community will rely on an automated nature to enable such monitoring and punishing. When punishing individuals in a network, the individuals might react in different ways. On the one side, the peer might look at the punishment positively, as it comes from the whole community, which might be an factor in the individual not reacting against the enforcer. On the other side, the same individual might be frustrated and helplessness.

DAOs automatization may result in facilitating the scaling and creation of layers of peers, which is in line with Ostrom's eight principle. A study done by [17], [29], found that scaling a community increases the formalization of rules and norms, as well as the bureaucracy. However, with a high degree of automatization, the bureaucracy could be scaled down, while accelerating processes. This can be seen in Dash, where adding new features and handling proposals is automated, and hence the bureaucracy is scaled down.

Although clearly defined rules are in place, there will be a need for humans to there will be a need for humans to complete multiple actions. In a DAO system, the rules can be implemented into code once they are agreed in the community, which then have the possibility of automating a huge proportion of internal processes, enabling coordination, monitoring actions of peers or transferring assets in line with the peers' contribution.

In DAO systems, the governance is digital and formalized. The governance formalization needs to tackle the potential conflicts which can arise. This is in line with principle six in Ostrom's work. With the automatization, scaling up and formalization, DAOs create an environment where conflicts are made explicit between peers of a DAO, between DAOs. This results in a community to define solid mechanisms for resolving conflicts, which to some extent can be handled by code.

However, there are some downsides. DAOs are only possible in the digital space. The digitalization developing rapidly and while affecting the real world, but the real world is still using own rules. DAOs can facilitate for systems like digital voting, but it would never know if an individual is coerced to vote in a specific manner. Another example is that DAOs enable the transfer of values in the digital space, but there is still laptops which can be stolen.

Regarding the services and conflict resolution, the DAO systems can resolve conflicts and hire services, but there is still the human legal framework which might differ from a DAO decision. On the topic of law, the DAO systems encounter issue like who is responsible when a DAO decision results in a misaction, for example economic loss. Looking to MakerDAO [22], there are possibilities to enable actions that can govern against misactions, as they do with GSM.

It may look too immature to use DAOs for commons governance, with the risks and challenges outlined above. On the other side, there are several opportunities when using automated processes for a community.

D. Decentralization of power over infrastructure

A study done by Forte [17], looked at the relation between technical and social power. The results show that the main platform for communication and cooperation usually becomes a center of tension and conflict. When a decentralized community expands increasingly, the control of the infrastructure is decentralized. This is done by formalizing at a higher level, such as outlining explicit and strict organizational processes and roles. The changes on the organizational level results in negotiation over time. When seeing this from Ostrom's third principle, it can be seen as the creation of collective choice arrangements, which usually don't happen in a environment of equality with regard to power.

When using decentralized systems such as blockchain, one has the opportunity to explore the changes in the relationship between technical and social power. An example from the blockchain world is the hard forking. The way blockchain is built, through open-source code, makes forking the whole infrastructure easier. This may result in the people having control over the infrastructure being concerned about others forking parts of the system, but also the whole infrastructure and the community rules embedded in the code. Blockchain systems can therefore shape the dynamics enabling a higher pressure for negotiation on the people with more power in the community, and hence foster permissionless innovation [13].

A study done by Baig [6], found that decentralized communities have implemented compensation systems into their governance. This relates to multiple principles in Ostrom's work. By decentralizing the infrastructure, the community reduce the cost of forking, as well as distributing the power within the community. This is also seen in the Dash system, where decentralization is looked at as a continuum.

The third principle in Ostrom's work, can be related to the fact that peers that have more power in the community, can experience greater pressure concerning the negotiations of collective choice arrangements. In addition, principle four relates to the situation where the peers who monitor the commons, might experience pressure as others might expect accountability. Also, by decentralizing the power, the community can innovate permissionless with a greater degree of autonomy [13]. It is however not risk-free, as it might lead to a shift of power to the programmers defining the rules in

code. Additionally, the different pressures could result in a fragmentation in the community.

E. Increasing transparency

Blockchain systems allow people in decentralized communities to create technologies where actions performed by peers are trackable, inspectable by other peers in the network. Decentralized environments have a natural culture where openness and participation are central. Though the possibility of inspectable data, the community may successfully increase the legitimacy of the monitoring tasks. This is seen in the Dash system, where anyone can download and run the Dash software. This is in line with principle four and six in Ostrom's model.

There are some issues which should be highlighted when discussing blockchain systems' governance transparency. For example, how would transparancy and immutability in the blockchain fit in the current discussion about privacy on the internet, and the right to be deleted online. This raises questions like, what information from the peers should be kept permanently. Another scenario could be how more transparency would affect the creation and evolution of participants' identities in a community.

F. Codification of trust

Within blockchain communities, the term trustlessness is often used by enthusiasts when discussing the potentials for blockchain technologies. The term codification of trust can be defined as programming trust in a trustless system. Trustless software can enable peers to agree without needing a third party to create a trust between them. Examples of this is found in MakerDAO, where smart contracts create trust between peers through immutable contracts.

A limitation related to the codification of trust, concern the transfer of trust defined in the development of the trustless technologies. One example could be when using smart contracts to enable governance, the trust is transferred to the code and later to the programmers. A study done by Werbach [33] states that the nature of blockchains have created a new architecture of trust.

The codification of trust is dependent on the common infrastructure, which enable several features. The first, which is in line with principle six and seven in Ostrom's work, concern the facilitation of internal interoperability between the nodes that defines the decentralized community, or as Ostrom states it, the different layers of nested enterprises. Second, the use of blockchain as a database enable interoperability beyond the boundaries of a traditional centralized system. An example could be that smart contracts enable agreements between community networks. Also, it might reflect the decisions from different community networks [13]. However, when coding trust in a trustless system that enable interoperability between and within a decentralized community, it will result in a social operation with negotiation. Therefore, it is not free from the risks outlines in the above principles.

G. Code deployment

The process of code deployment is an important aspect in the blockchain systems, as the infrastructure defines how the internal coordination works, as well as where the power is residing. It is important to highlight the internal processes in deploying new code, as the internal structures of peers and their potential power on the governance is shown. There are huge differences in how this is done. While some such as Makerdao [22], uses longer time to deploy code-changes through the two-step system others have quicker solutions. Looking to [12], their solution is built upon some open-source and some proprietary software. This makes it hard to see how things change for the users, and makes the users in the community powerless to a certain degree, altough they have access to the changes on the token, they do not have any insight into how the tokens mainsystem, Social mining, works. This token has shown great potential, although it goes against a lot of the principles from the model we've used to look at blockchain [13].

H. Code development

The code development is an important aspect to the internal blockchain dynamic. The development is dependent on well defined rules and guidelines to translate the rules defined through normal text and speech to lines of code. There is a lot of power and responsibility residing on the developers. Both Dash and MakerDAO have solved this by having their code accessible on GitHub, where anyone can work on bugs and contribute within the guidelines.

VIII. Conclusion

Decentralized systems such as blockchain communities have the possibility of self-governing, work anonymously and organize. On the other side, our analysis suggest that there is a current need to centralize some aspects of the network. However, there are important aspects which should to be fulfilled. These factors are based on Ostrom's model which is highly relevant in the context of blockchain systems. First, the community should have clearly defined boundaries to coordinate activities. Second, formalized rules which enforce monitoring and sanction the peers who violate the rules should exist and be inspectable, to increase the legitimacy. Third, one should outline explicit and strict organizational processes and roles. Lastly, tasks such as conflict management and maintenance should be clearly defined and may be tokenized to restructure the power dynamics. DeFi coins enforce decentralization as they are almost impossible to shut down, as well as the voting systems enabling power to be less centered.

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