SingularityNET

Decentralization Report

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Introduction

Decentralization has been achieved in many ways: some are based almost entirely on blockchain technology, while others rely on organizational restructuring to achieve the goal of fairer and better decision-making. The underlying challenges are manifold: how decisions should be made; who should be involved in the decisions; how to structure the way that such decisions are made; how to preserve the autonomy and security of the individual while protecting the interests of the whole? How to decentralize without some kind of fatal flaw?

This paper explores the literature on decentralization, both on and off the blockchain. It is based on a review of both academic and non-academic literature, as in addition to academic research, bloggers and YouTubers have a great deal to contribute to knowledge about decentralization, while public chats and forums are a good way to gain insights into the nuts and bolts of (and sometimes vocal disagreements in) decentralized communities. To gain a rounded view, this research has used a combination of Google Scholar and university library search, and searches on the main Google search engine and YouTube to access blogs and videos. All resources are listed at the end of this paper.

We intend this report to be used as a starting point for thinking about decentralization - especially, but not restricted to, Decentralized Autonomous Organizations (DAOs). It is meant for a wide range of audiences, including people who may not know much beyond the basics of DAOs to those who are considering decentralization for their organization. The outcome of this research is to provide some context for progressive decentralization, present some governance and decentralized coordination models, and finally present some recommendations. This paper argues that there are two layers in decentralization: the technical governance process, which is effectively a system to execute the release of funds from the treasury,[4] and sets of coordination processes. To develop a functioning decentralized ecosystem, such processes need to be carefully designed and migrated from the central leadership in conjunction with the technical implementation of the DAO (if applicable).

During this paper, we have purposely avoided any discussion of the legal challenges associated with DAOs, though these are many and pervasive throughout most contexts. It is our recommendation that in any attempt to decentralize, a careful analysis of the potential legal ramifications should be conducted in context. Attention must be given to any future changes in local laws as these can seriously impact individuals who are contributing to DAOs.

Section 1: DAOs, Governance and Voting

DAOs promised to revolutionize how we structure socio-economic relationships (both through the diffusion of political influence and the distribution of technology in a decentralized manner, for example through blockchain nodes). As it is taking place on an emergent set of technologies,

[4] Rachmany, 2020a. You Don't Need a DAO. https://hackernoon.com/you-dont-need-a-dao-un3937tu

to this day it is still an explorative, experimental process. Some have attempted to map the landscape of DAOs, but because it is changing rapidly, such resources either disappear or become outdated as DAOs are founded and dissolved (or abandoned). The emergence of DAO builders such as DAOstack, DAODAO and Aragon have enabled the genesis of thousands of DAOs. Daolandscape.today attempted to keep abreast of the state of DAOs but is now defunct, presumably for this very reason; many DAOs that were started on the first DAO builders are inactive.[5] Now the presence of DAOs is collated by DAO directories such as Messari[6] and DeepDAO[7] web resources, which list DAOs with details of governance processes and open proposals.

Definition and taxonomy

The definition of DAO is somewhat ambiguous across different sources. However, Rikken et al. (2021) arrive at a unified definition based on the common characteristics of DAOs:

> *A DAO is a system in which storage and transaction of value and notary (voting) functions can be designed, organized, recorded, and archived and where data and actions are recorded and autonomously executed in a decentralized way.*[8]

Rikken et al.'s (2021) study has also analyzed the definition of DAOs across different academic and non-academic sources, finding that while some elements appeared across different spheres, there was no unified definition of DAO, even among DAOs and DAO builders. This contributes to an ambiguity in the landscape of DAOs, making it challenging to analyze. Another common feature of DAOs is the power afforded to individuals in the organization to take part in the decision-making process - but this is variable across organizations. Decision-making can be reserved for certain members of the community, or it can be open to all; some resemble traditional organizations in that they have some sort of hierarchy or at least different tiers of authority, while others are entirely flat.[9]

Blockchain-based decentralized organizations are highly varied in both function and level of complexity. Many sites organize DAOs by function, including:[10]

- DeFi/AMM protocol (e.g. UniSwap, Aave)
- Philanthropy DAOs (e.g. UkraineDAO, BigGreenDAO)
- Investment/Venture (e.g. Metacartel, Stackerventures; PieDAO)
- Grants (e.g. MolochDAO)

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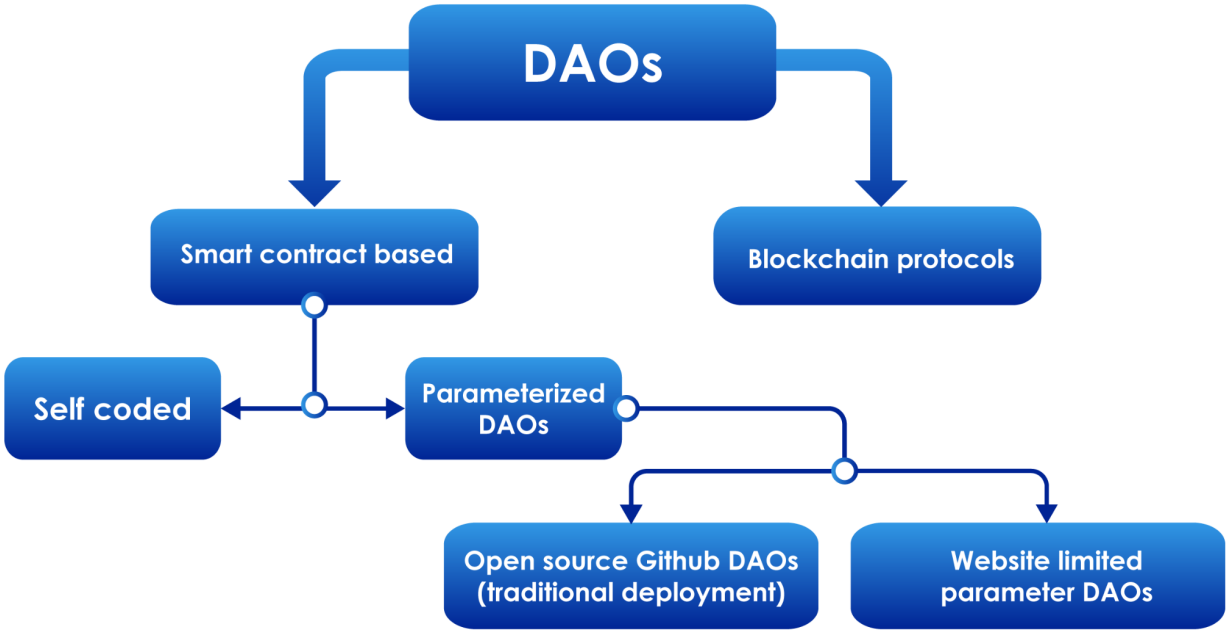
[5] Rikken, O., Janssen, M., & Kwee, Z. 2021. The Ins and Outs of Decentralized Autonomous Organizations (DAOs), p.5. *Available at SSRN 3989559*.
[6] https://messari.io/governor/daos
[7] https://deepdao.io/organizations
[8] Rikken et al., 2021.
[9] Sims, A., 2020. Blockchain and decentralised autonomous organisations (DAOs): the evolution of companies? New Zealand Universities Law Review 423-458.
[10] For example, BanklessDAO. 2020. https://banklessdao.substack.com/p/state-of-the-daos-1-october-20; Binance, 2020. https://research.binance.com/static/pdf/dao-report.pdf

- Social (e.g. HIVE; Hypersync)
- Media (e.g. BeetsDAO)
- Collector/NFT (e.g. Pleasr, Flamingo)
- DAO Builders/Operating systems (e.g. Aragon, DAOstack, Colony)

These categories are still in their nascent stages; other function-based categories will doubtless emerge. For example, if there are ever enough (genuinely) decentralized labor or more widespread peer-to-peer resource-sharing platforms to replace the gig or so-called sharing economy (e.g. RoomshareDAO), those could form a new category. Another could be education DAOs that could increase literacy and numeracy rates in areas that need them, or place ownership of higher education systems in the hands of students, reducing the power of monolithic institutions.[11]

Other categorization is by technology and deployment type:



Source: Rikken et al. 2021.

[11] CityDAO blog. 2022. Education's Last Mile. https://city.mirror.xyz/JLuzDxZm5uaGY0SDyMGLg-jbagDdd3VCnc1Ucli6iTQ

The deployment type of categorization can be helpful for informing thinking about the kind of infrastructure that may be appropriate for the type of organization, as the deployment type is a key decision made at the start of implementation. Higher levels of organizational complexity (for example those that run multiple projects) and scaling needs have different deployment needs from those that have relatively straightforward mandates. Self-coded DAOs require a higher level of technical expertise at the development stage but also affords a greater level of flexibility of customization. (It could also require a higher level of technical expertise to interact with the governance system, depending on design, which could impact engagement.) Organizations can use a prefab DAO template such as those on Aragon, JuiceBox, and DAODAO.[12] Another option is to use a DAO builder and combine with code such as on Aragon (which is not listed in the typology above. For single purpose DAOs such as collector DAOs, a simpler model may be enough, but for complex projects (especially a hybrid model or a purpose-built model could be useful). Aragon, for example, offers DAO templates, but many DAOs also use it as a base for their own smart contracts when there are higher complexity needs (such as more sophisticated models for assigning voting rights).[13]

A formal taxonomy of DAOs has been developed by Campisi (2022) across four dimensions:[14]

- **Scope of multilateral agreement** (the degree to which decisions are made jointly)
    - Restricted
        - Code upgradeability
        - Natural language guidelines
    - Unrestricted
- **Resource management**
    - On chain resources
        - Upgradeable contract
        - Non-upgradeable contract
    - Various types of resources
        - Natural person
        - Legal entity
- **Discussions** of proposals
    - Rule based
        - On chain
        - Off chain
    - Discretionary
        - Off chain
        - Linked
- **Voting**
    - Liquid stake (tokens also represent value)
        - Weighted voting

[12] Amann, 2022. Choosing the Right DAO Builder Platform. https://www.youtube.com/watch?v=W9S9iHLcCAI
[13] *ibid.*
[14] Campisi, F., 2022. *The Impact of Decentralized Autonomous Organizations on Corporate Governance* (Doctoral dissertation, Politecnico di Torino).

    - Dedicated voting
- Merit (tokens do not carry value but represent the activity of the token holder)
    - Weighted voting
    - ID level

Source: Campisi, 2022.

Different types of DAOs need different types of governance structures, depending on complexity and purpose, but are generally token-based (see below for voting models). DAO builders such as Aragon offer a standard set of voting protocols. However, there are known challenges to do with many of these varieties of voting that can lead to power imbalances. These are explored in each voting type. A straightforward, mostly automated governance structure can be useful if its primary goal is simply to manage the movement of funds and decisions are made relatively infrequently.[15] More complex ecosystems with multiple projects and teams may require more nuanced governance infrastructure, preferably supported by self-leadership/management practices (see Section 2).

Voting

Voting has typically taken place on blockchains as it is secure and the execution of passed proposals is automated. However, more recently some voting takes place off-chain, for example to gauge opinion or to contextualize proposals in a wider discussion. In some cases, both methods are used: off-chain discussion and voting leads to on-chain execution, such as on MakerDAO. The advantages of on-chain voting is that it is transparent and conforms to explicit rules regarding proposals and voting. It is also sometimes vulnerable to attacks and exploitations, as will be outlined in the voting. On-chain voting systems use governance tokens, which can have different functions. Some simply confer the power to vote, while others are used to carry out transactions (such as Uniswap),[16] which can bring its own disadvantages - see below in One-token-one-vote. Off-chain voting can happen through tools such as Discourse forums, Discord chat, and Snapshot, avoiding transaction fees associated with blockchain voting, and can result in more participation.[17]

Many voting systems are based on quorum voting, which requires a threshold of voting power to be reached before a proposal can have the opportunity to pass, and then the collective decision of the voters is arrived at once the proposal has qualified.[18] (That is, if the threshold is not reached, the proposal automatically fails, irrespective of the existing voters' decision.) Arriving at the right quorum requirement can be a challenge. If the number is too high, most proposals will

[15] Rachmany, 2020a.
[16] Phemex. 2021. What is Blockchain Governance: Setting Platform Rules. https://phemex.com/academy/what-is-blockchain-governance
[17] TallyDAO Documents. 2021. https://wiki.tally.xyz/docs/on-chain-vs-off-chain-voting
[18] Calcagno, R. and Campisi, F., 2022. The impact of Decentralized Autonomous Organizations on Corporate Governance. https://webthesis.biblio.polito.it/22366/1/tesi.pdf

fail owing to inadequate engagement, while if the number is too low, poor quality proposals can pass and the vote may not be representative of the majority.[19]

One token, one vote

A common voting model for DAOs is that in which one token is equal to one vote. This system is straightforward and easy to implement, but if the token can be traded, it also carries critical vulnerabilities such as the disproportionate power of large investors/token holders (also known as 'whales'). This can centralize power and create plutocracies.[20][21] Other challenges in this system include flash-loans, where an individual buys a large quantity of tokens for a short time in order to gain enough tokens to gain control of a vote.[22]

Time holding tokens are one way to mitigate this power, where voting power of each token increases proportionally to the length of time for which tokens are in the possession of the token holder. In theory, this helps to mitigate the power of whales and offers an incentive for early adopters.[23] However, in practice many whales are founding members who therefore have the most powerful tokens, so this is only a partial solution. Another refinement is conviction voting, where proposals are presented in rounds and tokens from each wallet holder are split between proposals.[24] Voting power is also increased proportionally to the amount of time the tokens are staked.[25] One disadvantage of this, however, is the time taken to make decisions; it would not, for example, be useful for crisis situations.

One wallet, one vote

This method tries to reproduce a 'one person, one vote' counting system in offline democracies. It can be achieved by having a non-transferable non-fungible token (NFT) that acts as a voting counter.[26] In theory, this system is meant to equalize voting. However, it is vulnerable to the creation of multiple wallets, also known as Sybil attacks.[27] Solutions are difficult to find without violating privacy; some Know Your Customer (KYC) solutions rely on identity verification, but

[19] Limechain blog. 2022. DAO voting mechanisms explained [2022 guide] https://limechain.tech/blog/dao-voting-mechanisms-explained-2022-guide/
[20] De Filippi, P. (2019). Blockchain Technology and Decentralized Governance:The Pitfalls of a Trustless Dream. SSRN Scholarly Paper ID 3524352.
[21] Binance. 2020.
[22] As happened with MakerDAO: https://forum.makerdao.com/t/urgent-flash-loans-and-securing-the-maker-protocol/4901
[23] Moralis Web 3. 2022. What are Governance Tokens? https://www.youtube.com/watch?v=8Sh8EOyWga8
[24] Emmett, J. 2019. Conviction Voting: A Novel Continuous Decision Making Alternative to Governance https://medium.com/giveth/conviction-voting-a-novel-continuous-decision-making-alternative-to-governance-aa746cfb9475
[25] Axelsen, H., Jensen, J. R., & Ross, O.. (2022). When is a DAO Decentralized?. *Complex Systems Informatics and Modeling Quarterly*, *31*, 51–75. https://doi.org/10.7250/csimq.2022-31.04
[26] Stanford Law School. 2022. DAO Symposium: the nuts and bolts of voting. https://www.youtube.com/watch?v=YrJBBTFO1Bk&t=976s
[27] Siddarth D, Ivliev S, Siri S, Berman P. 2020. Who Watches the Watchmen? A Review of Subjective Approaches for Sybil-Resistance in Proof of Personhood Protocols. Front. Blockchain 3:590171. https://doi.org/10.3389/fbloc.2020.590171

would go against the grain of privacy that defines many blockchain projects. A great deal of effort is being put towards finding solutions, including zero-knowledge proofs, which confirm identity without revealing identity to the main organization, and KYC NFTs.[28][29]

Quadratic voting

Quadratic voting has been designed to reduce the financial advantage of voters with large amounts of tokens, where cost is equal to the quadratic value of vote numbers, raising the price for each vote with diminishing returns on votes bought.[30] However, the system is also vulnerable to identity attacks such as creating more than one wallet or collusion with other members.[31] Furthermore, the financial advantage is not entirely eliminated with this system. It could, however, potentially be combined with other voting systems that reduce the chance of multiple identities. The risk is that more complex voting systems could result in confusion and low engagement, and solutions that involve third parties can increase security risks.

Holographic consensus

This voting method is used by a number of DAOs and is meant to address scaling and engagement issues experienced by growing DAOs. Holographic consensus voting is designed to reproduce the collective opinion of the community. This is used, for example, by DAOstack and DXDAO. Proposals can be made in the standard way, with the need for an absolute majority with a prescribed threshold of participation, or they can pass through an extra layer of voting: effectively a prediction market, where token-holders spend attention tokens (GEN on DAOStack) to “boost” proposals, essentially betting on the outcome and losing or gaining tokens if their supported proposal fails or succeeds, respectively.[32] Boosted proposals require fewer votes to pass, moving from a requirement for an absolute majority to a relative majority, while unboosted proposals continue to require an absolute majority. In such a prediction market, stakers try to align their stakes with the expected opinion of the community.[33] Participation can be encouraged by awarding tokens from failed stakers to successful stakers.

A challenge in holographic consensus voting is the time taken, as the stages of staking and voting can be a lengthy process.[34] This makes it unwieldy for mid-level decisions and for

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[28] A review of the literature on the anonymity/security challenge and various solutions can be found in Sánchez, D.C., 2019. Zero-knowledge proof-of-identity: Sybil-resistant, anonymous authentication on permissionless blockchains and incentive compatible, strictly dominant cryptocurrencies. *arXiv preprint arXiv:1905.09093*.

[29] KYC website. n.d. FAQ. https://kycdao.xyz/page-faq

[30] Hellström, E., 2022. Fair Voting System for Permissionless Decentralized Autonomous Organizations. Uppsala Universitet.

[31] Allen, D. W. E., Berg, C., Lane, A. M., & Potts, J.. (2020). Cryptodemocracy and its institutional possibilities. *The Review of Austrian Economics*, *33*(3), 363–374. https://doi.org/10.1007/s11138-018-0423-6

[32] El Faqir, Y., Arroyo, J., & Hassan, S. (2021). A Scalable Voting System: Validation of Holographic Consensus in DAOstack. In *HICSS* (pp. 1-10).

[33] *ibid.*

[34] Coinyuppie, 2022. https://coinyuppie.com/in-depth-analysis-7-common-voting-mechanisms-of-dao/

crisis-situations that require quick decision-making, such as responding to critical vulnerabilities. While it is potentially a fairer way of voting than one-token-one-vote because it creates a disincentive for damaging actions, it is questionable whether a consensus on the prediction market is truly representative and truly merit-based. The results may be skewed if people vote on what they think will pass (in other words, what will be popular) rather than what deserves to pass (*ibid.*).

Reputation-weighted voting

Another, more sophisticated type of voting is that which gives extra weight to governance tokens based on user behavior. Parameters can vary significantly; they can be based simply on wallet behavior and token staking, but other models can include other kinds of activities and contributions. In a wider activity-based reputation system, each member can have a decentralized identifier (DID), which tracks their participation in the DAO.[35] This would observe contributions such as suggestions, proposals, voting participation, forum activity, and operational work - and can track participation across other DAOs, increasing data diversity.[36] The reputation system is flexible because the parameters for accumulating reputation are highly customisable. For example, forum participation can count towards reputation, or successful proposal execution and/or project completion. The extent to which different actions can weight the reputation is also customisable.

However, reputation systems carry some vulnerabilities, such as susceptibility to scamming; governance mining such as bot-participation; voting arbitrarily or tactically just to participate and gain rewards; security and identity concerns. Another question is how to function in the early days of a system when no one has any reputation yet. Some of these challenges have been addressed by prospective implementers of reputation systems. For example, a “weighted liquid rank algorithm” has been simulated for online marketplaces to identify scams among seller ratings.[37] Results indicate that the algorithm has been able to successfully distinguish most of the time between honest and dishonest sellers, and proved to be significantly more effective than standard rating systems.[38] Such systems could be used to detect system exploitation in voting systems based on reputation as well.

In practice, reputation systems are comparatively rare among DAOs but gaining in traction. DAOstack uses a reputation system (and this is extended to any DAOs that are built using DAOstack’s operating system).[39] Actions that automatically give or remove reputation include proposal passing or failing. Other actions are linked to the holographic consensus mechanism; if a voter wins or loses in the prediction market, reputation tokens are gained or lost too.[40] The

[35] Ont.ology News. n.d. Using Reputation in Governance. https://ont.io/news/850
[36] *ibid.*
[37] Kolonin, A., Goertzel, B., Pennachin, C., Duong, D., Argentieri, M. and Znidar, N., 2019. A Reputation System for Marketplaces-Viability Assessment. *arXiv preprint arXiv:1902.03857*.
[38] *ibid.*
[39] DAOstack. 2019. A Guide to DAOstack’s Initial Reputation Protocol. https://medium.com/daostack/a-guide-to-daostacks-initial-reputation-protocol-f8365f157f7a

[40] *ibid.*

DAOstack system also enables the community to remove reputation via negative reputation rewards if it is considered to carry too much power. Though this system is relatively limited, DAOstack acknowledges that this is just a starting point and that DAOs can build more functionality into their systems.[41]

Another potential example of a reputation system is the proposed Ethereum-based Soulbound token, which are intended to "represent commitments, credentials and affiliations", and would be designed to be run across different groups, not just used in the governance of Ethereum.[42] Because Soulbound tokens are non-transferable and based across an individuals' unique activity, it has the potential to build trust through reputation, potentially in multiple spheres, and solve some problems such as Sybil attacks.[43] This is still in the early stages of development - however the authors propose a variety of ways of solving some of the problems associated with reputation voting, including protecting the system from people who might try to exploit it.[44]

One feature of reputation voting could be domain-specific distinctions and weighting. This would split voting into domains of expertise, and people with experience in one domain would have more voting power than if they are voting in another domain outside their expertise. This could work in a nested structure (see Section 2), where rather than providing a large pool of proposals that everyone must process and vote on, people mostly only vote on proposals that are directly relevant to them - but they are also given power to vote in other domains if they choose (albeit with less voting power if they have less expertise), and also in ecosystem-wide major proposals. The DeepFunding part of the SingularityNET ecosystem is in its first phase of trialing a reputation system.[45] This could be integrated with other parts of the ecosystem by expanding the reputation system uniformly, or as one domain in a linked domain-based structure.

Vote delegation/Liquid democracy

Liquid democracy allows governance tokens to be assigned to representatives who then vote on proposals. In theory this would allow people with insufficient expertise or time to understand and vote on proposals to transfer their voting power to those who do. Uniswap, Compound, and ENS (Ethereum Naming Services) use delegated voting, but the effects in each case are very different. On Uniswap, for example, delegation behavior is highly varied; some delegates are evenly voted for with few tokens by many token holders while others are given a large volume of tokens by one or two walletholders.[46] By contrast, the voting is very even on ENS, with many walletholders delegating a small amount of tokens to delegates. The study shows that in some cases, individuals were sending tokens to themselves through another wallet, illustrating one of

[41] *ibid.*
[42] Weyl, E.G., Ohlhaver, P. and Buterin, V., 2022. Decentralized Society: Finding Web3's Soul. *Available at SSRN 4105763*.
[43] Binance Academy. 2022. What are Soulbound Tokens? https://academy.binance.com/en/articles/what-are-soulbound-tokens-sbt
[44] Weyl et al., 2022.
[45] DeepFunding website. n.d. https://deepfunding.ai/
[46] Fritsch, R., Müller, M. and Wattenhofer, R., 2022. Analyzing Voting Power in Decentralized Governance: Who controls DAOs?. *arXiv preprint arXiv:2204.01176*.

the challenges associated with this mode of voting - continued susceptibility to individuals holding large quantities of tokens across multiple wallets.[47] This method also opens governance to lobbying by invested parties, or could encourage voters to vote once and forget or keep delegating to the same person out of convenience.[48] The examples of Uniswap and Compound show that in reality, those organizations are highly centralized, with power concentrated in the hands of a few large-scale token holders.[49]

Voting is usually part of a multi-step process that involves synchronous and asynchronous discussion before the proposal is made live and the votes are cast. The governance processes of many DAOs often pass through a three-phase process: first, responses to the proposal are relatively informally gauged in the community through chats and forum discussions; then an off-chain voting process can be done through Snapshot; then the final on-chain vote takes place (or some variation on this, with some differences in tools). The final vote is often just a ratification of what is already known about the community's orientation towards a topic.[50]

Challenges in DAO governance

There are evidently significant challenges in maintaining a functioning DAO. In 2021, an in-depth study of the DAO landscape found that 84% of DAOs on Aragon were showing no activity and only 4% were showing high activity (defined as over 10 transactions over the course of the 14 months of observation).[51] On DAOstack and Moloch, the defunct percentage was at 59% and 65%, respectively.[52]

Although it is unclear why the percentage is so high on Aragon compared with the others, DAOstack and Moloch emerged later and facilitated a much smaller number of DAOs. (Interestingly, all the self-developed DAOs cited in Rikken et al.'s paper are still functioning, but only out of a total number of 8).[53] The high rate of attrition could be attributed to a combination of factors - failures within DAOs, but also projects having reached the end of their natural life and persisting in the DAOspace. Another explanation, however, could be that when DAO builders began to emerge, Aragon's position as the first and highest-traffic DAO builder would also make it the site of the most experimentation. The high number of defunct DAOs could be earlier versions, forks, and tests that were run on the Aragon operating system, as well as some that fulfilled their purpose and came to a natural end - or eventually failed.

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[47] *ibid.*
[48] DeepFunding blog. 2022. Round 1 - Voting Analysis Part 3. Next Steps. https://deepfunding.ai/blog/voting-analysis-part-3-next-steps/
[49] Fritsch et al., 2022.
[50] Stanford Law School. 2022. Dao Symposium: the nuts and bolts of voting. https://www.youtube.com/watch?v=YrJBBTFO1Bk&t=976s
[51] Rikken et al., 2021.
[52] *ibid.*
[53] *ibid.*

In addition to the challenges specific to the voting systems detailed in the previous sections, there are other problems that DAOs must contend with.

Security

Many of the so-called hacks (most notoriously The DAO hack, but also many others) are not true hacks, but in fact exploitations of the code as it was meant to run. In the case of The DAO, one of the members voted for a change in the code that could be exploited and then did so.[54] Flash loans as described above are also a potential problem. Owing to the merging of governance and infrastructure on blockchain protocols, there has been a merging of issues around security and economics (that is, where the rules of the economic system forms the security vulnerability) has also been called “seconomics”.[55] The types of vulnerabilities vary according to the kind of DAO infrastructure and voting methods; consequently is it beyond the scope of this paper to list them all. A recommendation would be to choose a method of governance and leadership, and then survey the literature and look to an expert to conduct a thorough risk and “seconomics” assessment.

Scalability

DAO growth is often associated with problems in scaling. Proposal numbers can easily grow beyond members’ available time and attention, resulting in low voter turnout. It can be accompanied by an increase in proposals beyond the technical expertise of some (if not most) voters, which they may not feel qualified to vote on and abstain, or worse, may vote on without understanding it.[56]

A variety of solutions are available to solve this problem. One is to split the DAO into gated domains where people are only voting on their areas of expertise, with funds controlled and awarded by people who are able to assess proposals accurately. This can be achieved with some of the decentralized leadership structures described in Section 2, such as the Metropolis model. The domain model could be combined with a wider decentralized structure where large directional decisions are given to the community at large, but mid-level decisions remain within domains where the people are most likely to have the expertise to vote on them. This way, community members would need to take part in only the decisions that are specifically relevant to them. However, in order to maintain full transparency, there would need to be an up-to-date communication system to keep members updated on all upcoming votes in all domains. The purpose of this method would be streamlining, not exclusion; people could temporarily be added - or have the power to add themselves - to a domain in order to vote if they wish.

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[54] Dhillon, V., Metcalf, D., Hooper, M. (2017). The DAO Hacked. In: *Blockchain Enabled Applications*. Apress, Berkeley, CA. https://doi.org/10.1007/978-1-4842-3081-7_6

[55] Massacci, F., Ngo, C. N., Nie, J., Venturi, D., & Williams, J. (2017). The seconomics (security-economics) vulnerabilities of decentralized autonomous organizations. In *Cambridge International Workshop on Security Protocols* (pp. 171-179). Springer, Cham.

[56] Lu, C. 2022. The Sustainability of Digital Governance: Can a Smart Contract Serve as a Social Contract?. http://dx.doi.org/10.2139/ssrn.4101298

Engagement

A connected challenge to the scaling problem is engagement. As the DAO grows, engagement can drop because of the increase in numbers of proposals but the same amount of attention and time belonging to voters, and limitations on expertise.[57][58][59] A survey by the Governance Learning Forum (2022) has revealed a lack of interest around governance and leadership among DAO participants, potentially leading to accidental oligarchies in which only the same motivated and active people are consistently making the decisions.[60]

Incentives for voting such as token-based rewards (or other non-monetary rewards) have been suggested, as well as rewards in reputation on reputation systems); however, these can lead to attempts to 'game' the system to receive such rewards.[61] Channeling field-specific decisions to the correct domains could partially address the engagement problem, or outsource the cognitive load to outside experts who can produce reports that would form the basis of decisions.[62]

Lack of flexibility

The inflexibility of smart contracts can make it hard to reverse decisions. Also rigid governance structure and potentially lengthy voting processes can make it difficult and time-consuming to respond to crisis situations. This leaves the organization vulnerable; for example, requiring consensus to fix a bug could leave a malicious agent enough time to exploit the vulnerability in the code in a potentially terminal way. There are no straightforward answers to this. However, slow and small iterative growth cycles could help.

Another flexibility issue exists in various features of the voting structure. The autonomous aspect of voting is attractive because the execution is extremely difficult to interfere with.[63] Once the parameters for voting are set, the code is executed upon voting; the votes are cast; the results are transparent; the funds are allocated. However, many voting systems (especially the DAO builder pre-sets) are predicated on a pass-fail system with nothing in between, which lacks the flexibility of negotiation and does not allow for multiple solutions.[64] This can be partially solved by introducing more nuance into the voting system - multiple ranked options, for example, or a gauge for level of interest, or a facility for commenting. Increasingly, voting does not necessarily have to happen on-chain with the emergence of systems such as Snapshot, which includes some of the aforementioned features. Even non-automated decentralized

[57] Sims, A., 2020. Blockchain and decentralised autonomous organisations (DAOs): the evolution of companies? New Zealand Universities Law Review 423-458.
[58] Chohan, U.W., 2017. The decentralized autonomous organization and governance issues. *Available at SSRN 3082055*.
[59] El Faqir et al. 2021.
[60] The Problems of DAO Governance: GLF22 Survey Results (2022). https://glf.digital/fa5a954c2cfd429ba60122cc3ac3189e
[61] DeepFunding blog. 2022.
[62] *ibid*.
[63] Sims, A., 2020.
[64] Rachmany,G. & Houwen, M. 2018. *So You've Got a DAO….: Management for the 21st Century.* DAO Leadership: Luxembourg.

decision-making could serve if there was enough transparency to provide the required level of trust. Decision-making tools have been designed to optimize decisions between multiple parties, such as the Swarm AI platform.[65]

Lack of coordination and clarity

The move from traditional management to automated governance structures can create ambiguity regarding roles, responsibilities, and accountabilities. It has been observed that taking away leadership structure does not necessarily mean that power structures do not form; they are simply ambiguous and opaque - the opposite of the transparency issue that DAOs intend to solve.[66] One level of ambiguity is created by the interaction between anonymous wallets and the transferability of votes through capital. This is made evident in the comparison of Compound and Uniswap described above: voting is controlled by a minority, but it is not clear who is controlling it; only that control is happening. Other forms of ambiguity are created by lack of clarity around responsibilities and accountabilities, and absence of good coordination that replaces the management structure. This is explored in greater detail in Section 2. A connected challenge is the onboarding process; new contributors can find it hard to know where and how to contribute or explore other projects.[67][68] Discord servers, a common means of access for new contributors, are sometimes inactive or poorly organized, with little help for new users. If the organization wishes people to join up freely without some kind of formal recruitment process, individuals looking to contribute should be clear on the DAO's vision, purpose and values; be able to understand the structure of the DAO; how to begin contributing; accountabilities; and compensation terms and processes - without needing to ask anyone. A clear DAO structure on the main site and transparent, easy-to-understand process information (as well as straightforward processes themselves) are essential for maintaining clarity; see for example the Index Coop Handbook.[69]

DAO governance is a tool

DAOs are seen as an answer to the power inequities and opacity of traditional organizations because voting, disbursements of funds, and transactions are all visible and not controlled by any single authority.[70] DAOs offer a wide range of tooling and infrastructure for on-chain governance. However, while there are many types of governance systems and even more in development, they do not necessarily guarantee success, democracy, or even decentralization. In other words, the DAO governance structure is not the decentralized system - it is a tool that can help to create a decentralized system. The next section will discuss the challenge of

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[65] Unanimous website. n.d. How does Swarm work? https://unanimous.ai/what-is-si/
[66] DeFi, NFT & Web3 Insights - The Defiant. 2022. Here's Why DAOs Fail; Former SushiSwap CTO Reflects on Decentralized Orgs. https://www.youtube.com/watch?v=jDZByvCEsWI
[67] CabinDAO. n.d. How to DAO 201: Onboarding as Wayfinding https://creators.mirror.xyz/ggSQQlTSGqJ2_U7HVNjm4f3s98on5EfUyR9rW_z3fw0
[68] Tr3butor DAO. 2022. 8 tips for seamless DAO onboarding. https://mirror.xyz/tr3butor.eth/omHDnKG-AURKKJ01gPOulFn7dE_MZf6mO4--O6dP8cQ
[69] Index Coop. n.d. Index Coop Community Handbook. https://docs.indexcoop.com/
[70] Calcaterra, C.J. and Kaal, W.A., 2021. *Decentralization*. de Gruyter.

creating true decentralization, which may or may not need blockchain tools depending on the nature of the organization and its goals.

Section 2: Decentralized Coordination

In order to transition to a decentralized organization, some organizational principles still apply. No matter who is responsible for making the decisions, critical organizational coordination processes must continue. These are often lost in DAOs owing to a dilution (or loss) of clear responsibilities and accountabilities. However, there is also a risk of trying to reinvent the wheel by creating a complicated decentralized organizational structure, which may simply reproduce a different form of centralization. Indeed, some DAO designs start to look like traditional organizations again once they break into self-governed groups or use representation systems such as councils or liquid democracies. In order for decentralization to be worth doing, the decentralized mechanism must function better than the original centralized management structure.

This section takes an organizational perspective, considering the principles and practice of coordination that still apply to DAOs, working in conjunction with technical governance mechanisms.

Ostrom's principles

Ostrom's principles of governing commons-based peer production[71] can form the basis of many decentralization processes; Rozas et al. have proposed its adoption for thinking through blockchain-based decentralization.[72]

1. Clearly defined community boundaries: to define who has rights and privileges within the community, for example, to use certain resources or to perform certain actions on them.
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. These rules should be intimately associated with the commons, rather than relying on a "one-size-fits-all" regulation.
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. Sanctions against members who violate the rules are aligned with the perceived severity of the infraction.

[71] Ostrom, E., 1990. *Governing the commons: The evolution of institutions for collective action*. Cambridge university press.
[72] Rozas, D., Tenorio-Fornés, A., Díaz-Molina, S. and Hassan, S., 2021. When Ostrom Meets Blockchain: exploring the potentials of blockchain for commons governance. *Sage Open*, *11*(1), p.21582440211002526.

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.

Some DAOs manifest some of these principles; however, often few of them are formalized or clearly defined in the organization's processes, or in some cases included at all. This partly originates in the confusion of coordination with governance. Various organizational functions are lost in DAO formation; monitoring can be slack and intermittent, for instance, or responsibilities vaguely defined.

Organizational development perspectives

Regardless of whether a formal model is used or some kind of bespoke solution is developed, some common principles apply. Rachmany and Houwen, in what is effectively a playbook for DAO leadership, propose that there are a number of key features that need to be present for a decentralized organization to work well: alignment (of values, vision, and outcomes - not necessarily reasons), honesty and transparency, communication, responsibility, and good decision-making.[73]

It can be helpful to think in terms of macro- and micro-level needs to make critical decisions about how the organization needs to be structured - including whether it needs to be a DAO at all, or another form of decentralized organization. DAOs are useful for some purposes (financial, transparency, avoiding regulation [for now]) but not for others.[74] DAOs often omit the inclusion of management structures which in traditional organizations work well because they fulfill specific organization and individual needs (e.g. responsibilities, accountabilities, clear process definition). There are known problems emerging in DAOs when some form of structure is not applied, often to do with decision making and responsibilities.[75]

Every core function that is fulfilled in a hierarchical organization needs to find expression in the new decentralized organization. These functions are not necessarily just contractual; traditional hierarchical organizations also satisfy key individual needs outside the terms of the legal contract.

Organizational (macro) needs can include:

- Meeting project goals and broader company vision
- Developing and growing the utility and value of the organization

[73] Rachmany, G. & Houwen, M. 2018.
[74] Rachmany, G. 2020a.
[75] *ibid.*; Messari, 2021. Mainnet 2021: Progressively Decentralized: Building Toward a DAO https://www.youtube.com/watch?v=_NA3NxTEZGM

- HR (legal, recruitment, salary/compensation, dispute resolution, etc)
- Project fund allocation
- Alignment between organization and individuals (vision and values)
- Clear processes
- Crisis response

Individual (micro) needs can include:

- Psychological needs - role and process clarity; community; psychological contract
- Career development needs - moving intra organizationally/between projects and inter-organizationally (e.g. references)
- Healthcare and legal
- Other support needs (e.g. special needs support): avoiding burnout or overwhelm, maintaining happiness and health.

Only fund allocation is automatically fulfilled by the DAO structure (and, as the previous section has argued, democracy and personal power can actually be limited rather than freed by the type of governance system in place). The other organizational functions require some degree of coordination through a layer (or multiple layers) of infrastructure. However, these are unevenly executed among DAOs, sometimes leading to ambiguities around decisions, direction, and power. Such consequences have the potential to gain in effect as the DAO systems become larger and more complex, for example if multiple subDAOs are generated without a strategy.

The challenge is to create a system that devolves power from the central hierarchy to individuals in the community, but where the effectiveness of projects is not hindered by the governance processes, a disproportionate increase in responsibilities or cognitive load, or critical absences in the project management processes. For example, if someone is disrupting a team beyond capacity to negotiate or resolve, it is inefficient for the whole community to vote for their removal. The granularity of such a level of decision making would be extremely cumbersome and inevitably impact voter engagement. Either the team or an individual within the team needs to have local power over such local concerns. Consequently, it is necessary to define which processes the community votes on and, equally importantly, who has responsibility for all the other processes.

Organizational culture

Organizational culture is the set of collective values of people within an organization.[76] So far, we could find no academic research on organizational culture in DAOs; however, it is an important consideration. The organizational culture is co-created by a variety of elements: the original vision and ethos of the organization (and how well it is communicated and reinforced); the process elements that govern responsibility, accountability, and support; and the individual

[76] Rosemann, M., vom Brocke, J.. 2015. The six core elements of business process management. InHandbook on Business Process Management 1. Springer, 105–122.

values and attitudes of the people - all of which contribute to “the way we do things around here”.[77] These are mutually reinforcing, co-created elements; there are no elements that unidirectionally exert power. There are, however, steps that can be taken at the beginning to ensure a strong culture within the environment: alignment of values; good communication channels; transparency and honesty are all critical ingredients. The organization also needs to be an environment in which people can feel safe to express opinions and disagree without fear of punishment (formal or social).[78] This means that support and communication need to be active, not passive, but as we have argued in the introduction to this section, many organizational functions can become passive in the decentralization process. The potential for the lack of a “shared mission” and “social fabric” is noted both by authors and those who have experienced the consequences themselves in a DAO.[7980]

In other words, peer support and positive organizational culture cannot be taken for granted - or their significance underestimated. It has been noted that in some cases, DAO participants use funding to put on events, which often have few returns and few mechanisms to hold organizers accountable for such returns, but are mainly done because they are enjoyable to do so.[81] This suggests that events have a powerful role in DAOs, perhaps making up for the lack of face-to-face social interaction in day-to-day work life. Possible answers to the psycho-social element could be to provide local community events and spaces, such as coworking events, hackathons, local hackerspaces, retreats and so on.[82] In terms of returns, it may be desirable to set up accountability mechanisms for the return on investment in a high-cost event that interfaces with customers and the global community - or perhaps simply acknowledge the psychosocial element as intrinsically valuable and have a designated social fund for all kinds of community-based activity.

Another concern is how the technological parameters of voting and other functional processes of DAOs can encode certain cultural values. For example, incentives that effectively amount to a zero-sum game among token holders will create their own kind of organizational cultures - potentially encouraging competition over collaboration, and incentivising exploitation and hacking over participation. Furthermore some incentives (for example those that directly confer wealth or power) are also arguably not very incentivising to increase participation more widely than directly benefits the token holder). To harness the power of voting technology, it has been suggested that reputation systems can turn the zero-sum game into a positive-sum game.[83]

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[77] Mukhopadhyay, B.R., and Mukhopadhyay, B.K. (2021). Organisational Culture is “The Way We do Things Around Here”, North East Colours, Editorial, 15th April
[78] Rachmany, G. & Hoewen, M. 2018.
[79] Rachmany, G. 2020b. The State of the DAO: Rise, Fall and Rise. Hackernoon. https://hackernoon.com/the-state-of-the-dao-rise-fall-and-rise-0l8837dk
[80] GenesisDAO. 2021. Kate and Livia’s exit notes on Genesis Alpha DAO. https://docs.google.com/document/d/1yL8SO6GoREm_Rfcx1ygcJdfnNOHKo25JEY-pbam_voM/
[81] Rachmany, G. 2020b.
[82] Rozas, D. and Huckle, S., 2021. Loosen control without losing control: Formalization and decentralization within commons-based peer production. Journal of the Association for Information Science and Technology, 72(2), pp.204-223.
[83] Kaal, W.A., 2021. A Decentralized Autonomous Organization (DAO) of DAOs. Available at SSRN 3799320.

Consequently the technological parameters can form a powerful component of the organizational culture (though not necessarily always in a positive way - see the next section for the example of Steemit.)

Models of decentralized coordination

There are many examples of decentralized organizational structures. Some are self-organizing and highly organic, while others reconfigure the structure of the organization to smaller internal hierarchies or domain structures (much like Ostrom's 8th principle of nested enterprises). Rozas and Huckle identify a spectrum of formalization, ranging from mechanistic to organic, where highly mechanistic organizations operate with defined rules and roles (and sometimes hierarchies), whereas highly organic organizations are more free-form.[84]

On-chain freeform systems are somewhat difficult to pinpoint precisely because they lack definable structures; where they exist, they seem to be used for relatively straightforward purposes. Bitcoin, for instance, is governed by the voting protocol, and developers can join, leave, and decide for themselves where they want to contribute, though there are still formal(ish) job roles such as core developers and non-development jobs such as marketing. But two characteristics make such a freeform environment work for Bitcoin. Firstly, Bitcoin has a relatively narrowly-defined purpose, which means that the organization does not have to juggle multiple functions and jurisdictions. Secondly (though connected to the first point), Bitcoin does not have to interface with customers because the customer base is also the user and contributor base of the organization. Another example is Steemit, a decentralized application for blogging, where content creators are rewarded in tokens for their contributions.[85] The system is flat, allowing token holders to vote for changes and accumulate tokens by participating on the platform. However, the purpose of the Steemit system is limited to one function - content rewards. It has also been criticized for being unequal and creating a plutocracy owing to making voting power transferable, and to bots that mine for voting power by contributing strategically, concentrating power in the hands of a few token holders.[8687]

More complex projects that use on-chain governance systems often use some kind of team or domain structure. Some organizations have formalized the working group developments process using domains or pods; these structures can be implemented on- or off-chain. They can be organized in different ways, such as by function: Synthetix, as part of their progressive decentralization process, has used several DAOs to handle different functions of the organization, such as treasury, protocol management, public goods and grants.[88] Other domains could be based on project category or even individual projects, or a mix of all the above.

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[84] Rozas & Huckle, 2021.
[85] Steem. n.d. https://steem.com/SteemWhitePaper.pdf
[86] Guidi, B., Michienzi, A., & Ricci, L.. (2020). Steem Blockchain: Mining the Inner Structure of the Graph. *IEEE Access*, *8*, 210251–210266. https://doi.org/10.1109/access.2020.3038550
[87] Davis. 2018. The Vote Selling Plutocracy on Steem. https://medium.com/@v7davisa/the-vote-selling-plutocracy-on-steem-how-it-contributes-to-the-disenfranchisement-of-low-stake-832a0ca5cf33
[88] Messari. 2021.

DXDAO, for instance, has ‘squads’ that cover different functions (such as marketing and communication) and projects (such as individual product development).[89] Ethereum Naming Services (ENS) has four working groups: Meta-Governance, ENS ecosystem (developing the protocol), Community, and Public Goods (ENS as public good and funding other public goods).[90]

Current working examples of formal domain based frameworks include Holacracy,[91] Metropolis[92] (formerly Orca Protocol) and Colony,[93] though each is differently applied. Holacracy is an adaptable off-chain organizational model, while Metropolis and Colony provide technological on-chain infrastructure for decentralized governance.

Metropolis Pods are permissioned working groups linked to a multi-sig wallet, which work with an NFT.[9495] Roles include pod members and a pod manager, which is an administrative role that does not control day-to-day operations but does control pod permissions. This can be omitted entirely, with the group taking responsibility for this function, or can be performed by a smart contract. Pods can act as members of other pods, with the same rights and permissions as pod members.

Colony is a DAO operating system provider that uses a domain-pegged reputation system to confer authority to take action, so reputation carries weight in that domain but not others.[96] Consequently, it is possible to separate coordination from voting. Colony also operates through “lazy consensus”, which means that votes only happen when there is a conflict; the domains continue to manage their own processes through the reputation system until there is a problem, which reduces voting (but also potentially reduces community participation).[97] Colony’s reputation system has also now been integrated with Snapshot off-chain voting.[98] dOrg uses a reputation system in governance, using coordinator roles that provide gateway services to onboard people, but then final say over hires is given to the community.[99]

Domain-based systems can be helpful in that they can overcome some of the scaling challenges described in Section 1 by assigning mid- to low-level decisions to the appropriate

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[89] Öberg, L., Almquist, H. 2022. The Use of Management Control in Decentralized Autonomous Organizations. Linköping University. https://www.diva-portal.org/smash/get/diva2:1690452/FULLTEXT01.pdf

[90] Ethereum Naming Services Documentation. n.d. https://docs.ens.domains/v/governance/governance-proposals/term-0/ep4-social-proposal-creation-of-foundational-working-groups-and-working-group-rules

[91] Robertson, B.J. 2015. *Holacracy: The revolutionary management system that abolishes hierarchy*. Penguin UK.

[92] Metropolis website. n.d. https://www.metropolis.space/

[93] Colony website. n.d. https://colony.io/

[94] Metropolis website. n.d.

[95] Metropolis documents. n.d. https://docs.metropolis.space/docs/pod-basics/pod-basics

[96] Colony blog. n.d. The Colony Reputation System. https://blog.colony.io/the-colony-reputation-system-5616293c3949/

[97] Griffing, J. 2022. Colony.io's "Lazy Consensus" https://mirror.xyz/jasongriffing.eth/gERdgYkZ1LfbEBGbHQ8tlprjjaGhX9VqaPuLDzETe1A

[98] Nelson. 2021. Defi Tool Snapshot Now Using Colony to Rebalance Voting. https://decrypt.co/85171/defi-tool-snapshot-using-colony-rebalance-power-dao-voting

[99] dOrg member handbook. n.d. https://docs.dorg.tech/

groups. However, there are a couple of challenges associated with this, too. One is that by creating gated systems, it opens the way to diminished transparency and centralisation, and it would be important to ensure that there was sufficient information flow from and clear responsibilities for each group. It has also been noted that communication between domains in DAOs is sometimes fragmented,[100] so a clear plan for communication between domains and interfacing with the broader community would be essential.

The Holacracy model is a non-blockchain-based means of self-organizing. It uses a nested structure where teams are organized into ‘circles’ and ‘roles’, and in which an individual can have multiple roles.[101] The system is constitution-based and consequently can be applied somewhat rigidly, with potential for overload of individuals who may end up having too many overlapping role responsibilities. However, it is inherently customisable, and there are tools in it that can be used independently of implementing the full Holacracy infrastructure - many of which are useful but not unique to Holacracy (such as keeping discussions about work content and process separate).[102] Its high level of formalization could make it adaptable for a DAO, as some of the DAO builders and tools are oriented towards a pod structure already. Indeed, LeapDAO has integrated a Colony reputation system with Holacracy.[103] Circles or teams manage their own multi-sig wallet with individual budgets (as with Metropolis), with work done through bounties.

The cooperative model can be another helpful way of thinking about decentralization because it provides an alternative perspective on governance and coordination, which in DAOs can be somewhat technically focused. They offer a “time-tested toolbox for creating robust shared ownership through legally defensible means: bylaws, operating agreements, and IP ownership, in addition to clearly defined rights, responsibilities, and lines of accountability”.[104] Furthermore, as non-profit organizations with (generally) clear ethos and vision, they also create strong, supportive organizational cultures,[105] which could be helpful to point the way towards developing strong value-based cultures in DAOs. Some online cooperatives exist, and some are even hybridized with DAOs. The Distributed Cooperative Organization (DisCO) is a cooperative framework that uses blockchain technologies but positions itself partly as a counterculture to DAOs, seeing itself as a removal from capitalist systems. Contributors are not volunteers but compensated, though the organizations themselves are non-profit, moving towards a

[100] Stanford Law School. 2022.
[101] Robertson, B.J. 2015; Schell, S. & Bischof, N. (2022) Change the way of working. Ways into self-organization with the use of Holacracy: An empirical investigation. European management review. 19 (1), 123–137.
[102] Nixon. 2017. Good Holacracy, Bad Holacracy. Maptio blog. https://blog.maptio.com/good-holacracy-bad-holacracy-678a0001fffb
[103] Bitnewbot. 2018. LeapDAO’s Friendly Frankenstein: DAO Meets Holacracy Edition. https://bitnewsbot.com/leapdaos-friendly-frankenstein-dao-meets-holacracy-edition/
[104] Robey, A. 2022. What Co-ops and DAOs can learn from each other. https://www.fwb.help/wip/what-co-ops-and-daos-can-learn-from-each-other
[105] Walden, J. 2019. Past, Present, Future: From Coops to Cryptonetworks. https://jessewalden.com/past-present-future-from-co-ops-to-cryptonetworks/

post-growth model.[106] The DisCO goal - by its manifesto - is the development of commons-based resources and actions.[107] As the DisCO movement is still quite small, projects are limited. One pilot project is Laneras,[108] which works with local communities to preserve knowledge of weaving practices in western Spain and pass on that knowledge to local inhabitants.

Similarly, it can also be useful to look to other off-chain decentralized organizations such as Drupal,[109] an open-source web development community, to see how decentralized systems can function organically without blockchain governance structures (to strip out conceptually any ambiguities created by governance). In Drupal, tasks are variable in their levels of formalization.[110] For example, high complexity, more technical tasks are more formalized with clear accountabilities and responsibilities, while social tasks (such as event-organizing) are taken on in a 'do-ocracy', in which people self-assign to tasks.[111][112]

A final example of decentralization, but one that is useful to consider for DAOs, is the Teal system (which is more like an orientation).[113] Laloux proposes that consciousness has moved through developmental stages over the course of human evolution, and assigns different colors to each stage. Teal represents what he perceives as a new paradigm, a stage that is characterized by: "taming the fears of the ego"; "inner rightness as compass"; "building on strengths"; "dealing gracefully with adversity"; "wisdom beyond rationality"; "striving for wholeness" (with self, nature, and others). People who belong to this new paradigm, he suggests, create new kinds of organizations. The author researched a number of firms that represent this new type of organization, and discerned three fundamental paradigmatic shifts: moving to self-management in structures and processes; striving for wholeness in general practices and in HR processes; and listening to evolutionary purpose (that is, to what the organization wants to become, not what to make it).[114]

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[106] Guerilla Media Colllective Wiki. n.d. https://wiki.guerrillamediacollective.org/Distributed_Cooperative_Organization_(DisCO)_Governance_Model_V_3.0#Open_Value_Cooperativism_and_Distributed_Cooperative_Organizations

[107] Troncoso, S. 2019. Last Night A Distributed Cooperative Organization Saved My Life: A brief introduction to DisCOs. https://hackernoon.com/last-night-a-distributed-cooperative-organization-saved-my-life-a-brief-introduction-to-discos-4u5cv2zmn

[108] DisCO website. n.d. https://disco.coop/labs/laneras/

[109] https://www.drupal.org

[110] Rozas & Huckle, 2021.

[111] ibid.

[112] Rozas, D. 2017. Self-organisation in Commons-Based Peer Production. University of Surrey. https://openresearch.surrey.ac.uk/view/pdfCoverPage?instCode=44SUR_INST&filePid=13140381440002346&download=true

[113] Laloux, F. 2014. Reinventing organizations. A guide to creating organizations inspired by the next stage of human consciousness. Nelson Parker, Millis.

[114] ibid.

In terms of Teal's application, Laloux suggests Holacracy as a pre-developed system for new organizations, but also provides guidelines for those who prefer to develop their own system. Guidance focuses on fostering the wholeness, self-management, and purpose that characterize the new organizational paradigm. Such practices include promoting the independence of community members to make decisions and resolve their own conflicts (by putting good practices in place - not abandoning them to their own devices). They include keeping a finger on the pulse on the purpose of the organization, where anyone can tune in to their sense of wholeness for the organization. They include creating conscious meeting practices and safe spaces for anyone to communicate, and deep, connected recruitment practices.[115] Thus, the Teal system is more an organic set of principles that are sometimes formalized in a more focused fashion, depending on the organization.

Design phases

The following phases express the order in which decisions need to be made in order to avoid accumulating problems at a later stage.

Organizational layer

- Identify the purpose of the DAO and future directions (overall vision and goals)
- Identify level of complexity needed in order to express the purpose
- Identify main needs of the organization
- Outline vital organizational functions
- Define (collectively) which decisions should be made by which parts of the community; permissions (if applicable)
- Define the starting structures and processes (including flexibility for future direction; accountability; responsibility; conflict resolution etc)
- Design communication channels
- Design reflective mechanisms

Technical implementation

- Decide on a deployment type (see Section 1)
- Choose a voting method that best articulates the organizational needs
- Define token functionalities
- Identify most appropriate blockchain(s) for purpose

Evaluation

- Set periodic milestones at which evaluations will be made by the community of whether the system is working or not, and how to grow and optimize.

[115] ibid.

Conclusion

Running decentralized organizations on blockchain technology using smart contracts can be a good way to overcome regulatory difficulties, unnecessary bureaucracy, and streamline certain kinds of decisions by providing more direct access to funds. However, organizations can run into problems owing to the limitations of smart contracts and the omission of crucial organizational functions such as clear responsibilities and mechanisms for accountability. This can lead to in-fighting, process and role ambiguity, inefficiency, and potentially derail the purpose of decentralizing. Therefore, two layers of decentralization need to be addressed in the design phase, with enough flexibility to change: the technical layer and the coordination layer. The overall design, and the type and level of decentralization, need to be guided by the goals of the organization. Some designs are suitable for some purposes but not others, and their effectiveness is heavily influenced by complexity, culture, and attention to processes.

Future research

This report has only scratched the surface of some of the topics around decentralization and DAOs. More research would be useful to investigate different aspects of successful DAOs, for example governance, community, recruitment and onboarding. In-depth qualitative or mixed-methods research would be useful to discover the experiences of people who work in decentralized systems, both as contributors and as part of governance processes. This would give a better understanding of common problems, successes, and solutions in coordinating DAOs and DOs. Some research on DAOs from an organizational development perspective would also be helpful to more fully understand the functions and processes that need to be migrated into DAO form.

Recommendations for SingularityNET

As we have suggested throughout this paper, the design and development of DAOs vary according to function. The most straightforward systems are suitable for simpler, single purpose organizations, while organizations that are, or expect to be of greater complexity may need more elaborate systems to fulfill their needs. SingularityNET, as a relatively complex ecosystem already, requires planning on both technical governance and organizational levels to unify and develop towards an increasing level of decentralization. It has the advantage of already having a lot of practical infrastructure, but also the added complexity of multiple actors working in the community with different priorities.

One way of beginning the progressive decentralization process is to separate the practical infrastructure from the central funding system and split the parent organization into different functions, shrinking their dominance in the ecosystem. So for example, SNET treasury could become the community treasury, allocated by member voting through a governance mechanism, while the practical infrastructure becomes a pod with its own multi-sig wallet, and the open SNET projects also devolve into pods.

The main recommendations of this paper are:

1. Move through the decision phases described in the previous section.
2. Consult with experts to benefit from their experience. More research can be conducted particularly with DAO creators who work within complex ecosystems, or non blockchain-based decentralized organizations to better understand their dynamics. Outside experts who offer consulting on organizational change are helpful for ensuring the smooth transition to a DAO.
3. Design how people should be able to contribute: permissioned domain system, freeform self-assignment, or hybrid. Design a coherent, transparent, and clear onboarding and process. A ‘buddy system’ for new contributors could be considered. The communication system should have an overarching logic and coherence that spans the whole range of community activity.
4. Focus strongly on community building and consistent integration of all subunits of the ecosystem. The above can become part of a community/social/culture unit: partially or wholly responsible for process clarity, up to date information about the ecosystem and clarity of relationships within ecosystem; growing the ecosystem, recruiting, but also useful for maintaining social cohesion through events, chats and so on. Eventually this could extend to geographically located groups if the ecosystem becomes large enough and help the community cohesion through local hackerspaces, events, retreats, and so on. They can also keep their finger on the pulse of the community; whether people are happy, offer a career guidance service, keep communications open between teams, keep an eye on onboarding systems and so on. This could be shared between a practical HR unit and a social unit, or it could be kept separate, but the interests of the individual should be advocated for as well as protecting and cultivating the organization as a whole. The community is the heart of the organization, so understanding what is happening in the community will be paramount.
5. Start decentralization on a small scale, governing a smaller subset of the entire organization and focus on topics that are straightforward and easy to understand, and only expand step by step as processes have proven themselves.
6. Ensure that you are not walking into a dead-end street from which you cannot escape. So until your organization and processes are sufficiently matured, try to avoid rules baked in smart contracts that can not/hardly be changed; far-reaching decisions based on large-scale votes that will make any tweaks and changes afterwards very hard; layers of stakeholders with established rights and perks and revenues that resist change; being completely dependent on centralized tooling that offers little control. In other words, at this early stage, design for flexibility and adaptability.

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