Decentralized Autonomous Organizations: State and Perspectives

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Abstract—The concept of Decentralized Autonomous Organizations has gained significant attention in recent years due to their potential to transform the way we organize and govern ourselves. This paper presents a thorough review of DAOs, including their history, membership structures, voting mechanisms, and various applications. We also delve into the legal implications of DAOs, exploring the current legal landscape, regulatory frameworks, and legal challenges they face. Furthermore, we conduct an analysis of current trends and offer our perspective on the primary obstacles that hinder widespread adoption. In conclusion, DAOs hold enormous potential to impact society, but further research and development are necessary before their potential can be fully realized.

Keywords - DAO, blockchain, governance, token

I. INTRODUCTION

Decentralized Autonomous Organizations (DAO) are a new form of organizational structure that has emerged with the rise of blockchain technology. They distribute the decision-making power among members rather than concentrate it within a central authority [1]. As DAOs are becoming more prevalent in the blockchain space, there is a need to understand their governance structures and assess their effectiveness in promoting new forms of collaboration and value creation.

This paper seeks to investigate the current state of DAO technology, as well as discuss its main challenges and possible future uses in different fields. Our goal is to contribute to a better understanding of this emerging technology and take part in further research and innovation in this area.

II. DAO CONCEPTS AND TECHNOLOGY

A. DAO – Definition

DAO, or decentralized autonomous organization, is a digital organization that exists on a decentralized blockchain network [2]. It leverages the power of smart contracts and tokens for governance while all decisions are taken by a consensus of all members [3]. The goal of the DAO technology is to eliminate middlemen and create democratic, transparent, and efficient ways of organizing [4]. However, DAO technology is still in its early stages of development, and many legal, technical, and social challenges need to be resolved before the technology reaches its full potential.

B. Historical Background

The concept of DAO can be traced back to the development of blockchain technologies and the creation of Bitcoin in 2008 [5]. The idea of a self-governing organization that operates without a centralized authority gained popularity in the Ethereum community in 2015 when smart contracts were implemented, enabling the creation of self-executing code for automating organizational functions [6]. The first DAO, also known as "THE DAO", was started in 2016 and raised over $150,000,000 in community funds before it was hacked, resulting in a big crisis in the Ethereum community [7]. The crisis was later solved with a hard fork of the network [8]. Nevertheless, the initial failure of "THE DAO" didn't stop the technology from growing and developing, with new use cases appearing in many different industries.

C. Technical Aspect

DAO is built on top of a decentralized blockchain network, usually Ethereum, but also on other smart blockchains such as Algorand, Avalanche, and Binance Smart Chain. They use smart contracts to self-execute pieces of code that enforce the rules and guidelines of the organization. These smart contracts are implemented into the blockchain, making them transparent, immutable, and resistant to any censorship or tampering [9]. DAO usually uses a system based on tokens, in which members of the organization hold tokens that represent their ownership and the right to vote. These tokens are also stored on the blockchain and can be freely traded and exchanged. Governance in DAO is commonly managed through decentralized decision-making, where members can suggest, vote and enforce activities or changes in the organization [10]. Some of the technical challenges which DAO is facing include scalability, interoperability, and security [11].

D. Membership

A DAO can have any rule set and type of membership, but in this paper, we will mention the two most common ones.

1) Token-Based membership

In this type of membership, members hold tokens or digital assets representing their part of the ownership in the organization [12]. These tokens are often issued during the initial launch of the DAO. They can be bought, sold, or traded on decentralized exchanges without limitations. This allows anyone to become a member, and no central authority can forbid anyone from taking part in the DAO.

2) Share-Based membership

As opposed to Token-Based membership, Shared-Based membership is more permissioned and is usually used for human-centric organizations such as charities. In this type of membership, a prospective member is required to submit a proposal to join the DAO; depending on the organization, they might need to offer value in terms of assets or services [13].

E. Voting Mechanisms

DAO voting is usually done on the blockchain where the DAO is deployed. Members participate in the voting by interacting with the smart contract through a web interface or a decentralized application [14][15]. Nowadays, this process is simplified by companies such as "Aragon.org" which offers user-friendly interfaces for DAO voting [16]. Depending on the DAO rules, members may be required to spend or "burn" tokens for each vote, or they only may be required to hold a specified amount of tokens to have a vote.

1) Token-Weighted voting

In this case, DAO members hold voting power which is proportional to the number of tokens they hold [17]. This means that members with more tokens have a greater say in decision-making. While this way of voting is the simplest and most transparent, it has flaws. It could lead to centralization of power, as members could pool together 51% of the tokens and influence decision-making. In addition, minor stakeholders may encounter challenges in having their viewpoints adequately reflected or considered.

2) Quadratic voting

This mechanism allows members to vote on a decision multiple times, but every additional vote increases its cost quadratically [18]. The main purpose of this system is to ensure that voters who do not have a significant interest in the issue cannot overpower a smaller group of voters who hold a strong and passionate stance on the subject [19]. Nefarious actors may avoid this obstacle by spreading their tokens onto different accounts and voting. Verification of the identity of every member would decrease this risk, but it could create issues with the onboarding of new members.

3) Conviction voting

Conviction voting is a mechanism based on the continuous expression of the aggregated preference of the community [20][21]. In this case, the weight of the vote increases in correlation with the time it remains unchanged. Members are allowed to change their opinion, but doing so sacrifices the previously accumulated weight of the vote. While this mechanism prevents individuals with large stakes from overpowering minorities and reduces centralization, it is susceptible to "last-minute attacks," in which a group of members swings the outcome to their favor by changing the vote just before the voting is closed.

III. EXAMPLES OF USAGE

A. Current Projects

Uniswap is a decentralized protocol that enables users to trade tokens on the Ethereum blockchain [22]. It was launched in November 2018 and has since become the most popular trading protocol on the network. Its popularity can be attributed to its ease of use and utility. This protocol does not require users to go through Know-Your-Customer (KYC) verification, and it does not have a centralized authority that charges fees for the trades. Instead, it applies a 0.3% fee from each trade which is allocated to the members who are providing the liquidity necessary to execute trades. Uniswap DAO is a decentralized autonomous or-

ganization that governs the protocol with the help of its native token, UNI. The DAO is responsible for managing the development of the protocol, as well as making decisions related to its governance, such as changes to the protocol fees, allocation of funds from the treasury, and the addition of new tokens. These decisions are made through a system of on-chain voting and token staking. The Uniswap DAO is a textbook example of a very successful and innovative community-driven project.

Its native token, UNI, is used for voting on governance proposals, which means that anyone holding it is a part-owner of this protocol and has a voice in its future development [23][24].

Decentraland is a decentralized virtual reality platform running on the Ethereum blockchain [25]. Its users can create, participate in, and monetize the application's content and activities. The entirety of this virtual world is split into blockchain-based parcels, which users can claim ownership of. Landowners have the power to control what content is published on their portion of the land. The users entirely control this project through its DAO [26]. Holders of MANA, NAMES, or LAND tokens can participate in the DAO, which is responsible for managing the development of the platform, as well as making decisions such as:

- Size of marketplace fees
- Policy Updates
- Future LAND auctions
- Allocation of funds from the treasury

The voting takes place on Decentraland DAO's governance interface, which is hosted on their website at: https://governance.decentraland.org/ [27].

AAVE is an Ethereum-based decentralized non-custodial liquidity protocol in which users can participate as depositors or borrowers [28]. Depositors provide liquidity to the market to earn a passive income through interest, while the borrowers are borrowing assets without any need for traditional financial intermediaries. All AAVE operations are handled through the use of smart contracts which are transparent and immutable. Since its creation, the protocol was controlled by its DAO. Anyone holding its native token AAVE can discuss, propose and vote on upgrades to the protocol.

B. Possible Uses

While DAOs have already been used in various applications, such as crowdfunding and investment management, their potential applications are far-reaching and continue to be explored.

1) Gaming

One potential use of DAO technology is in the gaming industry. DAOs can provide a way of crowdfunding and developing community-run gaming projects. Investors can contribute funds, and in exchange, they will receive tokens that represent their ownership of the project. These tokens can be freely traded to other interested investors. Every token holder could be involved in the project, by voting on and submitting ideas for game features as well as providing feedback on the progress.

2) Real Estate

Another potential use of DAO technology could be in the Real Estate market. Investors could pool together and purchase expensive properties, while investors would own only a fraction of each. This could make real estate investments more accessible to a wide range of potential investors. Each share would be presented as a token on the blockchain, and each token holder would have a vote and the possibility to suggest what should be done with the property. Whether the property should be rented out, renovated, or sold, is democratically decided by the group.

3) Local Community Governance

The usage of DAO does not need to be strictly connected to investing, it may also be used as a tool for making democratic decisions. A community, such as a neighborhood, for example, can group up and create their DAO. Together, they can set the criteria and price for becoming a member, as well as rules for the voting procedures. A smart contract is then written with all of this in mind. Each member who is eligible, and donates a pre-set amount to the DAO, can be awarded a token that allows them to submit proposals and vote through a smart contract. If a proposal wins a majority of the votes, then funds from the treasury can be allocated for its realization. This can lead to more transparency, accountability, and fairness in a local community.

4) Healthcare

The health sector is massively benefitting from the rapid development of technologies such as Artificial Intelligence, the Internet of Things, big data, and such. Despite these advancements, access to health services, pricing, and interaction with medical professionals have remained mostly unchanged. DAOs could offer a new way of governance in the sector, which would allow for more transparency, and community participation and avoid spending resources on unnecessary expenses such as executive bonuses, as they will no longer be required.

IV. LEGALITY

A. Regulatory Challenges

DAO represents a unique regulatory challenge because they are not traditional legal entities and work autonomous-

ly through self-executed code. This can create trouble for regulators, especially in cases of possible illegal activity. The nature of decentralization in a DAO makes it harder to identify perpetrators of such activities, as decision-making is distributed between all members [29]. Furthermore, a lack of clear legal frameworks can instigate fear in participants of a DAO, especially when it comes to their legal rights and obligations. Potential new participants may be hesitant to engage with this technology due to the same reason. The fact that DAOs can operate in any jurisdiction around the world digitally, presents a huge challenge for the regulators. To tackle these concerns, it will be necessary for regulators to establish a fresh legal structure that is specifically designed to accommodate the unique properties of DAO. The frameworks should provide clarity on the legal standing of a DAO and the legal responsibilities of its participants. To achieve a viable solution, regulators, legal professionals, and DAO developers must work together and establish a regulatory structure that is fair and transparent for all parties.

Each of the present-day DAOs needs to have a legal structure or a so-called “DAO Legal Wrapper” to attract investments from a venture fund, sign agreements with contractors, or list tokens on a centralized exchange [30]. Different DAOs are incorporated as different entities based on their type or business model. Some are incorporated as foundations, some as associations while some are non-profit or for-profit LLCs. So far, only a small number of countries allow the incorporation of DAO, all with different conditions and regulations. Some of the countries which do are: Switzerland, Wyoming (USA), Panama, Liechtenstein, etc.

Wyoming is one of the few states in the USA which recognizes DAOs as legal entities. DAO LLC's business structure protects DAO members from unlimited liability for DAO’s actions and it allows the DAO to interact with the “real world” in a manner compliant with the law. Wyoming law allows the LLC to be managed algorithmically through a smart contract, but it has to be previously indicated in the articles of the organization. Under the applicable law, the underlying smart contract must be able to be updated, modified, or upgraded. To keep its status, DAO LLC needs to approve at least one proposal in one year, otherwise, it will be dissolved[30][31]. This requirement may create issues for projects which do not often vote on decisions. While Wyoming allows for the creation of for-profit DAOs, it is generally advised to avoid token-based voting systems as freely traded tokens may be deemed a security by the U.S. Securities and Exchange Commission.

As opposed to Wyoming, Switzerland does not have special regulations for DAO, but its existing legal frameworks offer a good environment for the creation of one. Under their law, a DAO with a predefined purpose and rules may be formed as a Swiss Foundation [32][33]. If the DAO takes any activities which do not match its pre-defined purpose, relevant regulatory authorities may interfere. This solution is ideal for long-term projects such as protocol development or charity projects, as the creation of for-profit DAOs is not allowed.

B. Taxation Issues

The nature of most DAOs allows anyone with an internet connection to participate. People from different countries and different jurisdictions can all be part of the same organization. This fact creates issues, as each country and jurisdiction can have a different understanding of DAO and tax their respective citizens differently.

Most of the current DAOs are unregistered and do not have a certain legal status in their respective countries. With a lack of exact laws, legal experts often try to fit DAOs into a mold of traditional organizations, which may end up hurting their members. Depending on the country a member resides in, they may even be in breach of local laws.

In the case of the USA, DAO members are taxed on a pass-through basis, which means that the DAO itself is not subject to federal income tax, instead, all of the income, gains, losses, and deductions are passed through to its members who then report their share on their tax reports [34][35].

If a DAO token is classified as a security by the SEC, it becomes subject to the same tax treatment as other securities, such as stocks and bonds. This means that any gains or losses from the sale or exchange of tokens would be subject to capital gains tax.

V. TRENDS AND MAIN CHALLENGES

Decentralized autonomous organizations (DAO) have appeared as a new way of managing decentralized systems and communities through blockchain technology. In the past years, the concept of DAO gained great attention due to the emergence of Decentralized Finance (DeFi) applications. The rise of DeFi was the main driver of the development and adoption of DAO, as it provides a new solution necessary for the management of these decentralized applications (dApps). Not only that, but DAO allows for safer and more transparent management of assets and properties, minimizing the need for intermediaries and increasing the control of participants. Currently, most of the biggest DAO projects are directly tied to DeFi. Recent trends in DAO technology also include the development of new protocols and standards to help with the interoperability and collaboration between different blockchains and DAOs. In addition, there's been a trend in creating more pleasant user experiences through the development of easy-to-use graphical interfaces and governance tools.

Some of the main challenges which DAO is facing are:

Legality. As was mentioned previously in the text, the lack of worldwide legal recognition presents a challenge

for the technology, and it may impact future adoption if it isn't solved.

Technical Complexity. To run a DAO, users require a high level of technical expertise, which raises the entry barrier for adoption by the wider masses.

Voting Issues. DAO relies on effective governance and voting to ensure that all decisions are made democratically. However, these mechanisms are also vulnerable to manipulation or corruption, which can undermine the legitimacy of the Organization. Common problems include voter apathy, the sale of votes, and 51% attacks.

Security. DAOs are vulnerable to issues such as hacking, fraud, or insider attacks. Organizations need to prepare and implement effective risk management strategies to mitigate risk and protect assets.

User Acquisition. To be successful, DAOs need to attract a mass of users who are willing to invest or participate in the organization. This would require a significant marketing and outreach effort, as well as a value proposition that incentivizes users to join and be active in the DAO.

VI. CONCLUSION

The emergence of Decentralized Autonomous Organizations (DAO) has uncovered a potential to bring groundbreaking innovation in the realm of blockchain technology and organizational structures. This technology offers a new solution for decentralized decision-making, trustless governance, and community-driven management of resources. The combination of these properties allows the revolution of the way organizations are structured and managed, by eliminating intermediaries, reducing costs, and increasing transparency and accountability.

Analysis of different current and future usages of DAO in this paper highlights the potential benefits and challenges which the technology is facing. On the positive side, DAOs can enable more democratic and transparent decision-making, while increasing efficiency in resource allocation. On the negative side, they face various legal, technical, social, and security vulnerabilities, which slow down their expansion. Finding solutions to these challenges is essential for further development.

As technology continues to mature, its impact on the economy and society can become increasingly important. Further research is necessary to explore the potential of DAO in different contexts and to design appropriate mechanisms needed for their efficient implementation and governance.

Overall, the potential applications of DAOs are vast and varied, and their full potential is yet to be realized. As research and development in this field continue to evolve, DAOs will likely become increasingly prevalent and transformative in various domains.

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