

The Advent Of Ownerless Businesses: Decentralised Autonomous Organisations

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Abstract: The introduction of blockchain and distributed ledger technologies have brought about numerous innovations, disrupting industries and societies. One of the most impactful among these innovations is the advent of the Decentralised Autonomous Organisations or DAOs. DAOs are a complex structure both legally and technologically whereby the company is in effect turned into code. Centralised governance structures monopolise power, leading to inequitable distribution of resources in the hands of the elite. This new form of organisation would have an effect on government as well as business structures, leading up to a fairer, equitable and collaborative society. This paper analyses the origins, implementation and uses of DAOs to highlight the potential impact it will have on economies and societies.

Index Terms: Autonomous, Blockchain, DAOs, Decentralised, DLT, DApps, Smart Contracts

1. INTRODUCTION

The turn of the millennium saw the formation of various internet companies which resembled less to the traditional businesses, shifting much of their operations online instead of the physical world. In another decade, some of these internet companies had survived bubbles, slowdowns and come out to monopolise economies. The web 3.0 revolution, that started with the advent of blockchain is all about democratizing data and giving the users back the control of their own data. Another innovation in this paradigm shift is that of Decentralised Autonomous Organisations or DAOs which will lead to a new form of open, non-hierarchical and ownerless business structure. To understand DAOs, we must first clearly define blockchain, the technology which enables their implementation. Blockchain is an incorruptible digital ledger of economic transactions that can be programmed to record not just financial transactions but virtually everything of value [19]. It has the properties of transparency, immutability and decentralisation. While initially known as the technology behind the cryptocurrency Bitcoin, blockchain has applications far beyond finance. One of the most important of these is in cases involving self-sovereign stores of data and identity. These properties make DAOs the solution to the problems being faced by stringent, centralised organisations with corrupt infrastructures.

1.1 Smart Contracts

A smart contract is the simplest form of decentralized automation. Smart contracts are self-executing programs deployed on a blockchain that can perform certain tasks like transfer of digital assets whenever a predefined set of conditions are met. They can also be understood to be a mechanism that collects and redistributes assets among a finite number of parties according to logic or formula, without the involvement of a third party. The condition for a mechanism to be a smart contract includes that the participants on the receiving end, ie, customers can be unbounded but the producers (people who hope to seek profit) should be bounded.

The smart contract is embedded in the blockchain making it transparent, immutable, inexpensive and decentralized. A smart contract gives a coder the power to create state transition functions, implementing a logic, covering a wide range of applications in a few lines of code. The implementation of a smart contract may differ according to the DLT for which it is written. A contract in the sense of Ethereum is a collection of code (its functions) and data (its state), written in the Solidity language, that resides at a specific address on the Ethereum blockchain.

1.2 Decentralised Applications or DApps

DApps or decentralised applications are applications run on top of a blockchain or some other distributed ledger technology with the help of one or more smart contracts without a third party. The major difference between a smart contract and a DApp a DApp has an unbounded number of participants on both sides [3]. The ethereum white paper divides DAapps into three types: apps that manage money(eg: derivatives, wills, saving wallets, etc) semi-financial apps (apps where money is involved but also requires another piece), and apps in the "other" category, which includes voting and governance system [5]. The blockchains capable of executing code in the form of smart contracts have made the implementation of DAOs possible.

1.3 DAOs

DAOs are algorithmic powered smart contracts that can execute decisions based on information provided without hierarchical management. A DAO involves a set of humans interacting with each other according to a protocol specified in code and enforced on the blockchain wherein the decisions are taken autonomously by the DAO but relies on individuals for tasks that automation cannot do. A DAO is a virtual organisation that has a certain set of members or shareholders which with a majority defined by some rules have the right to spend the entity's funds and modify its rules. The members would collectively decide on how the organization should allocate its funds, there will be no explicit hierarchy although weights of votes can be varied depending on reputation or stake. Governance in the blockchain economy may depart radically from established notions of governance. This paper aims to bring forth the potential impact DAOs can have by analysing its origins, implementation details and current applications. Section 1 covers the initial mention of the concept in literature and the earliest applications. Section 2 looks at implementation details for DAOs. Section 3 covers the

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potential applications that are being explored in different fields. Section 4 concludes the analysis by highlighting the potential impact this technology can create, inferred from the research and the future scope for research.

2 HISTORY OF DAOS

2.1 Bitcoin

Bitcoin is a trustless system for electronic transactions based on a peer-to-peer network and proof-of-work [13]. The earliest cryptocurrency which gave rise to blockchain technology is in a way the first implementation of a DAO. Bitcoin is a shareholder-owned, employee-run, not-for-profit crypto corporation [10]. The goals of the shareholders of this corporation are to secure the network and maintain a sequence of transactions. The proposals are primarily the order in which the blocks should be mined, on which they reach a consensus. The DAO analogy for Bitcoin also extends to the incentives for people (miners) to work to maintain it and to market it so that its value increases. The analogy departs, however, when we think about another important aspect of DAOs, that is to change the structure of the organisation itself. Hence Bitcoin is not a true DAO but the first implementation of DAO like concepts, giving rise to this new innovation.

2.2 Bitshares

The first mention of Decentralised Autonomous Companies was by Daniel Larimer, the founder of Bitshares in 2013 in a series of articles. In these articles, he defined DACs as being companies run by an incorruptible set of business rules implemented by publicly auditable open-source software, run by stakeholders in their computers [10]. He explained that the goal of DACs is to maximize value and minimize costs. This is where DACs differ slightly with DAOs, in that DAOs are essentially non-profit. There can be cases when DAOs have a pool of capital, the value of which increases bringing profits for the stakeholders, in which case it can become a DAC. A DAC is hence a subclass of DAOs and can be used interchangeably in a lot of cases. These concepts were implemented in Bitshares which was the first decentralized autonomous community that lets its core token holder decide on its future direction and products [15]. The consensus for this platform is Delegated Proof of Stake or DPoS, which essentially is a consensus mechanism for ensuring representation of transactions within a blockchain. The protocol has the BTS token which serves as a utility token and is also used for governance of the platform itself by its holders, which includes making decisions for its functioning as well as future changes to it.

2.3 Dash

Dash is an incentivized peer-to-peer network for a fast and secure digital currency, expanding on the concept of digital cash. Among the earliest DAOs, the Dash DAO is governed by stakeholders called Masternodes who have invested 1,000 Dash. Apart from the coin's functions, Masternodes also vote to fund proposals with Dash's treasury. Anyone can submit a proposal to the Masternodes for an anti-spam fee of 5 Dash, and the proposal may be funded if it gets enough Masternode votes.

2.4 The DAO

One of the earliest implementations of the DAO concept on

the Ethereum blockchain, The DAO captured the imagination of a large number of people, gaining popularity but quickly going down the infamous path after The DAO hack. It now remains a case study on what not to do when implementing DAOs.

The DAO was a venture capital fund for the crypto and decentralized space, meant to reduce costs and provide more control and access to the investors. An open system where anyone could submit an idea and the members could vote on whether or not to provide them with investment from The DAO fund. On May 16, a hacker found a loophole in the code called the "recursive call bug" which allowed the hacker to repeatedly take out funds from The DAO. He succeeded in taking out 3.6M ether and draining into a "child DAO". Fortunately, the funds in the "child DAO" were under a 28 day lockdown period, during which Ethereum hard-forked to send the funds back to the original owners [16]. The DAO hack is a reminder that immutable smart contracts that are given unprecedented power over funds and decisions, should be error-free and secure. Security auditing should be one of the first tenets of developers before releasing the code.

2.5 Aragon, DAOstack, Colony

The most recent developments in the DAO space have been for networks and platforms that help build DAOs with them. They provide the infrastructure for DAOs which includes tools, frameworks and APIs so that DAO builders do not need to start from scratch. The Aragon Network helps build global, sovereign companies and communities with its Aragon Core, a Solidity DAO frame-work and web-based decentralized app (dApp). It provides a modular way to build DAOs, specifying as little and as much as the creators want to specify. It has its built in concepts of Identity, Permissions, Reputation, Capital and Rewards [7]. It has some principles of a basic DAO and one can build a DAO agreeing with these principles and define the parameters of the above mentioned concepts. DAOstack is an operating system for collective intelligence and DAOs. They believe that the missing element in successfully implementing DAOs is a solid framework for decentralized blockchain governance, and in particular scalable and resilient governance protocols that can support the processing of large number of crowd decisions effectively [2]. To implement this vision, they have a modular and adaptive framework called Arc. It is not limited to a specific set of governance systems, and it makes it easy for third parties to create their own elements per their needs. Colony is a platform for building open organisations in the form of 'colonies'. It is like a social operating system for tracking people's contribution in decentralized networks. It wants to create distributed organisations with true "meritocracy" which it defines as rewarding workers based only on the quality of their contribution to the cause. It also has inbuilt mechanisms of handling tasks, reputations and tokens. All colonies can issue their own tokens to rewards member contributions. To ensure liquidity, all colony tokens can exchange with ETH or CLNY (Colony Network Tokens). Members get tokens for contributions, that represents ownership & influence in a colony. As a compensation for contributing, members get tokens and reputation. Reputation is built over time by demonstrating skills, it reduces of contribution reduces.

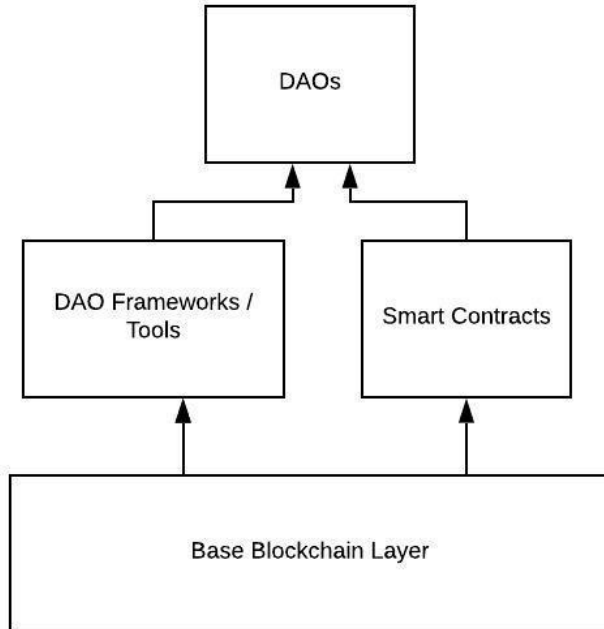
3 IMPLEMENTATION DETAILS FOR DAOS

In a DAO, the mechanical, mundane tasks are automated as the governance rules are specified in the code and automatically executed through smart contracts. Decisions requiring expertise and knowledge depend on the combined knowledge of the token holders and are taken through voting mechanisms. A high level architecture of a DAO is depicted in Fig 1.

The basic steps to implement a DAO are as follows:

- The first step is for a group of people to come up with an idea they want to implement through a DAO and write the code for it through smart contracts on top of a blockchain platform.
- The next step is to obtain funds for the running of the DAO by making public the idea through a whitepaper to attract investors who would be given tokens representing ownership in exchange for their investment (ICOs).
- People who are now part of the DAO (the coders as well as the token holders) can now make proposals on how to spend the fund of the DAO by voting on such proposals.

What a consensus protocol is for blockchain nodes, a voting protocol is for DAO participants [8]. Thus to implement DAOs, the models adopted for the voting mechanisms assume much importance. The simplest design is simply a piece of self-modifying code that changes if two-thirds of members agree on a change.



3.1 Simple Voting

The traditional one-person-one-vote voting scheme where the result is decided based off on a majority is Simple Voting. This is harder to implement in a public blockchain which works on the concept of pseudonymity. Without having an identity layer this voting would be vulnerable to a Sybil Attack where one node can create multiple identities, undermining the fairness of the system.

3.2 Reputation-based Voting

Reputation-based systems try to prevent or limit the problems associated with Simple Voting like vote-buying. To maintain a semblance of hierarchy such as those of legacy organisation, DAOs may have reputation based voting. Based on skills or contribution to the network, a reputation score is calculated which grants one the right to vote for proposed changes in the organisation structure. Similar to having a board of directors, this method ensures that there is an incentive to stay active in the network, perform and stay honest to maintain the reputation score and enjoy voting privileges. Reputation-based governance attempts to align long-term incentives.

3.3 Quadratic Voting

Another way to implement collective decision making, especially in the case of DAOs is Quadratic Voting. It allows people to strongly vote for a proposal most important to them by taking on additional votes. These additional votes can be bought at the cost of the square of the votes. One vote would be bought for \$1 while the 3rd vote will be bought for \$9. This exponential increase would deter voting through "sockpuppets". According to Weyl [9], this mechanism will save decision making from majoritarian views which care little for the minorities even if they passionately care about the cause. The issue with Quadratic Voting, however, like most forms of voting is that for large-scale issues, since the ability of a person to affect output is small, he is unlikely to reflect deeply about his beliefs. To solve this, there is a concept of Sortition Partition proposed by V. Buterin [20]. This mechanism randomly selects a small group of participants instead of polling everyone, ensuring the impact of everyone's vote is substantial, ensuring the votes are as per actual beliefs.

3.4 Security Considerations

While implementing a DAO based solution, security considerations must be of high priority. As seen in The DAO attack, there is no possibility of a code correction even after detecting a bug, the only possible solution which was implemented in that case was that of a hard fork. Another important reason for security a failure of a security property for DAOs may lead to the collapse of the entire economic functionality because such security attack could be combined with an economic attack [12]. Apart from the security vulnerabilities in the various voting mechanisms as mentioned before, there is always a possibility of bugs in the code or loopholes in governance rules. Hence, every DAO must have some way to rectify code that is not as extreme as the hardfork of the blockchain on which it is based. An example of this is the Aragon Network, which apart from being a platform for building your own DAO, is governed like a DAO itself. It has the provision to make changes to the network through Aragon Governance Proposals (AGP-1) [1] and even to the AGP-1 itself.

4 POTENTIAL APPLICATIONS FOR DAOS

By reinventing how organisations govern themselves, DAOs will find applications across industries and fields. Apart from replacing legacy systems, they will find novel applications in fields that require collaboration, trust and transparency. A broad analysis of some of the novel applications is given below.

4.1 DAOs for Social Good

Social service organisations such as NGOs and charities are usually run by a trust which collects funds and distributes them to the designated cause. In a bid to add transparency and efficiency to such organisations, there have been a number of online platforms that offer more credibility but charge a large amount of commission to enable them. A DAO for Social Causes, with a fund, would be able to transparently make decisions on spending people's money by making proposals and ensuring their say is taken into consideration.

4.2 DAOs for Remote Collaboration

DAOs will help create collaborative, borderless organisations which are censorship-resistant. By enabling self-regulation of the division of labour, decision making, and financial management, DAOs can bring about a paradigm shift in remote collaboration to achieve common goals. Without the need for trust and formal structures, DAO based companies can have members from across the world, working on tasks that are relevant to their skill sets, getting fair compensation for them. Use cases involving collaboration like open source development, remote work in the gig economy or even research in the scientific community can be successfully implemented through DAO based models. Rather than centralised ownership and hierarchical management, smart contracts distribute ownership according to the value each individual contributes, and influence emerges from the bottom up through systematic peer review of contributed work.

4.1 DAOs for Furthering Blockchain Projects

Blockchain applications and projects are fundamentally community based. Most of them are funded through Initial Coin Offerings or ICOs or STOs wherein people give the projects money in exchange of tokens. In simplified terms, the value of these tokens is in turn determined by the value the network adds as a whole, thus giving the token holders incentive to be constructive for the project. DAO based applications have more complex incentivisation structures in place and hence can help the blockchain projects grow by supplementing governance, financing or even marketing. For governance we can look at the above mentioned Aragon Network example. For marketing, there is an interesting new DAO on the Ethereum Network called the Marketing DAO with the goal of providing a unified marketing organisation to communicate the strengths, value propositions and vision of Ethereum [11].

5 POTENTIAL IMPACT

Wealthy societies around the world are facing a growing crisis of confidence in established authorities [6]. Economic slowdown, corruption, monopolisation of power in the hands of the elite as well as growing inequality have made people realise the need for a change in the way we govern our societies. The solution to these political and economic problems may just be a new kind of technological form of governance, be it of a country or a small business. Analysing the features and applications of DAOs, we can form an idea of the potential impact they would have.

5.1 Impact on Economy

The concept of "Radical Markets" as proposed by Glen Weyl aims to break up concentrated centralized authority in favour of a more free, open and cooperative world. According to him,

a truer, radical free market would create greater competition and equality by greater use of auctions and commonly owned property [14]. By ensuring that the value contributed to the network would be compensated along with the overall value of the network increasing, there are increased incentives to work for such organisations, promoting and rewarding loyalty and honest behaviour.

5.2 Fairer Systems of Organisation

Apart from economic equality, DAOs could potentially improve another major problem in organisations, unconscious bias based on race, gender or age. Diverse organisations have been proven to produce better results [17]. When mid-level functions like task assignment and compensation would be automated or moved to a distributed mechanism, the inherent unconscious bias in upper management would be drastically reduced, leading to fairer systems of organisations.

5.3 Fairer Systems of Organisation

With DAOs, smart contracts on the blockchain have an autonomous existence which means they can own and control capital. Another important aspect is that along with capital, they can now own, control and sell data, the most valuable asset of this age. By incorporating real-time data from data marketplaces into DAOs, we could potentially create powerful revenue-generating DAOs. Streamr [18] for instance, has created a data platform as a backbone for DApps or DAOs to provide a secure, robust stream of data. With data being owned by decentralised organisations instead of the current technology monopolies, it could lead to a paradigm shift to a fairer economy.

6 CONCLUSION

In this paper, we have endeavoured to give a comprehensive overview of DAOs in terms of their history, implementation, applications and potential impact. Although effective as an idea, DAOs have a long way to go in terms of being successful implemented in the real world, solving complex socio-economic problems. It is one of the hard problems for the cryptocurrency and blockchain space after 2019 as pointed out by V. Buterin [4]. The true impact of the revolutionary technology behind DAOs will only become apparent as more applications and realises and legacy systems get replaced in favour of these democratic structures. Before DAOs achieve their true potential, blockchain technology would have to achieve scalability and cryptocurrencies would have to reach mass adoption. When the world truly shifts the web 3.0 paradigm, DAOs will help create new forms of market and economies.

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