

# An overview of decentralized autonomous organizations on the blockchain

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## ABSTRACT

Blockchain technology has emerged as a new paradigm to build decentralized systems which do not require a central authority. It is most popular for enabling Bitcoin and other crypto-currencies. However, blockchain applications span beyond Finance, and recently it has been applied to decentralized governance. Blockchain-enabled "Decentralized Autonomous Organizations" (DAOs) have emerged as a new form of collective governance, in which communities may organize themselves relying on decentralized infrastructure. In this article, we introduce the concept of DAO and review the main software platforms that offer DAO creation as a service, which simplifies the use of DAOs to non-blockchain experts; namely: Aragon, DAOstack, DAOhaus and Colony. These platforms will be compared by showing their key features. Finally, we will review the available visualisation tools for DAOs, and we will introduce our open-source tool to plot DAOs activity, DAO-Analyzer. We will illustrate its potential with the case of the DAO *Genesis Alpha*, which is the main DAO of the DAOstack project.

## CCS CONCEPTS

• **Human-centered computing** → **Empirical studies in collaborative and social computing**; **Collaborative and social computing design and evaluation methods**.

## KEYWORDS

Blockchain, DAO, open collaboration, online communities, governance, visualization

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## 1 INTRODUCTION

Blockchain technology has emerged as a new paradigm to build decentralized systems which do not require a central authority. It has attracted international attention as the technology behind cryptocurrencies such as *Bitcoin*. However, its capabilities extend beyond cryptocurrencies and other financial applications. Blockchain enables existing applications to acquire new features, and new distributed applications to emerge [40].

The potentials of blockchain for governance are already being studied in the literature. Relevant features include distributed tokenization, self-enforcement through smart contracts, decentralization of server-less infrastructure, autonomous automation, transparent processes, or codification of trust [32].

The potential of blockchain governance is expressed especially through the so called Decentralized Autonomous Organizations (DAOs). In plain terms, DAOs are organizations where the interaction of members (humans or machines) is mediated by a blockchain application, which is controlled by a set of rules embedded in its source code. DAOs are said to be able to autonomously hire people, provide services, gain money for their own aims, own smart property, coordinate with other autonomous software, or facilitate cooperation, to name a few [9, 45]. As an emerging paradigm, these promises have attracted both idealistic defenders [30, 37] and those warning of its dangers [1, 10].

Nevertheless, this is a new field that emerged very recently, and thus still in active development and open for broader research. Thus, it is still early to assess if it will fulfill its decentralization promise. In this paper, we aim to provide some insights on recent DAO development and use from the main DAO platforms: *Aragon*, *DAOstack*, *DAOhaus* and *Colony*. Furthermore, we present a tool, currently under development, to visualize the activity of DAOs, and will illustrate its use with the case of *Genesis Alpha*.

## 2 BLOCKCHAIN: THE FIELD IN A NUTSHELL

Blockchain is a distributed ledger, which can be thought as a distributed append-only database with a synchronization mechanism. Like the Internet, the public blockchain has an open infrastructure, and it is not owned or controlled by one central authority. Generally, the ledger is copied in each of the network nodes, and thus can be viewed by all its users [40, 46].

The ledger is a sequence of blocks (hence block-chain) that contains a set of transactions already performed<sup>1</sup>. Each block points to the previous block in the ledger, forming a chain. Thus, when a user wants to add a new transaction to the ledger, the transaction data is verified (by the so called miners). If there is consensus of the new block validity, it is added to the chain in a decentralized process [14, 46]. This way to validate the transactions grants the blockchain immutability of its past records: nobody can delete and alter the data of the block placed [17].

The first implementation of the blockchain technology was *Bitcoin*, which is a "crypto-currency", i.e. decentralized digital currency validated through cryptography [28]. After that, thousands of new cryptocurrencies have emerged with their own features [18].

A second wave of blockchain applications started with the advent of *Ethereum* in 2013 [44], which provides a distributed computing platform and a programming language, *Solidity* [8]. *Solidity* addressed several limitations of the *Bitcoin*'s scripting language, like the lack of Turing-completeness [41]. This has enabled multiple types of decentralised applications (Dapps) and the so called "smart contracts", computational agreements between parties which may be self-executed and self-enforced.

Those Dapps have been applied in wide-ranging fields [3, 27]. These include financial applications such as general banking services [6], or cryptocurrency payment [4]. Other fields, like IoT, are using blockchain as a common communication layer [5]. The use of Dapps for community governance enables the object of this paper: Decentralized Autonomous Organizations, or simply DAOs.

### 3 DECENTRALIZED AUTONOMOUS ORGANIZATION

The use of blockchain as an infrastructure for governance has confronted two points of view [32]. The ones who have a high degree of techno-determinism, who embed the idea of "market" in the made decisions or the way that an organisation has to operate, however, they tend to ignore the complexity of social organisations [37]. In the other side, the critical ones defend the role of traditional central authorities. They consider central authorities necessary to enable democratic governance [1]. These views usually advocate regulating blockchain markets in order to reinforce the role of the state [32]. Moreover, governance under blockchain is challenging *per se*, since it is difficult to steer a decentralized community and promote its development without sacrificing decentralisation. The tool that has emerged to enable organizations to operate in the blockchain are DAOs.

There is not a consensus on how to define a DAO. However a comprehensive definition is that "a DAO is an internet-native entity with no central management which is regulated by a set of automatically enforceable rules on a public blockchain, and whose goal is to take a life of its own and incentives people to achieve a shared common mission".<sup>2</sup>

<sup>1</sup>In cryptocurrencies, each block holds transactions, i.e. movements of cryptocurrency between accounts. In other more general applications such as Ethereum-based apps (and DAOs), blocks contain operations, akin to typical instructions in a computer program, that need to be executed.

<sup>2</sup>Definition by Luis Cuende, co-founder of the Aragon DAO platform, in: <https://twitter.com/licuende/status/1263511552709267456>

Other definition states that: "A Decentralized Autonomous Organization (DAO) is an organization whose essential operations are automated agreeing to rules and principles assigned in code without human involvement. A DAO is a novel scalable, self-organizing coordination on the blockchain, controlled by smart contracts" [35].

In short, a DAO can be defined as people with common goals that join under a blockchain infrastructure that enforces a set of shared rules. Typically, the members of a DAO are registered, each with a unique address. They also have an amount of 'governance' tokens linked to that address, which are usually required for participation, and may take a role in the DAO decision-making system. It is also common that DAOs manage resources, e.g. cryptocurrencies. DAO members may decide how to allocate them through a decision system.

DAO activity is recorded in the blockchain and, as a result, implies a cost. Validating and confirming transactions on the Ethereum blockchain requires a certain amount of work, called *gas* (paid in crypto-currency). This work is performed by blockchain miners in order to include transactions in a block. Gas ultimately translates into money and the amount of gas depends on the size and type of each transaction. As a result, it is expected that DAO activity is conditioned by this, since users are required to pay small amounts of cryptocurrency if they want their operation to be executed.

We can consider two kinds of DAOs, those built from scratch, and those created from a template provided by a DAO platform, i.e. DAOs as a service. In the first type, the members are usually developers who have specialized knowledge to create and manage them. Both types are described below.

#### 3.1 DAOs built from scratch

The first remarkable DAO was *The DAO*, launched in April 2016 by a group of programmers. It was the most successful investment crowdfunding at that time. *The DAO* was a sort of hedge fund, in which contributors could directly vote proposed projects. Investors would exchange Ether for tokens during an Initial Coin Offering (ICO). Then investors would vote new projects with their votes or tokens. In June 2016, due to an error in *The DAO* code, an attacker robbed a large part of its funds [39]. However, due to *The DAO* representing the largest project in Ethereum at that time, the *Ethereum Foundation* decided to take action. After several days of discussions, the foundation finally decided to move forward with a hard fork<sup>3</sup>, and returned the stolen funds to *The DAO* investors. However, the concept of immutability of the ledger past records was damaged due to the fork [26].

Despite that traumatic event, the endeavor of creating decentralized organizations to operate in the blockchain persists, but tempered with the knowledge that any DAO operates under the logic of smart contracts, and due to the nature of the code, it is subject of security holes and risks.

Furthermore, creating a DAO from scratch requires highly specialized knowledge about blockchain programming. As a result, this kind of DAOs usually support blockchain-based businesses or/and blockchain programming projects.

<sup>3</sup>A "hard fork" means the blockchain is copied in a new version with some difference (e.g. different rules or some blocks removed). This provokes a divergence in the two paths forward the blockchain can take. Typically, only one is considered the "valid" path.

An example of DAO on decentralized finance (DeFi) is *MakerDAO*,<sup>4</sup> which began in 2015 and was released in December 2017 [23]. *MakerDAO* aims to “bring financial stability and transparency to the world economy”. This community governs the *Maker Protocol* (one of the largest Dapps on Ethereum), which defines the use of the *Dai* token, a stable cryptocurrency that avoids financial risk when *Ethereum*’s cryptocurrency value fluctuates.

Other DAOs are focused on investment, such as *The LAO* that provides a legal structure to enable members to invest in blockchain-based projects in exchange for tokenized stock or utility tokens. *The LAO* is expected to limit the liability of its member in a manner that conforms with U.S. law [21].

### 3.2 DAOs enabled by a platform

Several platforms have emerged in recent times to facilitate the deployment of DAOs in the blockchain by significantly reducing the technological knowledge required. They provide DAO infrastructure *as a service*. These platforms allow users with scarce knowledge on how blockchain works to create a DAO using a template that typically can be customized. The main platforms are *Aragon*, *DAOstack*, *DAOhaus* and *Colony* [20].

**3.2.1 Aragon.** *Aragon*<sup>5</sup> is by far the largest DAO platform. *Aragon*’s approach is to extend the use of DAOs as a free and open-source technology to allow the creation and management of decentralised organizations [38]. *Aragon* provides a static template to make your own DAO, but it also allows you to create a customized one. Customization is enabled through “apps” (sets of smart contracts) which can be installed or removed from DAOs. The function of apps widely vary: a vault in which to store DAO’s funds, or decision-making systems, including an app which introduces the *DAOstack*’s decision system [33], discussed below, in *Aragon* DAOs. In addition, those apps can be used to create a template which enables the creation of DAOs with a more specific purpose. For example, the *Committee* template [7] sets a special token which is used by a small group of members to take decisions, like accepting new members. All this is sustained by the *aragonSDK*,<sup>6</sup> which provides a wide-ranging number of tools to allow developers to make their own apps.

The other key feature that *Aragon* introduces are *permissions*,<sup>7</sup> which is an access control system intended to safely connect apps and entities (users or other apps) together. Initially, the DAO creator has the permissions to manage it, but usually, the creator transfers those permissions to the voting app, so the DAO is managed through voting. This enables more democratic decentralised governance.

**3.2.2 DAOstack.** Unlike *Aragon*, the *DAOstack* platform<sup>8</sup> does not offer many customizations. For example, they currently provide a single decision-making system for all their DAOs. This voting system, called *Holographic Consensus*, aims to solve the problems of scaling a DAO [12]. They argue that increasing the scale of a DAO (in terms of either members or decisions) makes it susceptible to attacks, or to require many users to make it work. In *Holographic Consensus* [13], the quorum required to approve a proposal can

be reduced from absolute majority to relative majority if some conditions are met. The most significant condition concerns to the predictors or stakers, who are not necessarily members from any DAO. Those predictors can stake a special token<sup>9</sup> to predict the result of a proposal. If stakers are right, they are rewarded, while if they fail, they lose their stake. Regarding the proposal, if the staked amount reaches a specific limit, then the quorum of that proposal will be reduced to a relative majority. As a result, stakers help DAOs to highlight meaningful proposals and make profit if their service is useful. In practice, this behaviour mimics a prediction market [43].

**3.2.3 DAOhaus.** *DAOhaus*<sup>10</sup> is a fork of *Moloch DAO*’s smart contracts [16]. Thus in order to better understand *DAOhaus*, we will first introduce *Moloch*. *Moloch*, named as an ancient God of sacrifice, allegedly seeks to promote an infrastructure where the collective benefit is always greater than the individualised benefit of any particular entity [36]. *Moloch* DAOs have a voting system that tries to minimize attacks and abuses. For each new decision, the proposer has to pay a tribute in tokens, and some amount of influence, which any *Moloch*’s member has. When the decision is finally taken, if any participant does not agree with the result, they will be able to make *rage quitting*, exiting with their portion of resources. *Moloch* simplifies the voting system as no minimum quorum is needed to approve proposals. They just count cast votes, and if there are more than 50% up-votes, the proposal passes. *Moloch* DAOs include the original *Moloch DAO*<sup>11</sup> that coordinates resources for issuing development grants for Ethereum, or *Metacartel*, which is a DAO that runs a grant program to incentivize and support early-stage Dapp teams.

In August 2019, *DAOhaus* was created as an interface to allow anyone to deploy a *Moloch*-like DAO by setting a few parameters like the name, currency, tribute size, etc. These DAOs follow the same *Moloch* architecture, such as the *rage quitting* explained above.

**3.2.4 Colony.** *Colony*<sup>12</sup> has been the latest DAO platform to enable the creation of DAOs, or “colonies”, as they named them. *Colony*’s DAOs are shared by people with common goals, and resources to accomplish them, but these DAOs can be split into domains or even sub-domains with more specific purposes [31]. Those purposes are translated into tasks that DAO members can accomplish to gain more influence. For example, a web company could split its organisation into a ‘front-end’ domain, or a ‘back-end’ domain, and finally, assign tasks to those domains. On the other hand, DAO members have a reputation token and the only way to gain more is by performing tasks<sup>13</sup>. Unlike *Aragon* or *DAOstack*, which are vote-driven due to the use of voting systems to allocate resources, *Colony* has a meritocratic system [24] because the only way to increase the member’s influence is working for the organisation (i.e. work-driven).

<sup>4</sup><https://makerdao.com/en/>

<sup>5</sup><https://aragon.org/>

<sup>6</sup><https://aragon.org/blog/introducing-aragonsdk>

<sup>7</sup><https://help.aragon.org/article/21-permissions>

<sup>8</sup><https://alchemy.daostack.io/>

<sup>9</sup>GEN is the *DAOstack* token used to stake [42]

<sup>10</sup><https://daohaus.club/>

<sup>11</sup><https://www.molochdao.com>

<sup>12</sup><https://colony.io/>

<sup>13</sup>Performing tasks can also be exchanged by non-reputational tokens like Ethereum’s cryptocurrency, ether

As discussed in [20], *Colony* tackles the problem of scalability. First, by splitting DAOs into domains which are potentially independent, and can work without interactions across them, in a stigmergic manner, as it happens in other online communities, e.g. FLOSS teams [15]. Second, by avoiding to vote, all decisions are approved by default unless someone has an objection, in which case it is discussed and solved with voting.

Table 1 shows a summary of all DAO platforms with their main key features, release date in the Ethereum mainnet, and the number of DAOs<sup>14</sup> at the date of June 5th of 2020. *Aragon* is by far the biggest platform with 1459 DAOs, followed by *DAOhaus* with 118 and *DAOstack* with 22 DAOs, while in the case of *Colony*, which has been released very recently, we found no information on its current number of DAOs.

	Release	DAOs	Key features
Aragon	Oct. 2018	1459	* Modularity * Permissions
DAOstack	Apr. 2019	22	* Holographic consensus improving scalability.
DAOhaus	Aug. 2019	127	* Rage quitting * Simple decision system
Colony	Feb. 2020	-	* Work driven (meritocracy) * DAOs split into domains.

**Table 1: Summary table of the DAO platforms**

#### 4 VISUALIZATION TOOLS FOR DAOS

Online communities can be analyzed with the help of visualization tools that represent their main stats. For example, wikis have several tools to see at a glance how they are, *Wikimedia Statistics*<sup>15</sup> shows the evolution of *Wikipedia* and the rest of Wikimedia Foundation projects, but there are others, like *WikiChron*,<sup>16</sup> which provides an in-depth analysis on Mediawiki wikis, such as those from *Fandom* [11, 34].

When it comes to DAOs, there are not many tools. First we can mention *My-DAO-Dashboard*,<sup>17</sup> a tool to help you manage the DAOs you belong to. The tool supports *Moloch DAO*, *Aragon's DAO*, and some DAOs of *DAOstack*. Given an Ethereum address, it shows transactions, token balances, and view proposals of the DAOs associated.

In the case of *Aragon*, it has *Apiary*,<sup>18</sup> a web page that shows basic stats for each organization and each app. *Aragon* also has *Aragon Connect*,<sup>19</sup> which is an API to fetch data and has a bunch of features. However, those APIs does not provide so far information about users. There are also tools that provide a global view of the Aragon ecosystem. *Scout*<sup>20</sup> is a proprietary tool developed to

support the data analytic needs for Aragon team. *Scout* provides a set of plots for *Aragon* to display the number of active DAOs, the number of DAOs created by template, the amount of Ether, and other cryptocurrencies, in the Aragon DAOs.

By contrast, *DAOstack* has *Alchemy*,<sup>21</sup> a dashboard that provides comprehensive information about a DAO in terms of members, funds and proposals. *DAOstack* also provides an open API to retrieve detailed information from their DAOs.

More interestingly, *Deep DAO*<sup>22</sup> is another proprietary tool recently launched that aims to display analytics for membership, proposals, and financial data to all DAO platforms. So far they provide a table to compare DAOs across platforms and different plots to show metrics evolution and tables with the state of the DAO.

Finally, we are also developing an open-source tool to guide our research on how DAOs operate and evolve over time. This tool is intended to allow us to better understand cooperation in DAOs and it is presented below.

#### 5 DAO-ANALYZER

Our tool is called *DAO-Analyzer*<sup>23</sup> and so far provides a dashboard to visualize the evolution of *DAOstack* communities. We focused on *DAOstack* due to the quality of its open API,<sup>24</sup> which provides information about DAOs, users, proposals, and decision-making events, including votes and stakes. An overview of the *DAOstack* architecture is given in the appendix A.

In *DAO-Analyzer*, it is possible to select a specific DAO from *DAOstack*, or the view that aggregates all of them to show the stats of the entire *DAOstack* platform. The purpose is to show the activity evolution, providing time series plots for token holders (users), votes, stakes, and proposals. Those last three (vote, stake, proposal creation) are the main actions performed in *DAOstack*; thus, we use them to define activity in *DAOstack*. The definition of activity is highly dependent on the purpose of the open collaboration community. For example, edits are usually considered in wiki communities [19] or commits in open source development [25].

Table 2 summarizes the stats available so far in *DAO-Analyzer*. Every DAO member has a reputation amount, so we have denoted them as *reputation holders*, and we count how many of them are new or active (performs at least one of the main actions) each month. The *vote* and *stake* stats count how many votes, voters, stakes and stakers are there in a community over time. Finally, the *proposals* stats show time series the number of new proposals and its outcome (approved or rejected). Additionally, we show a breakdown of the proposals by their outcome, and the quorum they reached (absolute or relative majority). Stats like 'proposal outcome by prediction' confront the proposal result (the result of the voting by the DAO's members) against the result predicted for the proposal by the stakers. Finally, we include a success rate statistic to see how accurate *predictions* from stakers were and hence, how useful is staking for each community.

<sup>14</sup>Aragon data retrieved from <https://apiary.1hive.org/orgs>, DAOhaus data retrieved from <https://daohaus.club/stats> and DAOstack retrieved from <https://alchemy.daostack.io/>

<sup>15</sup><https://stats.wikimedia.org/#/all-projects>

<sup>16</sup><http://wikichron.science/>

<sup>17</sup><https://devpost.com/software/my-dao-dashboard>

<sup>18</sup><https://apiary.1hive.org/orgs>

<sup>19</sup><https://aragon.org/connect>

<sup>20</sup><https://scout.cool/aragon/mainnet>

<sup>21</sup><https://alchemy.daostack.io/>

<sup>22</sup><http://deepdao.world>

<sup>23</sup>The tool can be found at <http://dao-analyzer.science/> and the source code is released under the GPLv3 license in this GitHub repository: <https://github.com/Grasia/dao-analyzer>

<sup>24</sup><https://thegraph.com/explorer/subgraph/daostack/master>



Figure 1: Caption of DAO-Analyzer displaying aggregated statistics for all *DAOstack* DAOs

Figure 1 shows a caption of our tool that displays some plots on votes, stakes, and proposals. The plots show monthly time series that aggregate the counts across all *DAOstack* DAOs. June 2020 has a dark blue because it was the current month on the date this article was written. During the months that *DAOstack* has been

running it shows constant activity. There is no significant increase, probably because the number of DAOs barely changes. It is worth to mention that until very recently, it was not possible to directly create a *DAOstack* DAO, and it was required to ask for it to its administrators.

Stats	
Rep. holders	* New reputation holders * Active reputation holders
Votes	* Total votes option * Different voters
Stakes	* Total stakes * Different stakers
Proposals	* New proposals * Proposal outcome * Proposal outcome by prediction * Success rate * Success rate by type

Table 2: Available stats in *DAO-Analyzer*

### 5.1 The case of Genesis Alpha

In this section, we are going to show the evolution of a DAO with our tool. Data was collected on April 22th 2020, an overview of the process followed is provided in Appendix A.

We will consider *Genesis Alpha* or *Genesis DAO*, which is the *DAOstack* DAO.<sup>25</sup> The name is a reference to *Genesis Protocol*, an implementation of the holographic consensus. *Genesis* mission is to promote the use of DAOs through *DAOstack* and to boost the use of the *GEN* token as a specific tool for decentralised governance. The interested reader can find more details about *Genesis* objectives and principles described in [2].

In order to extend and to achieve their purposes, they state that *Genesis Alpha* receives monthly funding of 40k USD dollars (in cryptocurrencies) from *DAOstack* [2]. Due to that, they can use those assets to fund *Genesis DAO* proposals which improve or/and extends the use of *DAOstack* as a DAO platform. Due to a vulnerability in its code, it was hacked, and approximately 15k USD were drained from *Genesis DAO* on the 6th of February 2019. This delayed its launch until the vulnerability was fixed [22]. The final launch of *Genesis Alpha* was in April 2019, when our analysis starts.

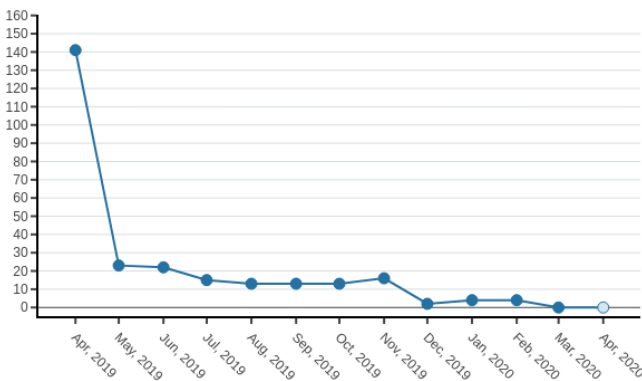


Figure 2: Genesis Alpha new members time series

*Genesis Alpha* has 266 registered users. Figure 2 shows how users joined to *Genesis Alpha* over time, 141 of them joined in the

<sup>25</sup><https://alchemy.daostack.io/dao/0x294f999356ed03347c7a23bcbcf8d33fa41dc830>

first month. However, the DAO still registered a regular number of newcomers in subsequent months (a mean around 15). Since December 2019, this number has significantly decreased, even no new members registered in the last two months.

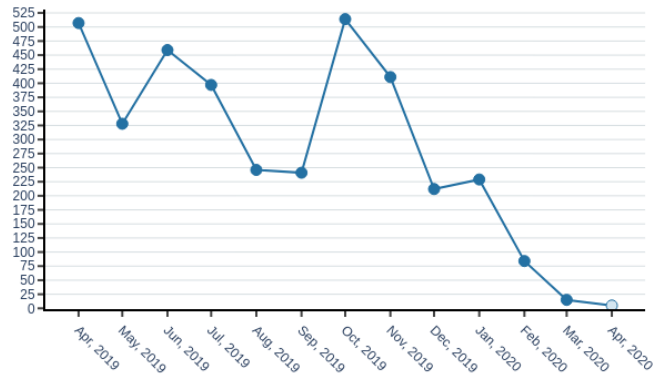


Figure 3: Genesis Alpha activity (new proposals + votes + stakes) time series

Regarding the activity, Figure 3 represents its evolution, adding the number of new proposals, votes, and stakes in each month. *Genesis Alpha* has recorded a total of 3648 actions; it is important to remark that it represents the 53% of the whole *DAOstack* activity. Thus, we can state that *Genesis DAO* is the most active DAO in *DAOstack*. *Genesis DAO* registered a peak of activity in October 2019, and since then, its activity has been continuously decreasing.

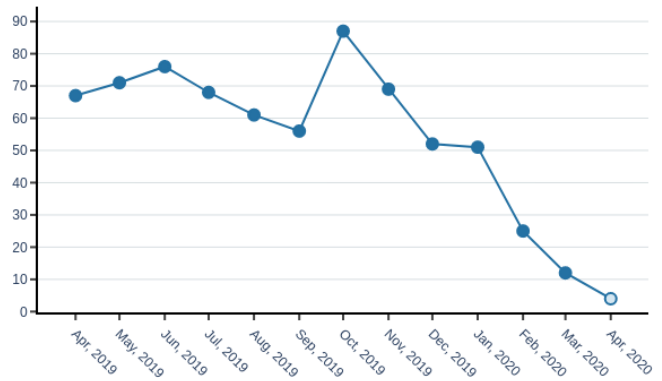


Figure 4: Genesis Alpha active members time series

Figure 4 shows the number of different users who performed at least one action over time. It has a mean of 53 active users, but again since October 2019, which is its peak of active members, that number has decreased.

All in all, indicators show that *Genesis Alpha* is the most active DAO in *DAOstack*. However, from November 2019, *Genesis* has abruptly started a downfall on activity, having its peak just a month before. The sudden change is explained in [29], where it is said that *DAOstack* cut the funds to *Genesis Alpha*. This can be confirmed by looking at the *Genesis DAO* address on *Etherscan*<sup>26</sup>. It can be

<sup>26</sup><https://etherscan.io/address/0x294f999356ed03347c7a23bcbcf8d33fa41dc830#analytics>

seen that since November 2019 its total balance of Ether has been strongly reduced. If funds decrease, then proposals, where members ask for money, diminish and subsequently votes and stakes shrink. In addition, part of the *Genesis Alpha* community was not aligned with the *DAOstack* objectives, as it aims to be self-funded and independent from *DAOstack* commercial aims [29].

Since the decline of *Genesis Alpha*, the more active and funded DAO in *DAOstack* is *dxDAO* that develops DeFi protocols and products.<sup>27</sup> However, the problems happened in *Genesis Alpha* suggest that while DAOs are excellent tools for distribution of funds and for the automatic implementation (on-chain) of decisions, in their present form they may have problems for creating social cohesion and ensuring accountability since “the lack of accountability measures turns passed proposals into ‘promises’ and requires the community to become vigilant of one another”.<sup>28</sup>

## 6 CONCLUSION

The last few years have seen the emergence of decentralized organizations on the blockchain as a new form for running organizations on the Internet. DAOs are novel sociotechnical systems that set a new way for online coordination and decision-making. Most of them so far mainly host blockchain projects or some sort of blockchain-based businesses. However, the *DAO as a service* platforms have eased the access to such organizations for non-technical users and non-blockchain related organizations, and has lead to a surge of DAOs in recent years.

Surprisingly, there is a lack of empirical research on the topic so far. DAOs are particularly conditioned by the idiosyncrasies of the blockchain technology, which is decentralized and serverless, with immutable records, and where operations imply a cost. Furthermore, despite being in their infancy, these sociotechnical systems are already facing problems [29] that may relate to those that affect to other sociotechnical systems and already studied in the literature.

Thus, we believe DAOs deserve interdisciplinary research attention to ascertain whether their problems are similar or not to those from other online and offline alternatives. Furthermore, to determine whether they provide an effective mean for running a decentralized organization, or they only work under certain conditions, for example, when voters are known and the topics are limited in scope. We hope that this paper and the tool presented here serve to spark scholarly interest in DAOs.

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<sup>27</sup><https://alchemy.daostack.io/dao/0x519b70055af5a007110b4ff99b0ea33071c720a>

<sup>28</sup>Quoted from the notes of two outgoing Genesis DAO members <https://daotalk.org/t/kate-and-livias-thoughts-on-genesis/1161>

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## A DAOSTACK ARCHITECTURE

In [42] is presented how is *DAOstack* architecture in depth. Summing up, it is composed of several stacked layers. Base layers (Infra, and Arc) are in charge of providing and dealing with Ethereum blockchain and its smart contracts. The next layer, *ArcGraph*, is a data one, it is used to fetch and to store changes produced on smart contracts, to do that, this layer uses *The Graph*, a *Ethereum* protocol which allows detecting as events any change made on the blockchain. Furthermore, *ArcGraph* layer is used to provide an *API*, on *GraphQL*, enabling the access to the data already stored. Finally, a frontend, *Alchemy*,<sup>29</sup> allows showing, creating, and interacting with DAOs.

Data from Section 5 has been gathered from *DAOstack GraphQL*.<sup>30</sup>

<sup>29</sup><https://alchemy.daostack.io/>

<sup>30</sup><https://thegraph.com/explorer/subgraph/daostack/master>