DAO-Analyzer: Exploring Activity and Participation in Blockchain Organizations

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Decentralized Autonomous Organizations (DAOs) are a new kind of organization that relies on blockchain software to govern their projects. Typically, DAO members may put forward and vote on proposals. For instance these proposals may consist on someone doing some tasks in exchange for a share of the DAO crypto-funds. In recent times, DAOs have gained a remarkable adoption, and yet they are still understudied by the academic literature. In this work, we present a visual analytics tool to study DAO activity focusing on their participation and temporal evolution. Our tool will hopefully help to stimulate research on this new kind of online community and collaborative software.

CCS Concepts: • **Human-centered computing** → **Computer supported cooperative work**; **Visual analytics**.

Additional Key Words and Phrases: decentralized autonomous organization, DAO, online community, governance, Ethereum, blockchain

ACM Reference Format:
Javier Arroyo, David Davó, Elena Martínez-Vicente, Youssef Faqir-Rhazoui, and Samer Hassan. 2022. DAO-Analyzer: Exploring Activity and Participation in Blockchain Organizations. In *Companion Computer Supported Cooperative Work and Social Computing (CSCW'22 Companion), November 8–22, 2022, Virtual Event, Taiwan.* ACM, New York, NY, USA, 6 pages. https://doi.org/10.1145/3500868.3559707

1 INTRODUCTION

The rise of blockchain and in particular of Ethereum, the blockchain-based computing platform, has prompted the emergence of a new form of decentralized organization, the so-called Decentralized Autonomous Organizations, i.e. DAOs. The term DAO was coined by Ethereum's founder Vitalik Buterin in 2014 [1]. According to formal definitions [4], a DAO enables people to coordinate and self-govern themselves mediated by a set of self-executing rules deployed on a public blockchain, where governance is independent of central control. In essence, most of them implement governance through proposals, that is, DAO members can put forward proposals and vote on them, and voting power is usually related to the possession of governance tokens. In addition, proposals are usually related to the allocation of a share of the DAO crypto-funds. DAOs have gained a spectacular adoption, totaling 1.7 million members and managing $9.2 billion in crypto-assets as of May 30, 2022.[1]

In spite of this popularity, the DAO phenomenon remains largely understudied by academia. However, scientific research could provide very needed insights from fields such as law, sociology, organization science, or, obviously,

[1] According to DeepDAO https://deepdao.io/

computer science, including experts on distributed systems, usability, or computer-supported cooperative work (CSCW). For example, CSCW researchers could help DAO members to overcome the hurdles of building an online community. In addition, they could study the particular features of DAOs, for example, the fact that operating on the blockchain implies the payment of a fee and that DAO activity is often linked with tokens that have economic value.

Fortunately, despite its niche and relatively uncharted nature, the DAO phenomenon is mainly developed "in the open", i.e. with open source software, public discussions, and overall high levels of transparency. Thus, it should be easy for the scientific community to catch up. In particular, DAOs are covered in the web gray literature (e.g. specialized websites, blogs, white papers, online forums, or chat rooms). DAO software is usually available in public open source repositories, typically Github, such as the case of DAO platforms DAOstack, DAOhaus or Aragon. But also, and more interestingly, DAO activity is recorded in public blockchains and this means that it can be publicly accessed by anyone (with the appropriate knowledge and tools). Besides, it is immutable as its activity history cannot be modified or shut down, contrary to what happens with other communities hosted on private servers.

This work presents a tool, called DAO-Analyzer, that shows visual analytics for DAOs. The tool capitalizes on the open nature of the DAO phenomenon. At the same time, it aims to facilitate DAO research by following the same open approach and providing plots and metrics on DAO activity.

In particular, DAO-Analyzer aids to understand the evolution and the current state of a DAO in terms of activity by answering questions such as:

- How many people participate in putting forward proposals? And how many vote for them?
- Are the results of the votes disputed? Are the proposals mostly approved or rejected?
- How does DAO activity evolve over time?

The inspection of DAOs using DAO-Analyzer can help to tentatively answer more general questions on this new kind of community, including:

- Is the participation in DAOs highly unequal, as it happens in other online communities?
- Is DAO governance disputed?
- Are DAOs prone to being abandoned after some time?

The potential answers should be corroborated and further understood by quantitative (statistical) tools and qualitative approaches, such as ethnographies or in-depth interviews.

1.1 DAOs in a nutshell

In practical terms, a DAO is composed of people, identified by a unique address, that typically hold 'governance' tokens linked to their addresses. The amount of governance often correlates with voting power. It is also common for DAOs to manage resources, e.g. crypto-funds, and decide how to allocate them through voting proposals. Proposals usually consist of tasks that a member is willing to do in exchange for a share of the common crypto-funds. Thus, in many cases, DAOs main function is to provide a voting system to decide how to allocate common crypto-funds.

Since creating a DAO from scratch requires highly specialized technical knowledge on blockchain programming, in the last few years, several platforms emerged in order to facilitate the process, e.g. Aragon, DAOstack, DAOhaus, Colony, etc. Still, there is a high entry barrier imposed by the user interfaces of blockchain applications [5], which hinders their adoption by the general public [2]. As a result, DAOs are mostly used by blockchain programmers and experts on crypto-finance. Web searches show that most DAOs run projects related to blockchain technology (e.g. decentralized finance ventures, Web3 development projects, programmer guilds, etc).

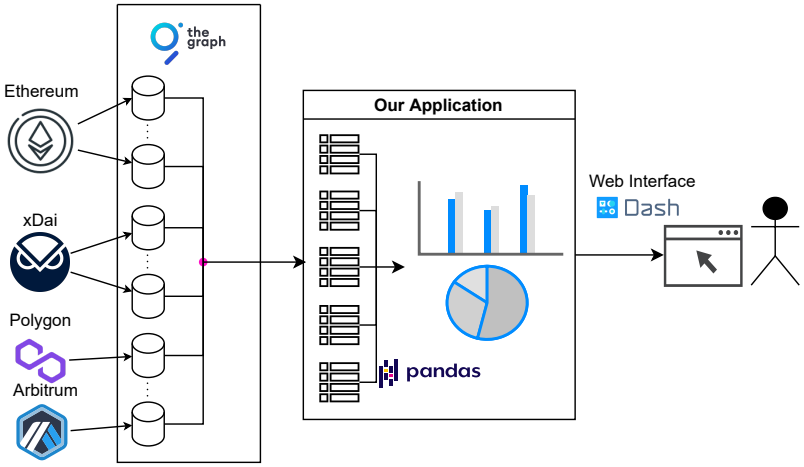

Fig. 1. Data flow of DAO-Analyzer.

DAOs take advantage of the affordances of blockchain infrastructure to enable transparent decision processes, formalized rules, tokenization, automation, and an alleged decentralization of power [6]. As a result, DAOs are mainly used for managing crypto-funds and enforcing voting decisions in a decentralized environment. At the same time, operating in a DAO deployed in a public network costs money to compensate nodes for their work. Thus, the activity of users may depend on their respective funds and also on the computation prices, as happened when Ethereum prices greatly rose in 2020 [3]. To alleviate costs, some DAOs are deployed in sidechains, which are cheaper blockchains compatible with Ethereum and connected to it, while others vote off-chain and record the results on-chain.

2 DAO-ANALYZER

DAO-analyzer is a web tool that provides visual analytics of DAOs. It is publicly deployed[2] and the source code is available under a free/open source GPL 3.0 license.[3] To the best of our knowledge, only the commercial site DeepDAO offers a similar service. While DeepDAO mainly covers the most relevant and wealthy DAOs at the moment, our tool also covers inactive DAOs and focuses on participation. We also offer full transparency as other free/open source visualization tools for collaborative projects such as wikis and free/open source software.[4]

2.1 Architecture of the system

A DAO is deployed in a specific public blockchain, typically an Ethereum-compatible one such as Ethereum mainnet or sidechains such as Gnosis Chain (formerly xDai), Polygon, or Arbitrum. DAO activity is executed by smart contracts (code deployed on the blockchain) and its result is permanently registered in the blockchain.

Fig. 1 shows the main elements of our system. The protocol called *The Graph*[5] makes it possible to index the data stored in the blockchain and retrieve it by means of an API. In particular, we need to deploy and query APIs (or *subgraphs* in *The Graph* jargon) to retrieve the data created by the DAO smart contracts, specifically data of its members, proposals,

[2] https://dao-analyzer.science/
[3] https://github.com/Grasia/dao-analyzer
[4] See Wikiapiary or Bitergia Analytics.
[5] https://thegraph.com

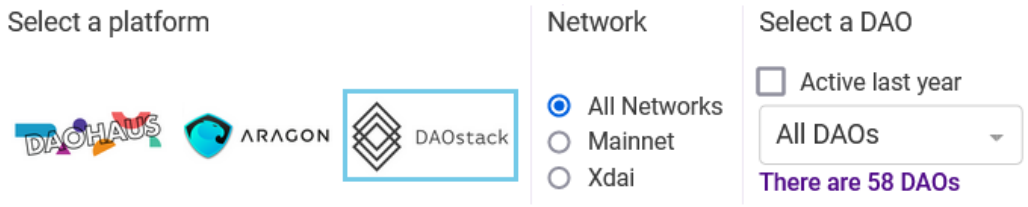

Fig. 2. Selectors of the application.

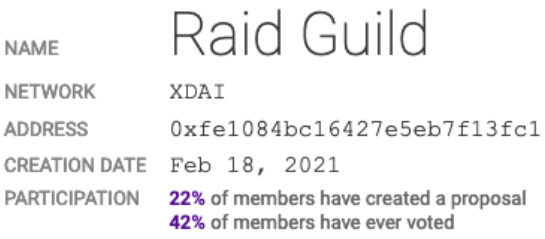

Fig. 3. DAO id and participation data.

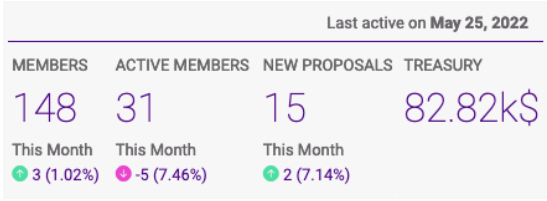

Fig. 4. DAO state panel.

votes, etc.[6] We daily query the APIs for updates and store them in a local *data warehouse* in the form of tables using an efficient binary file format (Apache feather). We process (clean, sort, and model) the tables using Python, Numpy and Pandas, create interactive plots with Plotly, and present them on a website using the Dash framework.

2.2 Interface of the application

The interface presents two levels of analysis. On the one hand, the general activity of a DAO platform in a precise network (e.g. Aragon in mainnet), and on the other hand, the activity of a precise DAO. The user can choose the object and the level of analysis using the three filtering components at the top of the screen (see Fig. 2). The first one is the selector of the DAO platform (currently DAOhaus, Aragon, and DAOstack). The second one selects the Ethereum-compatible network that you want to inspect or where is deployed the DAO you are interested in. The third one is a drop-down menu that displays the DAOs of the selected platform and network. If no DAO is selected in the drop-down menu, the application displays the general data of the platform and network selected. On the other hand, if a DAO is selected, the application shows the activity data of that DAO. Both levels of analysis are visually displayed in the same way. We summarize the main elements below.

On the left side, the tool shows the identification data of the selected DAO (or DAO platform), such as the name, Ethereum address, and network where is deployed, together with some summary statistics related to participation, i.e. voting and proposal creation (see Fig. 3). On the right side, the tool shows a panel (see Fig. 4) with a summary of the state of the DAO in the present month and a comparison with the previous one. It includes the number of total and active members, number of proposals made, and crypto-treasury in USD.

Below and divided by tabs, we can see plots that mostly show the temporal evolution of some variables measured on a monthly basis. The tabs group the plots by the general concept measured, e.g. activity, members, votes, proposals and

[6]The scripts for data retrieval can be run independently of the web application.

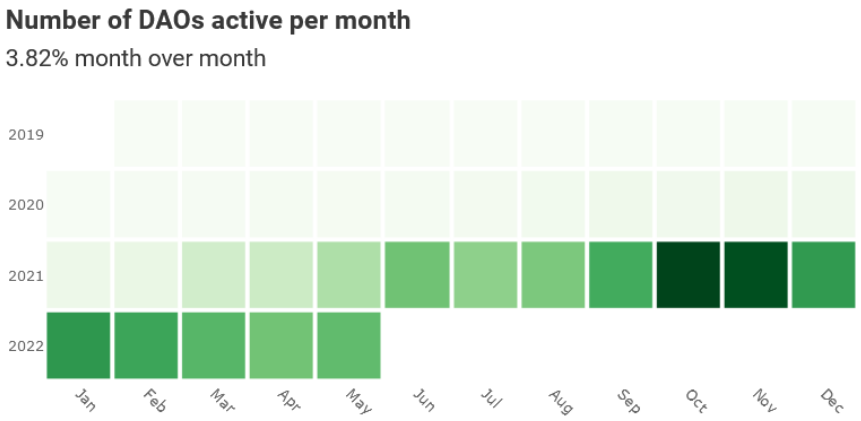

Fig. 5. Plot of active DAOs in DAOhaus.

assets. For example, in the "members" tab we show the monthly time series of new members, outgoing members, total members and active members.

3 INSIGHTS FROM USING THE TOOL

In this section, we will show through a brief example some of the insights that a user can obtain from using our application. We will consider the data of the DAOhaus platform as of May 30, 2022.

At a platform level, from using the filter of active DAOs (the checkbox in the right-side filter in Fig. 2), we can see that there are 3,100 DAOs hosted by DAOhaus since its creation (February 2019) and that only 1,028 (a 33%) were active in the last year. The heatmap of active DAOs in Fig. 5 shows a peak of 248 DAOs in October 2021, but just around 130 DAOs in the last three months. Given our relaxed definition of activity (at least an action performed in the period considered), the share of active DAOs is small. This could stem from multiple causes, including that some DAOs are not used on a monthly basis (e.g. holding discussions on communication platforms but without carrying out on-chain voting procedures) or that some DAOs are used for some time and then abandoned for different reasons.

To illustrate our tool at DAO level, we will consider the DAO of *Raid Guild*, which is a collective of Web3 developers. Its identification data and DAO state panel are shown in Fig. 3 and Fig. 4, respectively. According to them, the DAO is 15 months old and has 148 members, but only 31 (a 21%) were active in the last month (May 2022). The participation stats also show that only 22% of the members have put forward a proposal and that 58% of the DAO members have not voted yet. Thus, apparently, only a fraction of the total members participate in the DAO governance.

If we look at the outcome of the proposals per month in Fig. 6, we see that most proposals are approved (green color) and that rejection is rare. Still, it could be possible that the votes were disputed and won by the majority, but the plot of monthly votes for and against in Fig. 7 also reveals that except in one month, the votes-against are extremely rare. Apparently, this speaks of an organization whose governance is very cohesive but it could also mean that proposals are discussed and agreed upon elsewhere (e.g. in Discord, Slack, or other chat platforms), and thus they barely show opposition when voted on the blockchain.

This example, even if brief, shows the potential of our tool to understand how DAOs work. With the tool, it can be seen that the insights showed also hold for other DAOs and other DAO platforms. Some of them, such as the high

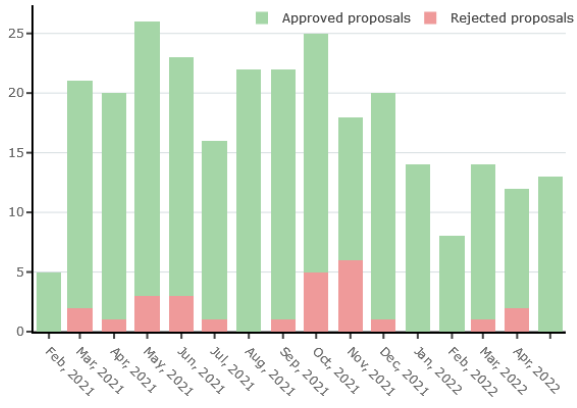

Fig. 6. Proposals outcome per month in Raid Guild.

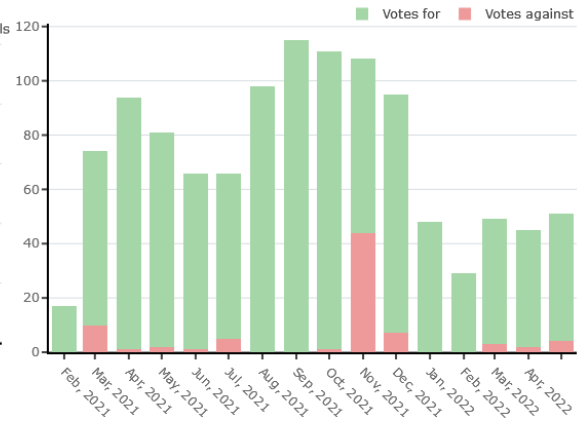

Fig. 7. Votes for and against per month in Raid Guild.

project abandonment rate and the low participation, also take place in other types of online communities, such as those around wikis or software projects. The validation and understanding of these and other hypotheses is part of the future research lines that this tool may provide guiding light on.

ACKNOWLEDGMENTS

This work was partially supported by the projects DAOapplications (grant no.: PID2021-127956OB-I00) and Chain Community (RTI2018-096820-A-I00), both funded by the Spanish Ministry of Science and Innovation, and by the project P2P Models (https://p2pmodels.eu) funded by the European Research Council (ERC-2017-STG 625 grant no.: 759207).

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