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The Role of White Papers in the Governance of Decentralized Autonomous Organizations

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Abstract

The informational content of white papers is traditionally of interest to investors and stakeholders. While whitepapers' utility in outlining the technical specifications of investment proposals are well documented, their role in defining governance structures and shaping accountability measures in DAOs is rarely attempted. Thus, there is less agreement on the extent to which they are effective in promoting good governance practices. This thesis addresses that gap by examining 154 DAO white papers by combining qualitative research methods like the PRISMA protocol and sentiment analysis. This has led to a nuanced understanding of complex themes such as governance in DAOs in a multi-theoretic framework. Positive sentiments towards voting and proposals emerged as critical under the Principal-Agent theory, manifested through encouraging stakeholder engagement and explicitly outlining accountability procedures. Further links are found between the clarity of governance structures in white papers and the degree of alignment between principles and practices within DAOs. The evolution of DAO white papers from 2017 to 2023 highlights the increasing weight placed on transparent and enforceable dispute resolution mechanisms for aligning governance practices with white paper principles. By filling gaps in the limited literature on DAO governance, this thesis further contributes by identifying areas ripe for theoretical and empirical exploration while proposing the intricate task of reconciling democratic ideals with pragmatic governance in DAOs as a topic in need of urgent exploration.

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1 Introduction

1.1 Background and Problem Statement

Whitepaper refers to a commonly used document in the tech and financial world which is generated by an issuer with the purpose of showcasing the most promising, and marketable aspects of a specific product, or a service (Samieifar & Baur, 2021). They provide valuable information that enables market participants and stakeholders to shape forecasts and incorporate the data into pricing strategies, Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis, and competition management efforts (Doxat, 2022). In the tech world, whitepapers have become a popular tool for explaining new ideas and concepts, in addition to the traditional approach of highlighting the advantages of a product or technology. Such literature vary in terms of details and scope: some are verbose, while others read more like marketing brochures; some are full of technical details, and others assume an uninitiated reader and walk them through difficult concepts like a tutorial. In short, their purpose is to equip readers with essential knowledge and insights, enabling them to make well-informed decisions (Willerton, 2007). Whether it's a potential investor looking for information on a startup's business model, a customer trying to understand a product, or a policymaker seeking insights on a particular issue, whitepapers offer the information necessary to help them make well-informed choices.

As whitepaper evolved in nature, so did their usage. They grew popular as literature designed to persuade capital flow by bolstering investor confidence—especially at the initial stages of a project. As such, displaying the founder's vision, and technical abilities often carry high weight in white papers. Studies have found this to favorably attract potential customers and generate business leads (Florysiak and Schandlbauer, 2019). Another use of whitepaper is as an outlet of thought leadership. Studies have found that businesses and startups successfully build credibility and rapport with stakeholders via whitepapers. It was exemplified to a great extent during the great ICO boom (Initial Coin Offerings). It is through white papers that the world became acquainted with applications of token economics, token distribution, credentials and technical portfolios of team members, project roadmaps, etc., which helped stakeholders determine the feasibility and profitability of ICOs (Zhang et al., 2019)

A reasonable body of literature already exists capturing the essence of white papers and their roles within the ICO domain. In a similar manner, there are credible reasons to believe that the complex principles underpinning DAOs are extensively detailed in their white paper documents (Samieifar and Baur, 2021). Therefore, a thorough examination of whitepapers in DAOs hold the key to gaining a proper

understanding of DAOs, their operations, mechanics, governance principles, objectives, visions, pros and cons. (Zhang et al., 2019). Drawing from the lessons learned during the ICO boom, we can anticipate how whitepapers might adapt to address the unique complexities and governance requirements related to DAOs, a concept that represents the next frontier in the blockchain revolution. It would be expected that the usage of whitepapers in DAOs will be more mature and nuanced and that whitepapers will play a pivotal role in outlining the technical specifications and governance structures of a given DAO project. These documents provide a detailed overview of the project's objectives and their functional components while enabling investors to make informed investment decisions. The efficacy of whitepapers in the governance model of DAOs and ensuring their continued growth and success is a topic of great interest and importance to researchers, policymakers, investors, and regulators (Singh and Kim, 2019). By shedding light on the interplay between whitepapers and DAO governance, this thesis aims to contribute to this dynamic and evolving field.

The current state of knowledge on the role of white papers in the governance of DAOs is limited but growing. While there is a consensus that white papers are an important tool for outlining the technical specifications and governance structures of a given DAO project, there is less agreement on the extent to which they are effective in promoting good governance practices. There are many puzzles, controversies, and paradoxes that need to be addressed in the study of white papers and DAOs governance. For example, there is a need to understand how white papers are perceived and interpreted by different stakeholders, and how this affects their efficacy in promoting good governance practices. Additionally, there is a need to explore how white papers are updated over time to reflect changing circumstances and to ensure ongoing alignment with project goals. Besides, white papers themselves serve as a rich source of sentiments harbored and/or expressed by the DAO's designers with respect to the goals they want to achieve and how it reflects in governance principles and mechanisms. A preliminary scan of literature also reveals more concrete gaps in this; e.g., inconsistencies in governance protocols, contrasting participation dynamics, evolution and adaptability issues, security hazards and risk management, regulation, compliance, legal uncertainties, etc.

Motivated by a large gap on the informational content of white papers for DAOs, this thesis strives to engage in the governance methods of DAOs. By analyzing the selected white papers, we hope to gain insights into the mindset of the project's creators and participants, through the project's organizational structure. Literature in other disciplines already shows white papers to be a valuable tool for deciphering the founders' vision for governance. We aim to assess this in line with established economic and business

theories to map out general trends and themes in the governance visions prevalent in the DAO industry. This is an important addition to literature that complements the existing body of works on the technical and structural aspects of DAOs. To uncover the sentiments and attitudes espoused by the DAO founders, we adopt a sentiment analysis to explore their motivations and aspirations embedded to their retrospective whitepaper. This thesis thus acts as a link between the theoretical underpinnings of DAOs and their practical implementations, while unraveling the complexity of governance attitudes, challenges, and prospects.

1.2 Research question

Our exploration into the prevailing governance culture within DAOs require a thorough analysis of white papers, which serve as crucial resources in defining the organizational structures and decision-making mechanisms of DAOs. These documents showcase how DAO governance often employs innovative mechanisms such as reputation-based voting systems in which tokens or scores are attributed based on the levels of action, contribution, and stake (Ding, et al., 2023). The idea behind this is that this would empower members to participate, propose various solutions and ideas, and collectively decide upon them. In the realm of governance, security is of paramount significance (Krahmann, 2003). DAOs put attention to that with introduction of innovative mechanisms such as multi-signature wallets (multi-sig) that require approval before transaction validation (Sims, 2021). Along similar lines, escrow accounts are also employed, serving as neutral entities that secure assets (Sabry,2019). Combining them together, these mechanisms aim to mitigate disputes, prevent unilateral actions, and foster a conducive environment for governance. Considering these evolving practices that show the progress of blockchain governance and the associated complexities, this thesis aims to understand the significance of whitepapers in explaining how DAOs are governed. Specifically, this thesis aims to answer the following research question:

“How do the governance principles and values reflected in DAO whitepapers align with the actual decision-making and governance practices within the DAO?”

To provide meaningful responses to this research question, we propose two hypotheses, which we build based on the theoretical assumptions poised by Institutional theory, Principal-agent theory and Social Contract Theory, combined with the characteristics of the blockchain technology, which underpins DAOs.

Hypothesis 1A: DAO whitepapers that include clear accountability mechanisms and prioritize stakeholder participation are more effective in ensuring compliance and mitigating the risk of misconduct within the DAO.

This hypothesis builds atop the notion of participatory governance as described in institutional theory, which implies that participation of stakeholders can generate more efficient and responsible governance.

Hypothesis 1B: The presence of clear and enforceable mechanisms for dispute resolution within a DAO is positively correlated with the degree to which its governance principles and values align with those outlined in its whitepaper.

This hypothesis builds atop the notion of enforceable mechanisms as described in Principal-Agent Theory, suggesting that within a DAO, the agent's actions that are represented by the clear and enforceable mechanisms for dispute resolution are predicted to align positively with the principal's interests. Furthermore, this hypothesis also constructs upon the notion of dispute resolution as expounded by Social Contract Theory. In this context, the presence of dispute resolution mechanisms within a DAO is posited to be an indicative measure of the effectiveness of the underlying social contract.

In order to address these hypotheses through qualitative research, we have determined that our primary data source will be the DAO whitepapers and relevant literature associated with our topic of interest. The collected data, which serves as a foundation for hypothesis testing, is then utilized to construct a formal answer and a framework is implemented to test the validity of those hypotheses.

This master's thesis examines the function of whitepapers in the governance frameworks of DAOs using a qualitative research methodology. The research begins with a thorough analysis of the DAO and whitepaper literature, which is followed by an extensive case-by-case research of the governance model in DAOs that were selected by their market value. This allows for a thorough understanding of the prevailing governance processes, and ultimately, identifying possible areas for further development. Additionally, to dive down into particular aspects of DAO governance and provide a more accurate picture of each component's efficacy, we incorporate segment analysis into our study approach. Notably, the study offers a basis for future research into decentralized decision-making and governance while also adding to the body of knowledge on DAOs and blockchain technology for all actors interested in its promise. Furthermore, the findings of the study will provide valuable insights into the role of whitepapers

in facilitating defensive mechanisms for disputes, accountability, and participation in the governance model of DAOs.

The structure of this thesis begins with an introduction to the subject of DAOs, their significance and rationale behind studying them. The second section discusses the research methodology, describing in detail the data collection and analysis procedures. This is followed by a literature review in the third section, conducting a comprehensive exploration of existing works related to DAOs, blockchain technology, governance models and their mechanisms. In the fourth section, the findings of the sentiment analysis and keyword frequency analysis are presented, critically evaluating each concept's implications on the governance of DAOs. The fifth chapter then presents a discussion and interpretation of these findings, contextualized within the broader theories used. Finally, the sixth chapter provides a conclusion to the study, summarizing the key findings, identifying limitations, proposing areas for future research, and discussing the potential implications of the research on both the theory and practice of DAO governance.

2 Research design

In this study, we examine how the governance values and concepts stated in DAO whitepapers correlate with the actual governance procedures used by these organizations. A comprehensive understanding of the topic was sought after, taking into consideration different perspectives of market participants. In order to accomplish this, we chose a qualitative research strategy, and we implemented the PRISMA protocol to guide our literature review process - a structured approach known to enhance the trustworthiness and accuracy of research findings. PRISMA protocol equips us with a repeatable, structured mechanism for reviewing existing literature, ensuring we don't miss any relevant information (Moher et al., 2009). This ensures a broad range of literature is taken into account, minimizing the chance of missing critical sources or incorporating subjective biases. (Page et al.,2021).

In the past, PRISMA has been successfully employed in academic studies dealing with similar subjects. For instance, Balcerzak et al., (2012) utilized PRISMA to systematically review the literature on blockchain technology and smart contracts in decentralized governance systems and came to the conclusion that blockchain technology can reconfigure organizational governance mechanisms, providing credible and insightful findings. Similarly, Jamadaret al. (2022) applied PRISMA to evaluate literature on corporate governance, firm performance and insider trading which provided valuable information to assist market participants in the stock market.

Moreover, we have incorporated segment analysis into our methodology, enabling us to reach different aspects of DAO governance. By breaking down the larger domain into more manageable pieces, segment analysis allows us to derive more targeted and precise insights, which further bolster the effectiveness of our research. In the study of González et al., (2019) sentiment analysis has been effectively utilized as a tool to look deeper into governance practices and their impact on initial public offering (IPO) underpricing.

We believe that combining qualitative research methods like the PRISMA protocol with sentiment analysis can provide a nuanced understanding of complex themes and phenomena, such as governance in DAOs. We also believe that this is optimal method for investigating the proposed hypotheses as they allow a thorough investigation of the realities that exist within DAOs and how those realities align with ,or deviate from, the principles stated in their whitepapers.

2.1 Description of the research method

Integrative literature review will be applied in this research to systematically collect, evaluate, and synthesize prevailing literature to answer the research question formulated in section “1.2.” The next step involves finding key literature pertinent to the research questions. This will be achieved by using databases such as Google Scholar, RUQuest, and Web of Science, reference lists, and other sources. The objective of the search approach was to discover academic papers that presented a perspective on the role of whitepapers in the governance model of DAOs. Ultimately, the search yielded a total of 70 articles using a specific combination of search terms such as : “whitepaper”, “decentralized autonomous organizations”, “governance model”, “decentralized governance” ,”governance token”, “token economics”, “blockchain technology”, “Web 3.0”, “ smart contracts”, “investor protection”, “ accountability mechanism”, “ governance participation”, “ Initial Coin Offering”, “consensus mechanism”, “dispute resolution”, “enforceable mechanism”, “incentive structure”, “on-chain governance”, “off-chain governance”. Once the relevant books, articles, conference papers, white papers, policy papers, and all relevant material are identified and collected, the evaluation process will begin. At this phase, the quality and relevance of the content will be determined by going through the methodology used by the respective authors, data analysis techniques, etc. Thereafter, synthesis will start. At this stage, findings from the studies and white papers will be patched together to identify patterns and themes relevant to the research question in section “1.2.” This should aid in identifying common themes, concepts, and theories, which will be used to confirm or deny the hypothesis posited in this thesis.

2.2 Eligibility criteria

The search was limited to white papers related to blockchain technology, specifically to decentralized autonomous organizations that were published in English language. There were no restrictions that it only includes whitepapers from specific date. Absence of the keywords used to analyze the given research can be just as meaningful as their occurrence, especially when these terms are expected in the context (Neuendorf,2017). Older versions of whitepapers and those not written in English were not included in the data collection since the most recent whitepapers had been considered to be the most transparent.

2.3 Search methods of the research

Our main database for literatures and references for citation that was utilized is Google Scholar from where the relevant scholarly articles were extracted and provided us with literature that gave us an opportunity to present new perspectives. Databases were searched from the period of March 2023 to the period of June 2023. Our data that we extracted from the top 1000 DAO that were listed on CoinMarketCap (www.coinmarketcap.com) between the period of March 2023 to the period of June 2023. This website provides an overview of all crypto market capitalizations and pricing and is one the most used websites that provide a ranking of the crypto market, based on the market value at that moment. For each DAO that we used for the research purposes, we downloaded their whitepaper that was extracted from the corresponding website of the DAO that we analyzed.

2.4 Data collection process

Data extraction was performed using a standardized method that included fields for the whitepaper title, publication date, and keywords related to the research hypotheses. The clarity of the presented information, the extensiveness of the governance framework, and suggested accountability and conflict resolution processes were taken into consideration while evaluating the quality of the included whitepapers.

2.5 Data items

The study aims to address the governance of DAOs by utilizing data items extracted from the selected whitepapers by encompassing various aspects, such as accountability mechanisms, stakeholder

participation strategies, compliance measures, and dispute resolution mechanisms proposed in the governance of DAOs. The research will employ these data items to fulfill the following criteria:

1. Clarity of goals: How well the whitepaper outlined its objectives within the framework of DAO governance.
2. Comprehensiveness of governance system: The extent to which the governance structure, including the roles and obligations of stakeholders, was described in detail and in a coherent manner in the whitepaper.
3. Adequacy of accountability systems: How well-developed and efficient accountability procedures were recommended in the whitepaper to ensure compliance and reduce the risk of misbehavior.
4. A whitepaper's ability to incorporate effective conflict resolution procedures that are in line with its governing principles and objectives will depend on how appropriate its dispute resolution procedures are.

2.6 Risk of Bias Assessment

In order to provide an unbiased evaluation of the role of whitepapers in the governance model of DAOs, it is essential to conduct a comprehensive risk of bias assessment in which focuses on possible biases presented in the data collection which impact on the overall conclusions derived from the study. Firstly, we are mentioning selection bias which can occur when the whitepapers included in the study are not representative of the entire population of DAO whitepapers. To minimize this bias, a systematic search strategy was employed to ensure a comprehensive identification of whitepapers by clearly defining search criteria and using multiple databases for the study (Winship and Mare, 1992). Furthermore, to minimize performance bias in which systematic differences can occur while collecting data for research (Pannucci and Wilkins, 2010), we used an approach that was followed for the extraction of keywords and the analysis of their frequency and context. Finally, with publication bias we are afraid that only cases that have positive findings or have high profile sponsors will be published (Thornton and Lee, 2000) and to reduce that bias we compare the cases to different sources of the whitepaper.

2.7 Limitations and potential confounding factors

Despite efforts to minimize biases, some limitations and potential confounding factors must be acknowledged. First, the analysis was limited by the availability of whitepapers and the extent to which they accurately reflect the actual governance models and practices of DAOs. Second, the rapid evolution

of the DAO landscape might introduce some inconsistencies in the terminology used across different whitepapers. To account for this, the study incorporated a keyword list which tried to include as much relevant information as possible for the analysis. Thirdly, white papers are written by the founders of a DAO and might be biased, as they reflect founders' views, and philosophies which may not fully encapsulate the actual functioning and dynamics of the DAO's governance structure. Lastly, whitepapers generally lack empirical data about the practical application and effectiveness of their governance structure. Without such data, it can be difficult to assess the real-world implications of the stated governance practices.

3 Theoretical Framing

3.1 White papers

White papers represent an effective tool for communication, particularly in the fields of technology, healthcare, and policy. One of the benefits of whitepapers is that they can help establish a company or organization as an authority on a particular topic, through their well-researched and well-articulated content, while fostering trust with potential customers (Doxat,2022). Before the blockchain technology, they were often used in the technology industry to explain new products and their benefits, or in the healthcare industry to explain new treatments (Soldani,2019),but were also used for other topics, ranging from environmental concerns to economic policies. One of the primary purposes of a white paper is to highlight the technical aspects of a product or service, and technical writers are often responsible for creating these documents. (Campbell and Naidoo, 2017). Thus, white papers function as a bridge between the technical language of professionals and the lay language of the general public, broadening understanding of their objectives and filling up the knowledge gap.

3.2 Blockchain technology

The 2008 Bitcoin white paper by Satoshi Nakamoto introduced the world to the concept of a decentralized which has since then impacted various industries and sectors. Initially designed as a peer-to-peer currency transfer system, this approach to data and transaction management has disrupted traditional trust mechanisms by eliminating the need for a centralized third party. Instead, trust is now embedded within the system itself through a combination of decentralized storage, consensus mechanisms, and advanced cryptography (Nakamoto, 2008). Due to certain characteristics, such as semi-

irreversibility and permanent storage, this invention is anticipated to produce a major shift in organizational structures, making it impossible to reverse or delete a transaction or data point (Rikken et al ., 2019). Blockchain networks, often structured as open-source platforms, grant unrestricted access to their core code, promoting innovation by allowing modifications and distributions by anyone. Consequently, this transparency encourages participation without limits and potentially provides participants with a degree of anonymity (Swan, 2015). This research question aims to examine how the governance principles, influenced by such decentralization and transparency, align with actual governance practices, exploring if the promises made in these documents are truly reflected in their operations.

3.3 Consensus mechanism

Despite the presence of unknown network members, blockchain systems are designed to ensure proper execution and maintenance of the network through various consensus mechanisms, such as Proof of Work (PoW) or Proof of Stake (PoS). These mechanisms are employed to achieve agreement among network participants on the state of the blockchain, guaranteeing that transactions are valid and secure. The consensus mechanisms also provide incentives for participants to act in the best interest of the network, as any malicious activity can be detected and penalized by the community (Zhang et al., 2020). PoW is the original consensus mechanism introduced by the Bitcoin network. In PoW-based systems, network participants, referred to as miners, engage in a competitive process of solving complex mathematical problems to validate transactions and create new blocks. The first miner to successfully solve the problem earns the right to add the block to the blockchain and, as a reward, receives newly minted cryptocurrency and transaction fees (Nair and Dorai,2021). A primary concern related to PoW systems is the substantial computational power and energy consumption required for mining activities, as miners must compete against each other to solve the mathematical problems as quickly as possible. This competition has led to an arms race among miners to develop more powerful and energy-intensive mining hardware, raising questions about the environmental sustainability of PoW-based blockchains (Mora et al., 2018).

Proof of Stake is an alternative consensus mechanism designed to address some of the concerns associated with PoW, particularly its energy inefficiency. In PoS-based systems, network participants, known as validators or stakers, validate transactions and create new blocks based on the number of coins they hold (their stake) and other factors such as the age of the coins held (Buterin & Griffith, 2017) . Unlike

PoW, PoS does not require validators to expend significant computational resources or consume substantial amounts of energy. As a result, PoS systems are generally considered to be more environmentally friendly and cost-effective compared to PoW systems. However, there are some arguments against PoS as it may lead to centralization of power among the wealthiest participants in the network, potentially undermining the decentralization principle that underpins blockchain technology (Saleh, 2021).

3.4 Smart contracts

Szabo (1997) first proposed the idea of smart contracts in 1997 as a way to automate and secure contracts using cryptography. It was with the emergence of blockchain technology, specifically Ethereum, that smart contracts truly gained attention (Buterin, 2014). Smart contracts are simply pieces of code on a blockchain network, which are activated when specific conditions are met. Once these conditions are satisfied, the smart contract conducts the agreed actions automatically, ensuring transparency, speed, and permanence (Christidis & Devetsikiotis, 2016). As they operate within the consensus of the underlying blockchain, smart contracts inherit its core features such as security, and not needing trust between parties as it works hand in hand with the blockchain technology, enhancing system reliability (Tapscott & Tapscott, 2016).

3.5 Decentralized autonomous organizations

In June 2016, cryptocurrency investors lost around \$50 million, when the first DAO collapsed (Wang et al., 2019). We are mentioning this event, as it was the first organization to use the term "Decentralized Autonomous Organizations (DAOs)" to describe an experiment with a novel organizational structure. This first DAO was based on Ethereum, a blockchain-based smart contract code system that was introduced in July 2015, utilizing the Ethereum coin called Ether (ETH), with the objective to construct a digital, cooperative peer-to-peer (P2P) community of investors and entrepreneurs, and to strengthen the whole blockchain ecosystem (Santana and Albareda , 2022). DAOs are defined as blockchain-based organizations supported by open virtual contributor networks with the goal of strengthening the ecosystem .The governance and operation of DAOs are decentralized, meaning there is no central controlling authority and instead, their operations are dictated and executed by automated instructions, known as smart contracts, which are stored within blockchains. (Buterin, 2014). They have a unique system of governance that combines on-chain (online) and off-chain (offline) decision-making processes,

fostering independent work and building trust among members (Weill, 2004). However, blockchain governance involves both human and technological elements, and not all on-chain governance models have proven effective, as offline consensus can be more reliable. Currently, the rapid implementation of changes after achieving majority votes online, a characteristic of on-chain governance, is partially in use and undergoing trials (Yermack, 2019).

3.6 *White papers in DAOs*

With the introduction of ICOs, the whitepaper's popularity risen drastically. According to Zhang et al. (2019), these whitepapers often outline the problem the project aims to solve, the suggested solution, and the team driving the initiative and as a result, they attract funders and generate interest in the project. The inventors from the venture capital fund were the ones who first introduced the DAO in a paper known as a "DAO whitepaper.". Often, DAO whitepapers advocate initiatives on particular issues (such as venture finance, sustainability, and the metaverse) and provide solutions by working together through a decentralized organizational structure, creating a community of peer-to-peer contributors (DuPont, 2019). In order to foster software development collaboration with other developers engaged in their DAO project, the founders not only disclose the blockchain and smart contract code, but they also set the guidelines for governance and operation, which are then executed by computers (Arrunada and Garicano, 2018 and DuPont, 2019). Most DAO creators deliberately employ a whitepaper to share information about their projects (such as their blockchain platform architecture, founding team background, token distribution, intended use of funds, milestones, etc.) in an effort to close this knowledge gap, but as white papers' are not regulated nor they need to follow the strict guidelines, some founders may use them to promote their organizations.

3.7 *Different governance models of DAOs*

The governance model of a DAO is of paramount importance, as it determines how decisions are made and how power is distributed within the organization. A well-designed governance model ensures that the organization remains transparent, accountable, and capable of making efficient decisions, while also allowing it to adapt and evolve as needed (Morrison et al., 2020). There are several types of governance models that can be found in DAOs, each with its advantages and disadvantages. In the model of on-chain governance, all governance decisions are made through smart contracts and recorded on the blockchain which ensures a high level of transparency and automation, as decisions are automatically

executed and visible to all members (Beck et al., 2018). However, on-chain governance can be slow and inflexible, as it requires consensus among a large number of participants and can be difficult to modify once implemented (Reijers et al., 2021).

Furthermore, off-chain governance refers to decision-making processes that occur outside the blockchain, for example, traditional voting systems. This model offers more flexibility and can be more efficient than on-chain governance, as it allows for faster decision-making and easier modifications (Reijers et al., 2021). However, off-chain governance may be less transparent and more susceptible to manipulation, as decisions are not recorded on a public ledger (Wang et al., 2019). The last governance model, hybrid governance, combines elements of both on-chain and off-chain governance. This approach seeks to balance the benefits of transparency and automation offered by on-chain governance with the flexibility of off-chain governance. For instance, a DAO may use on-chain governance for critical decisions that require consensus, while using off-chain governance for less critical or more time-sensitive decisions (Arribas et al., 2020).

3.7.1 Governance mechanisms

DAOs are characterized by their decentralized nature, enabling participants to collectively govern the organization through various mechanisms. One prominent governance mechanism employed by DAOs is token-based voting in which allows token holders, who are often considered stakeholders or members of the DAO, to participate in decision-making processes and influence the direction of the organization. (Christodoulou and Christodoulou,2020). In token-based voting, each token holder is typically granted voting rights corresponding to the number of tokens they possess which means the more tokens a participant holds, the greater their voting power with whom they can express their opinion with proposals, ranging from protocol upgrades, resource allocation, to policy changes (Fan et al, 2020). It allows token holders to directly participate and engage in the DAO's decision-making processes and gives them opportunity to have a say in shaping the direction and policies of the organization. Because the voting records are typically stored on the blockchain, provided transparency strengthens the trust among stakeholders, creating a more reliable governance system. There are several procedures about token based voting, such as mechanisms that ensure the security of the voting process, preventing manipulation of buying the votes and managing voter turnout(Christodoulou and Christodoulou,2020).This is connected to signaling mechanisms which provide a means for participants to communicate their stance on specific proposals, issues, or directions of the organization. Through signaling, stakeholders can indicate their

support, opposition, or neutrality towards certain decisions, giving valuable insights into the overall sentiment and consensus (Bergh et al., 2014) within the DAO community.

Furthermore, delegation mechanisms play a crucial role in DAO governance. These mechanisms enable token holders to delegate their voting power to trusted representatives, often referred to as delegates or proxies. Delegation allows participants who may not have the time, expertise, or inclination to engage directly in every decision to still have a voice in the DAO's governance (Goldberg and Schär, 2023). It enhances participation by accommodating diverse levels of engagement among token holders but at the same time maintains the principles of decentralization and collective decision-making which are the fundamentals of the DAO's (Fritsch et al., 2022). Finally, mechanisms called dispute resolution are vital for addressing conflicts and maintaining the integrity of the governance system. DAOs implement several approaches to dispute resolution, such as decentralized arbitration, voting-based resolution, and escrow and multi-signature mechanisms (Sims, 2021). Decentralized arbitration involves the appointment of independent arbitrators or judges who assess the dispute and make impartial decisions. These arbitrators may be selected from a pool of qualified individuals within the DAO community with the task to evaluate the arguments and evidence presented by the involved parties and provide a resolution that is binding or enforceable within the DAO framework (Chevalier, 2021). Secondly, voting-based dispute resolution mechanisms allow token holders to collectively vote and make decisions on contentious matters. In case of a dispute, affected parties present their arguments and evidence to the DAO community, and token holders cast their votes to determine the outcome. (Minn et al., 2019). The last mechanism that is implemented with DAO's is the escrow and multi-signature mechanism which utilizes smart contracts to hold funds or assets in a secure manner until certain conditions are met. When parties engage in a transaction or enter into an agreement, the funds or assets are temporarily held in the escrow account. The conditions for releasing the escrowed funds are predefined and agreed upon by the parties involved or determined by the DAO's governance rules and when those conditions are met, the escrowed funds will be automatically released to the wallet by a smart contract (Jarvenpaa et al., 2017). Escrow mechanism combined with the multi-signature mechanism which involves multiple parties to provide their digital signatures for executing a transaction or accessing assets adds an extra layer of security and prevents fraudulent activities by requiring the consensus of multiple trusted parties (Aitzhan and Svetinovic, 2016).

Simple majority voting is a governance mechanism commonly employed in DAOs to facilitate decision-making where each token holder typically possesses voting rights equal to the number of tokens

they hold and decisions are made based on the majority of votes. While it provides accessibility and democratic decision-making, attention must be paid to potential challenges such as voting power concentration and exclusion of minority voices (Fritsch et al.,2022). On the other hand, the quadratic voting approach provides a framework where token holders can express their preferences on various proposals by allocating voting credits rather than casting single votes. The number of credits required to cast a vote increases quadratically with each additional vote (Lalley and Weyl, 2018). One of the key advantages of quadratic voting is its ability to capture the collective wisdom of the DAO community and it encourages token holders to carefully consider their allocation of voting credits, incentivizing them to vote strategically and maximize their impact on proposals they genuinely care about (Allen et al., 2020)

4 Results

In this section, the findings and analysis of the collected whitepapers are presented to address the research question: “How do the governance principles and values reflected in DAO whitepapers align with the actual decision-making and governance practices within the DAO?” Examining this role is crucial to understanding the foundation of governance mechanisms within DAOs and their impact on decentralized decision-making processes. The data collection involved the compilation of 154 whitepapers, which were selected based on their market value ranking and were published between 2017 and 2023. Key information related to the governance model was extracted from each whitepaper, including voting mechanisms, decision-making processes, and governance accountability and the goal of extracting the relevant data is to analyze how much of an impact governance model has on the overall success of the DAO. The selection criteria ensured the inclusion of whitepapers that were directly relevant to the governance model of DAOs and that it included factors such as the presence of a dedicated section on governance, a description of decision-making processes, and the incorporation of token-based voting mechanisms. It is important to note that certain challenges were encountered during the data collection process, such as limited availability of whitepapers for certain DAOs or potential biases in the selection process. Nevertheless, these limitations were mitigated through extending my research on multiple data sources.

4.1 Stylized Facts on Literature Reviewed

The earliest whitepaper in the collection was published in 2017, while the most current was published in 2023. Figure 5 presents the distribution of DAOs whitepapers by year of release, to find out

that there was a steady increase in the number of whitepapers over time, and consequently indicating a growing interest in exploring governance models within DAOs.

The frequency of various governance model keywords found in the whitepapers is shown in Figure 6. The percentage of whitepapers that mention particular topics, such token-based voting systems, decentralized decision-making procedures, and governance token distribution, is shown in the graph.

These results demonstrate how common these components were in the examined whitepapers. For example, The whitepapers described many voting procedures in detail, demonstrating the variety of techniques used in DAOs such as simple majority voting or Snapshot voting. The degree of decentralization and community involvement in the decision-making procedures outlined in the whitepapers also showed considerable differences. In certain whitepapers, community-driven decision-making was strongly emphasized, giving token holders the ability to actively affect the decision-making process. The use of delegated voting, which can be seen as expert committee, was highlighted in certain whitepapers, allowing for the use of specialized knowledge or representative decision-making. The broad range of possibilities available for governance inside DAOs is reflected by the diversity of voting systems outlined in the whitepapers which demonstrates how adaptable DAOs are based on their unique objectives and community dynamics.

4.2 Integration of Governance Models with DAOs

To understand how various governance models synchronize with DAOs, we looked into how they correspond with DAOs' principles and goals. As we analyzed different governance models, some proved to be quite impressive, giving power to community members and promoting inclusive decision-making. This led to encouraging decentralization with voting directly on the blockchain and transparent governance mechanisms. Some models encountered issues when it came to scaling up or depended heavily on a select group of decision-makers. In addition, certain mechanisms boosted decentralization by allowing a large number of token holders to participate in decision-making. Some put a spotlight on transparency, utilizing blockchain technology to publicly record votes and governance activities. Others favored a community-driven approach, leading to higher levels of community involvement. By examining the alignment of governance models with the concept of DAOs and analyzing their impact on decentralization, and community participation, this paper provides a comprehensive understanding of how these models integrate with the overarching principles and goals of DAOs. This analysis sets the stage for further exploration of the implications of governance models on the functioning and effectiveness of

DAOs. Future studies could consider a larger and more diverse sample of whitepapers, including unpublished or proprietary documents, to capture a wider range of governance models. Additionally, empirical studies could be conducted to assess the practical implementation and effectiveness of the identified governance models in real-world DAOs.

4.3 *Sentiment analysis*

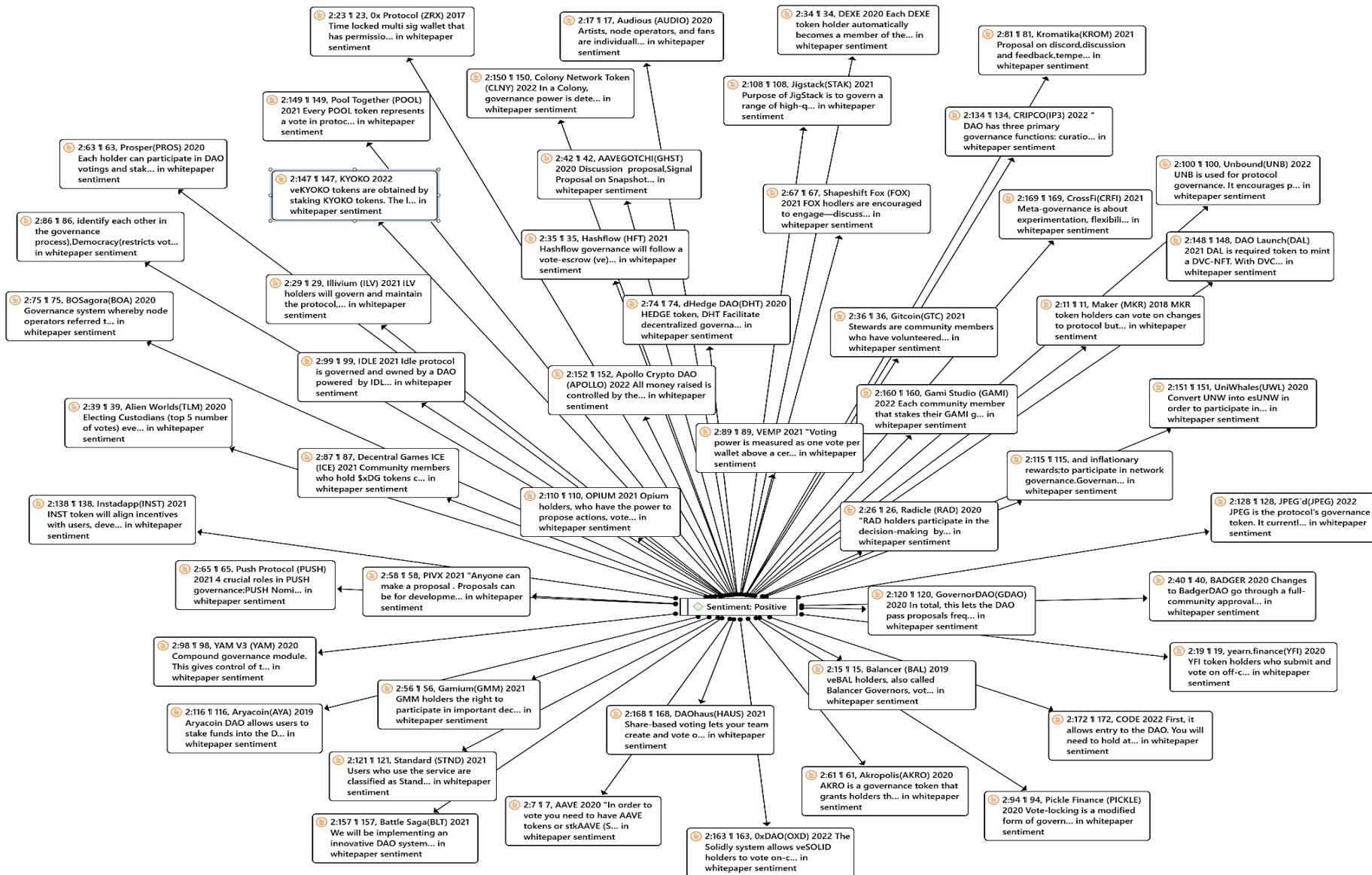
Sentiment analysis, also often called opinion mining, is a technique within Natural Language Processing which is about figuring out the sentiment or emotional tone behind words to understand the attitudes, opinions, and emotions of a speaker or a writer. Its main task is to categorize the polarity of a given text - whether the sentiment is positive, negative, or neutral (Mejova, 2009). One of the primary benefits of sentiment analysis is its ability to conduct scale-based data analysis, which overcomes the challenges associated with manually analyzing vast amounts of papers which would pose significant difficulties for a human team, whereas sentiment analysis enables the efficient analysis of millions of papers (Medhat et al., 2014).

The criteria or protocol for determining positive, negative, or neutral sentiments in sentiment analysis can vary depending on the specific approach or methodology employed. However, here are some common factors considered when classifying sentiments: Lexicon-based approaches, Machine learning algorithms, Sentiment rules and patterns and Contextual analysis (Medhat et al., 2014). Firstly, Lexicon-based methods incorporate the use of lexicons or dictionaries of words or phrases that have been predefined and given sentiment scores which may indicate the polarity (positive, negative) or intensity of sentiments (Taboada, 2011). Furthermore, with machine learning algorithms, the model learns patterns and correlations between input characteristics such as words, n-grams, or grammatical structures, and the associated emotion labels (Agarwal, 2016). In sentiment analysis, linguistic rules or patterns specific to the language or domain being analyzed are employed to capture semantic structures indicative of sentiment, such as the strong positive suggestion conveyed by phrases like "I love" or the negative connotation conveyed by phrases like "I hate" (Poria, et al, 2014). Finally, it is crucial to understand the contextual information surrounding a text, as the sentiment connotations of the same words or phrases can vary depending on the context in which they are employed; thus, analyzing the surrounding words, sentence structure, or broader discourse can offer valuable clues for sentiment classification (Ito et al., 2020).

In this research, we employed ATLAS ti's Sentiment Analysis function, which utilizes text analysis techniques to interpret and classify emotions (positive, negative, and neutral) within text data. The analysis is powered by spaCy (<https://spacy.io/>), a natural language processing engine that processes input data through a sequential pipeline to enhance knowledge derived from preceding steps. The first step involves tokenization, where the given text is divided into meaningful parts and ellipses are replaced. Additionally, the tokenizer utilizes language-specific vocabularies to assign vectors to words, which were pre-learned from a corpus and demonstrate contextual similarity within the utilized corpus. The next element is a tagger that assigns part-of-speech tags and lexemes to each token representing a word. By employing a diverse range of texts, including social media discussions and individuals' opinions on various subjects and products, the sentiment analysis pipeline integrates modified pre-trained or custom-built models to facilitate comprehensive analysis (ATLAS.ti 22 Windows - User Manual).

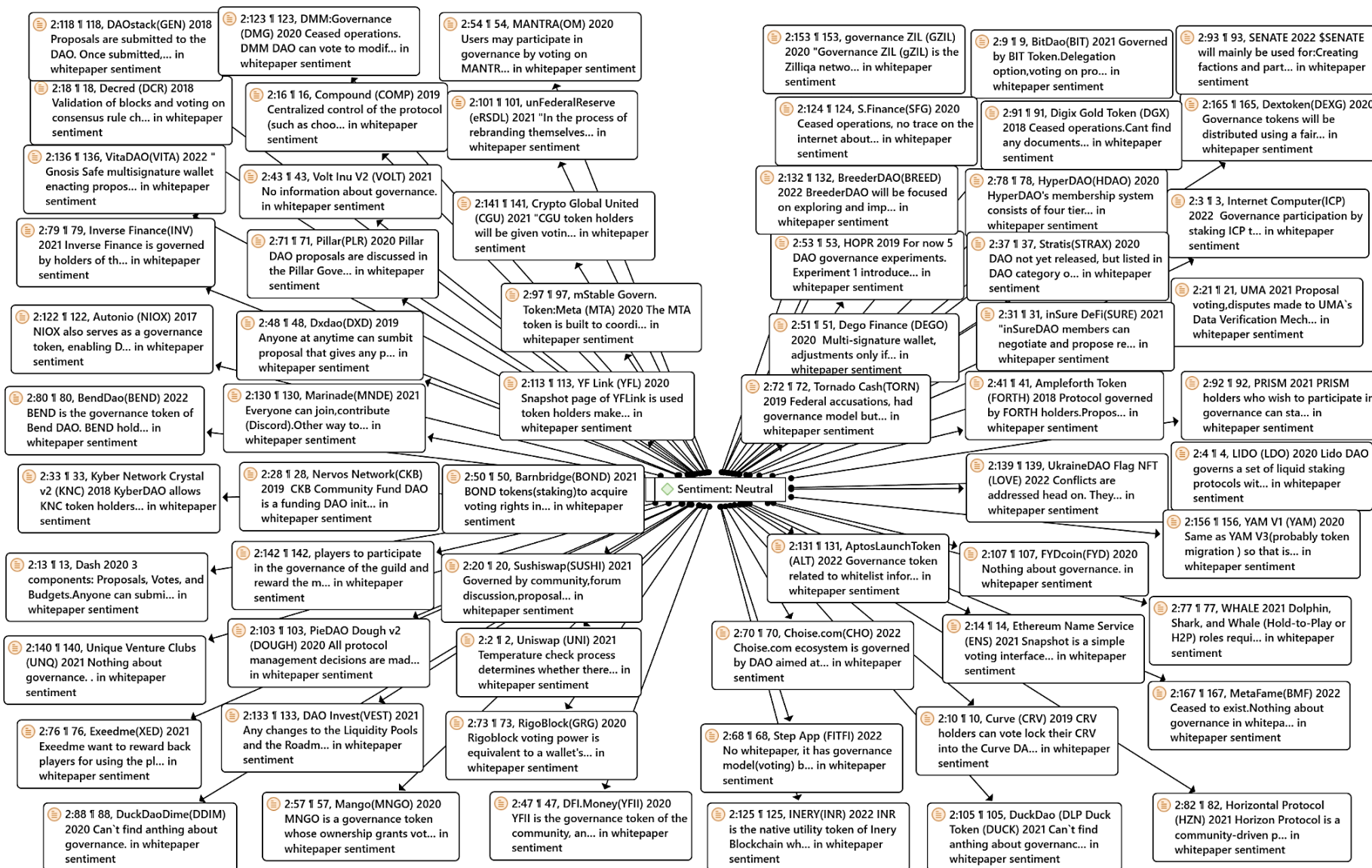
Positive sentiment, one of the categories, denotes favorable opinions or feelings towards a subject which present an optimistic perspective, excitement, or confidence about the organization (Nasukawa and Yi, 2003) .In our analysis, we found that 51 whitepapers demonstrated a predominantly positive sentiment . With our research, we got the number of 51 whitepapers that have positive sentiment. Figure 1 offers a visual representation of this data, providing a list of the DAOs associated with the whitepapers that expressed positive sentiment.

Figure 1 - Positive sentiment



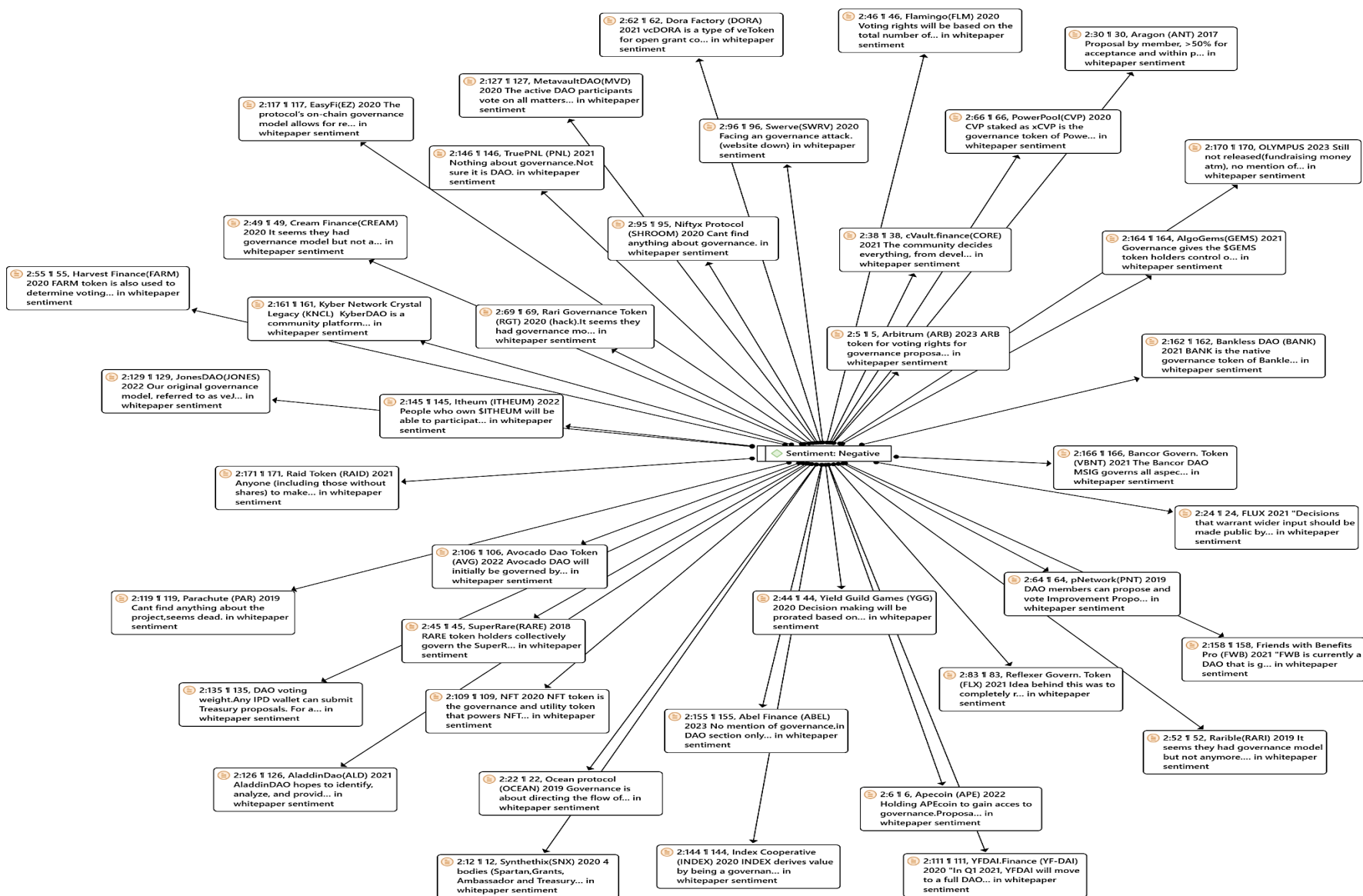
In contrast, neutral sentiment is indicative of an indifferent or unbiased stance and it often represents a middle ground where the expression neither sways towards positivity nor negativity but maintains a balance, sometimes due to lack of sufficient information (Shamantha et al., 2019). In the context of our analysis, we found that 63 whitepapers conveyed a predominantly neutral sentiment, and figure 2 offers a comparative view of all the DAOs that are classified as neutral.

Figure 2 - Neutral sentiment



Finally, negative sentiment embodies unfavorable views or emotions which typically indicates dissatisfaction, annoyance, or disappointment with the subject in question (Nasukawa and Yi, 2003). In our analysis, a total of 40 whitepapers were categorized as expressing a predominantly negative sentiment (see Figure 3).

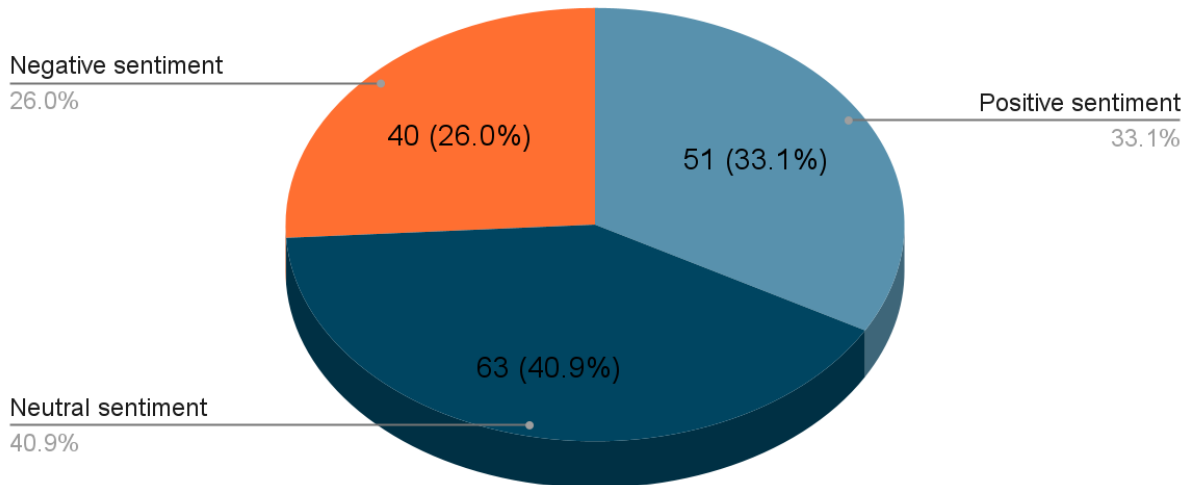
Figure 3 - Negative sentiment



Upon assessing the sentiment scores assigned to the DAO whitepapers, we have represented the results in Figure 4 as percentages to provide a more intuitive understanding of the overall sentiment distribution. From our analysis, we found that a total of 33.1% of the whitepapers exhibit a positive sentiment, 40.9% of the whitepapers display a neutral sentiment, and lastly, our analysis revealed that 26% of the whitepapers demonstrate a negative sentiment.

Figure 4. Sentiment analysis of whitepapers

Sentiment analysis of whitepapers



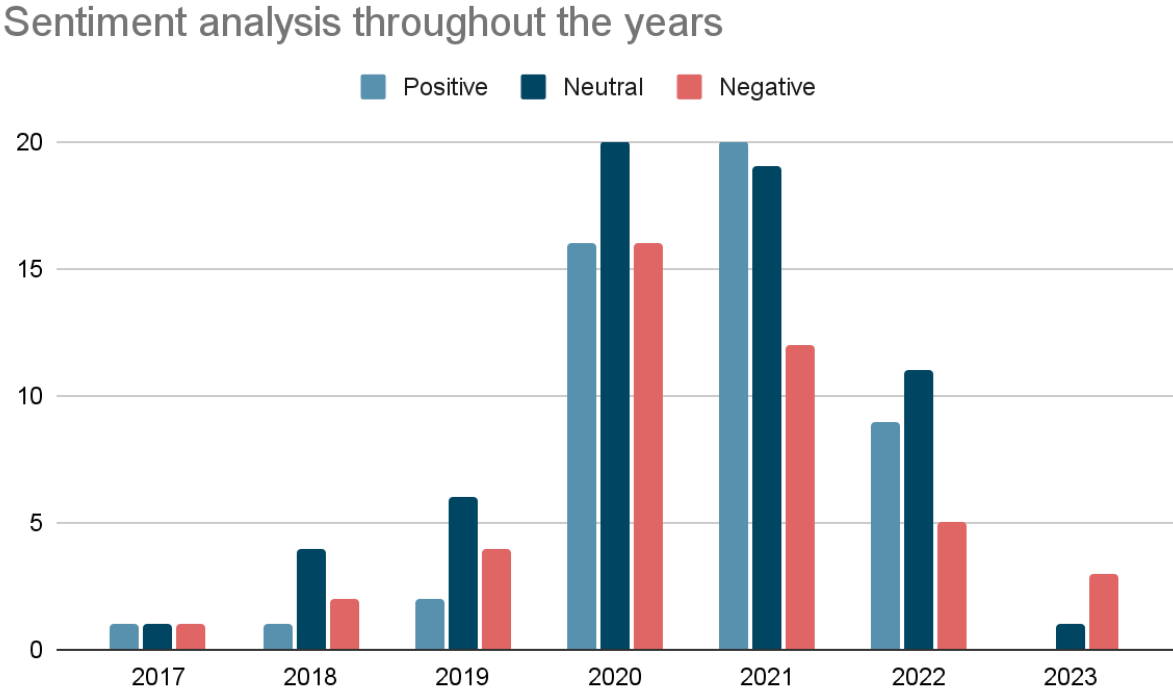
In this paper, we categorized the DAO whitepapers based on their release years to observe any shifts in sentiment over time. During 2017, when the whole concept of DAO was invented only three DAOs existed that currently hold a position within the top 154 organizations by market value. These three DAOs reflected a diverse sentiment spectrum, with one indicating a positive sentiment, one neutral, and one negative. The year 2018 saw a mild rise in the number of DAOs to seven, yet only one (14%) showcased a positive sentiment.

In 2018, the seven DAOs showed a distribution of sentiments where one was positive (14%), four were neutral (57%), and two portrayed negative sentiment (29%). The subsequent year, 2019, saw a modest rise in DAOs to twelve in which two were positive (16.67%), six remained neutral (50%), and four

projected negative sentiments (33.33%). The year 2020 marked a significant expansion in the DAO domain with the emergence of 52 new DAOs. Sentiment analysis of these DAOs revealed 16 positive (31%), 20 neutral (38%), and 16 negative sentiments (31%). Similarly, 2021 recorded the establishment of 51 DAOs, with sentiment analysis showing 20 positive (39%), 19 neutral (37%), and 12 negative sentiments (24%).

In 2022, the number of new DAOs noticeably reduced to 25, with sentiment analysis revealing 9 positive (36%), 11 neutral (44%), and 5 negative sentiments (20%). As of now in 2023, we've recorded 4 high market value DAOs, none of which displayed positive sentiment in their whitepapers, while one showed neutral sentiment (25%) and three exhibited negative sentiment (75%). In Figure 5, we have visually presented the results of sentiment analysis conducted on the collected DAO whitepapers across different years which enables a comparative understanding of the changing sentiments embedded within the text of these whitepapers over time.

Figure 5. Sentiment analysis throughout the years



4.4 *Keyword extraction and frequency analysis*

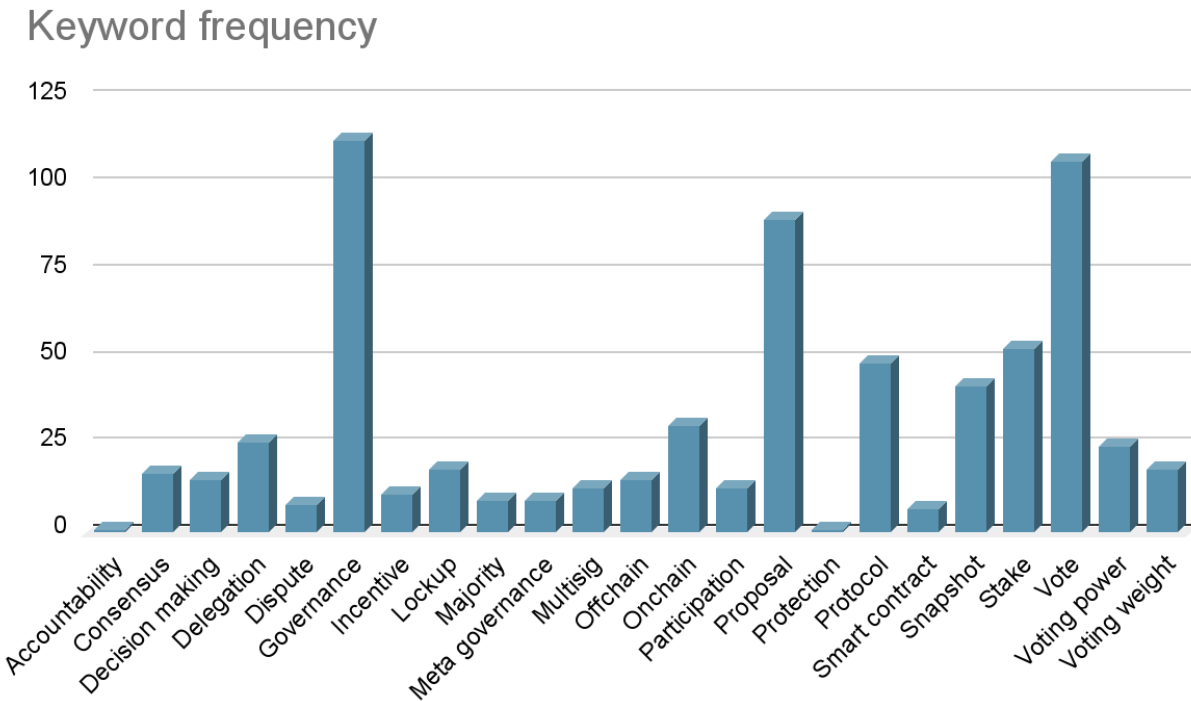
Keyword extraction is the process of identifying the most important words or phrases inside a text that reveal the main ideas of the material. Because it works like filtering through a piece of paper and pulling out the most crucial information, we can quickly understand the primary concept without having to read the entire text. (Firoozeh et al., 2020). However, frequency analysis quantifies these small pieces of information by monitoring the frequency with which each term appears in the text, enabling us to evaluate the significance of certain phrases or subjects in the text (Beliga, 2014). In the end, keyword extraction and frequency analysis offer a method of condensing enormous volumes of text data into manageable and comprehensible pieces of information making it simpler to perform in-depth research and enabling us to more efficiently gain insights from our data (Luo et al., 2016). In our research, we utilized several powerful tools available in Atlas.ti, including Opinion Mining, Find Concepts, and Text Search. The Opinion Mining tool performs sentiment analysis on text, identifying positive and negative segments and extracting the main aspects associated with them, presenting a visualization of the most important aspects for each sentiment. In the Find Concepts tool, significant noun phrases are detected to uncover frequently occurring concepts across the dataset, filtering out the most relevant ones. Lastly, with Text Search, researchers can input their own search terms and rely on Atlas.ti's automatic coding feature. It's worth noting that inflected forms, including plural nouns, verb tenses, and adjective and adverb forms, are considered during the search process (ATLAS ti 22 - User Manual)

The extracted keywords for this research are following : “ accountability “ ,”consensus”, “decision making “ ,”delegation”, “dispute” , , “governance” , “ incentive” , “lockup”, “majority”, “meta governance” ,”multisig” which stands for multisignature, “offchain”, “onchain” , “ participation “ , “ proposal” , “ protection”, “ protocol”, “smart contract “ , “snapshot” , “stake” , “vote” , “voting power” , “voting weight”.

The frequency analysis results are as follows: "accountability" was mentioned once, "consensus" received 17 mentions, and "decision making" was referenced 15 times. "Delegation" was mentioned 26 times, while "dispute" was noted 8 times, and "governance" was a frequent keyword, appearing 113 times. "Incentive" was mentioned 11 times, and "lockup" received 18 mentions. The keywords "majority" and "meta governance" each got 9 mentions, while "multisig" was mentioned 13 times. The terms "offchain" and "onchain" were mentioned 15 and 31 times respectively. The keyword "participation" was mentioned 13 times, "proposal" 89 times, and "protection" only once. "Protocol" was mentioned 49 times, "smart contract" 7 times, and "snapshot" appeared 42 times. The term "stake" was found 53 times,

"vote" was mentioned 107 times, while "voting power" received 25 mentions and "voting weight" was mentioned 18 times. Figure 6 serves as a pivotal visual representation that showcases a comparison of all the keywords identified in the DAO whitepapers and their respective number of mentions to provide valuable insights into the areas of focus and concern within the DAO ecosystem.

Figure 6. Keyword frequency in whitepapers



4.5 Keywords' relation to sentiment analysis

The word "accountability" surfaced only once, linked to a negative sentiment. "Consensus" appeared more frequently with 5 positive, 4 neutral, and 9 negative mentions. The term "decision making", although evenly spread, was slightly more positive, with 7 positive, 3 neutral, and 5 negative instances. The word "delegation" saw more mentions and was generally seen in a positive light, with 11 positive, 8 neutral, and 7 negative mentions. As for "dispute", it came up 4 times positively, once neutrally, and 3 times negatively. The keyword "governance" was mentioned much more, with 39 positive, 47 neutral, and 27 negative mentions. The term "incentive" generally evoked positive sentiments, showing up 5 times positively, 4 times neutrally, and twice negatively.

Moving on, the term "lockup" was predominantly neutral or positive, being mentioned 7 times with a positive sentiment, 8 times neutrally, and only 3 times negatively. The word "majority" saw fewer mentions with 2 times associated with positive sentiment, 2 times with neutral sentiment, and 5 times with negative sentiment. The keyword "meta governance" showed an equal distribution of sentiment, having 3 mentions each in positive, neutral, and negative contexts. In the case of "multisig", it was generally viewed positively, with 8 positive mentions, 3 neutral, and 2 negatives. For the keyword "offchain", it was largely received positively or neutrally. It was seen 7 times positively, 6 times neutrally, and 2 times negatively. Same happened with keyword "onchain" which was mentioned in a positive or neutral context as it was viewed positively 14 times, neutrally 12 times, and negatively 5 times.

The term "participation" had a mixed sentiment rating: it was seen 5 times in a positive context, 2 times neutrally, and 6 times negatively. "Proposal", on the other hand, had more balanced sentiments with 36 positive, 34 neutral, and 19 negative instances. When it came to "protection", there was only a single instance of a positive connotation. The term "protocol" was viewed positively, showing up 20 times as positive, 15 times neutral, and 13 times negative. The concept of "smart contract" was mostly well-received, having 3 positive mentions, 3 neutral, and only 1 negative. The term "snapshot" had a considerably more positive perception, with 22 positive instances, 12 neutral, and 8 negatives. In the context of "stake", sentiments were fairly balanced as it was seen 21 times positively, 20 times neutrally, and 13 times negatively. The concept of a "vote" generally received a positive response with 44 positive mentions, 38 neutral, and 24 negatives. Finally, the terms "voting power" and "voting weight" had more favorable connotations overall. "Voting power" had 14 positive, 9 neutral, and 2 negative mentions. "Voting weight", though less frequently mentioned, also skewed positive with 7 positive, 5 neutral, and 6 negative instances.

The collected keywords from our research are arranged into a primary theme, 'Governance and Decision Making', as visualized in Figure 7. Moving forward in this thesis, we will use color-coding in our figures to represent different sentiments: green for positive sentiment, gray for neutral sentiment, and red for negative sentiment This theme includes the following keywords:

1. Accountability
2. Consensus
3. Decision Making
4. Delegation
5. Governance

6. Meta Governance
7. Offchain
8. Onchain
9. Protocol
10. Smart Contract

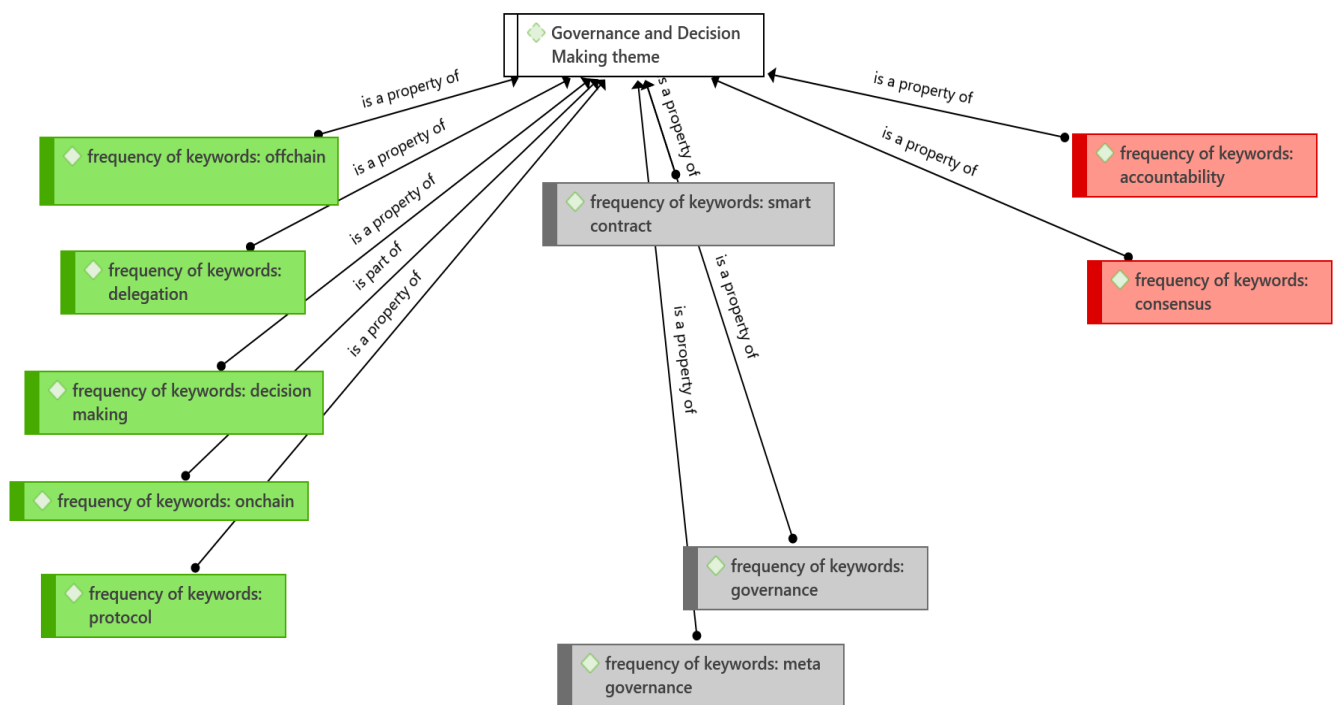
Upon performing sentiment analysis on these keywords, we can divide them into three categories based on the conveyed sentiment:

Positive Sentiment: Decision Making, Dispute, Delegation, Offchain, Onchain, Protocol

Neutral Sentiment: Meta Governance, Governance, Smart Contract

Negative Sentiment: Consensus, Accountability

Figure 7. 'Governance and Decision Making' theme



The second theme derived from our analysis is 'Participation and Voting', as represented in Figure 8. The keywords associated with this theme include:

1. Participation
2. Proposal

3. Stake
4. Vote
5. Voting Power
6. Voting Weight
7. Majority

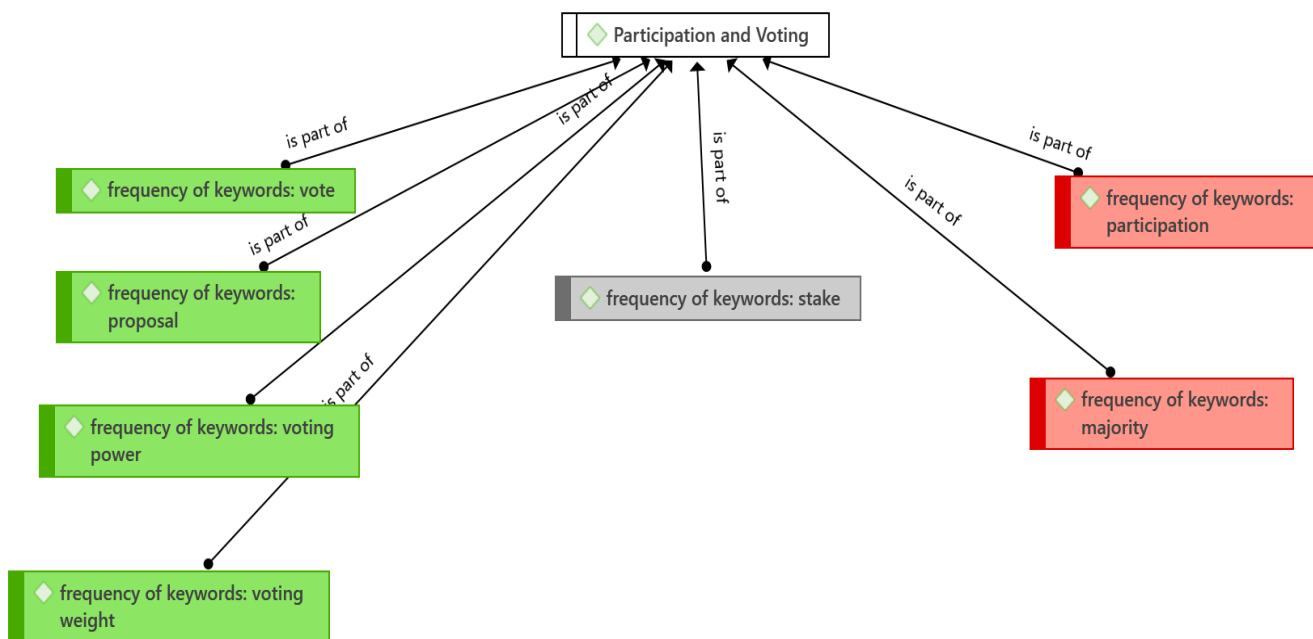
Following our sentiment analysis, these keywords are categorized into distinct sentiment groups as follows:

Positive Sentiment: Proposal, Vote, Voting Power, Voting Weight

Neutral Sentiment: Stake

Negative Sentiment: Participation, Majority

Figure 8. 'Participation and Voting' theme



The third theme we have identified in our analysis is 'Dispute Resolution and Protection', illustrated in Figure 9. The key terms related to this theme are:

1. Dispute
2. Protection
3. Multisig

4. Snapshot

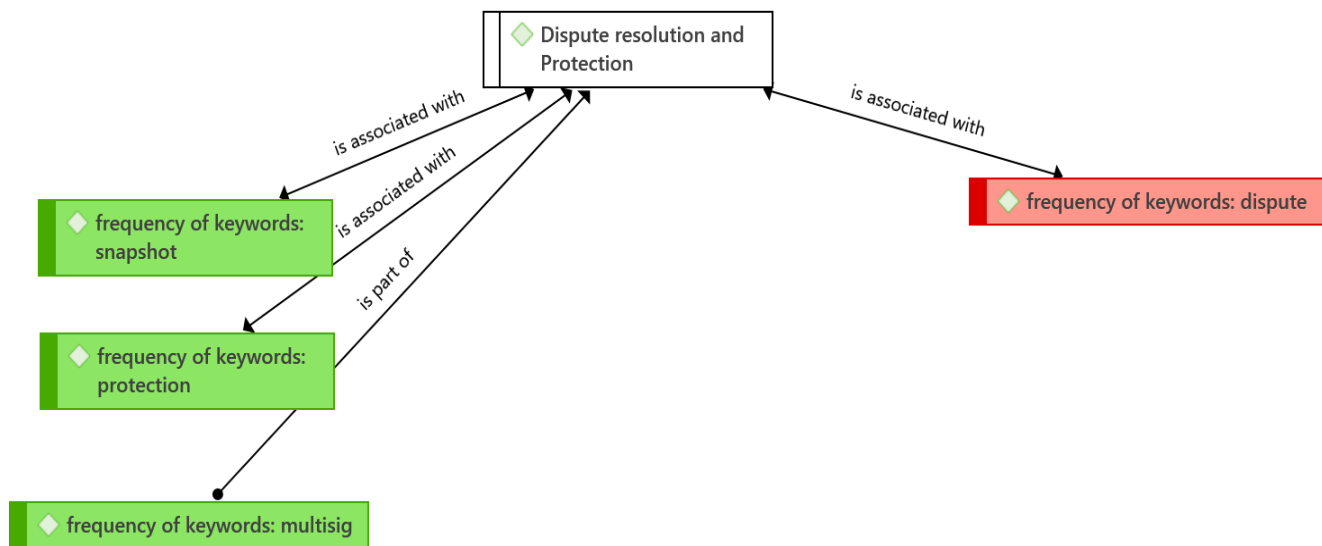
After conducting a sentiment analysis, these keywords have been organized into the following sentiment categories:

Positive Sentiment: Protection, Snapshot, Multisig

Neutral Sentiment: None

Negative Sentiment: Dispute, Majority

Figure 9. 'Dispute Resolution and Protection' theme



The final theme in our analysis is 'Incentives and Lockup', depicted in Figure 10. The keywords associated with this theme are:

1. Incentive
2. Lockup

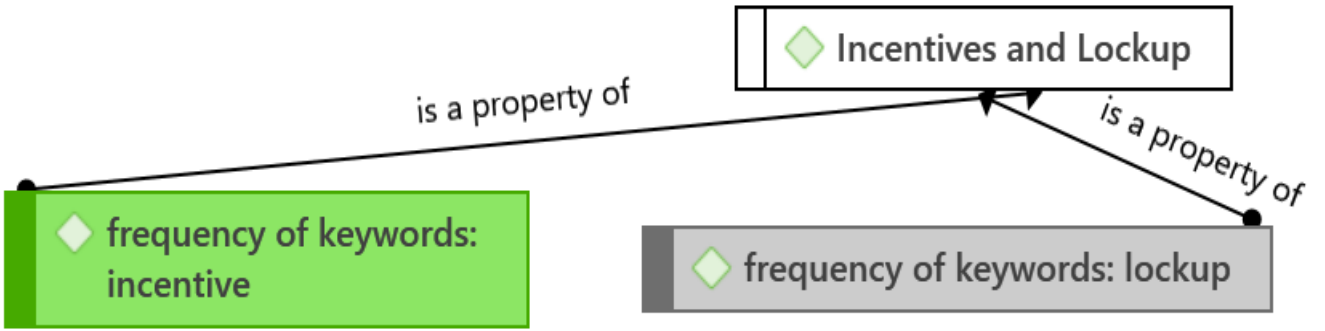
Based on our sentiment analysis, these keywords fall into the following sentiment categories:

Positive Sentiment: Incentive

Neutral Sentiment: Lockup

Negative Sentiment: None

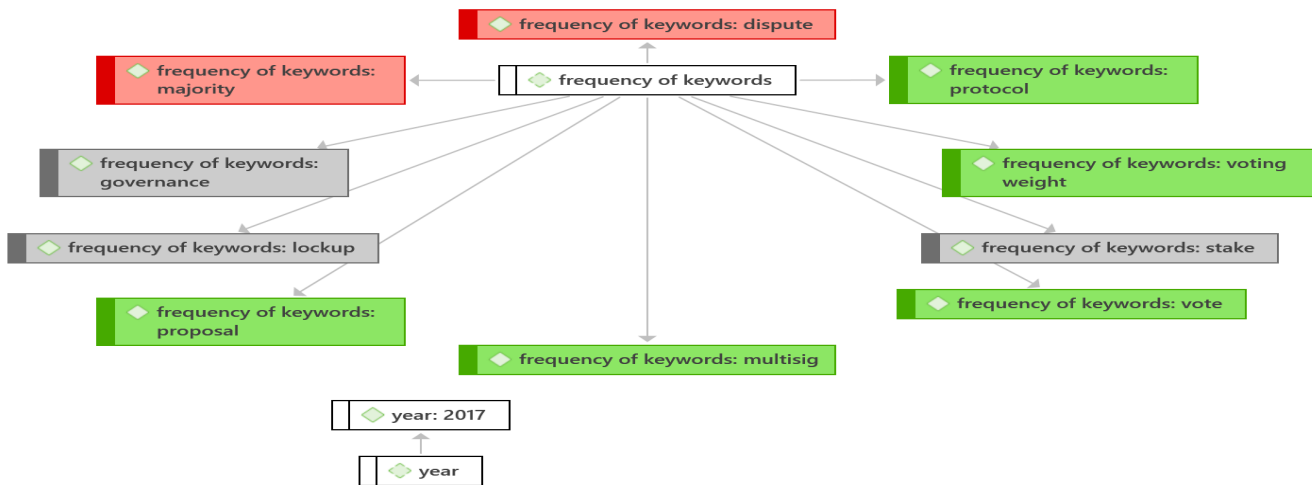
Figure 10. 'Incentives and Lockup' theme



4.6 Keyword analysis throughout the year

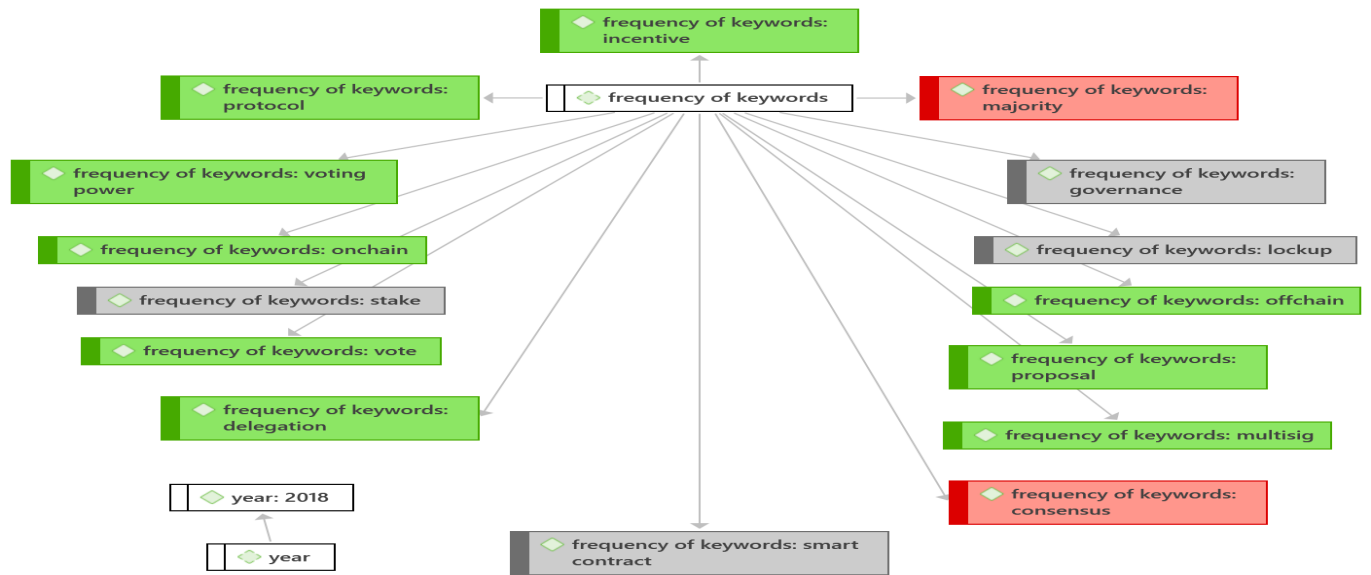
During the year 2017 (figure 11), a keyword frequency analysis in the context of DAO governance models revealed the following sentiments: The terms "Dispute" and "Majority" had a negative sentiment, while the keywords "Multisig", "Vote", "Proposal", and "Protocol" were associated with positive sentiments. Meanwhile, the terms "Stake", "Lockup", and "Governance" were perceived neutrally, suggesting they were viewed as standard elements within the discussion of DAO governance.

Figure 11. Keyword frequency and their sentiment in year 2017



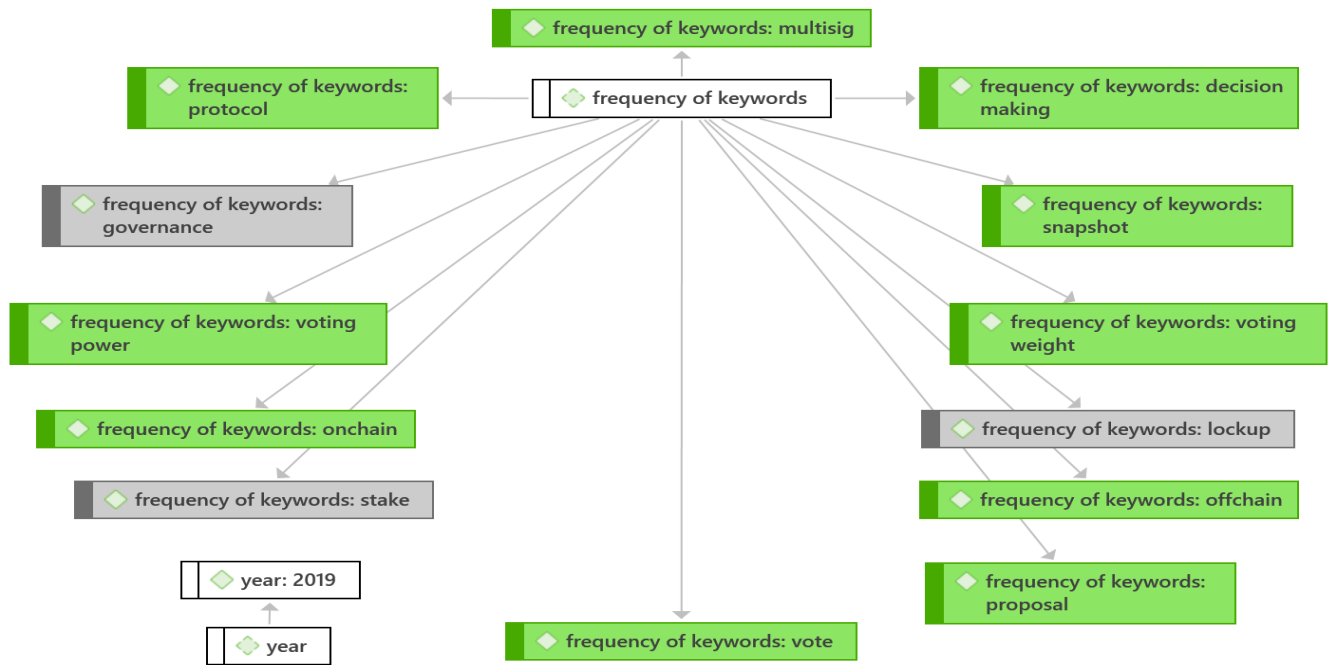
In 2018 (figure 12), the keyword analysis of DAO governance models revealed different sentiments. The terms "Incentive", "Delegation", "Multisig", "Vote", "Proposal", "Offchain", "Onchain", "Voting Power", and "Protocol" all registered positive sentiments. On the other hand, the keywords "Consensus" and "Majority" were associated with negative sentiments. Finally, the terms "Smart Contract", "Stake", "Lockup", and "Governance" carried a neutral sentiment within the analyzed content.

Figure 12. Keyword frequency and their sentiment in year 2017



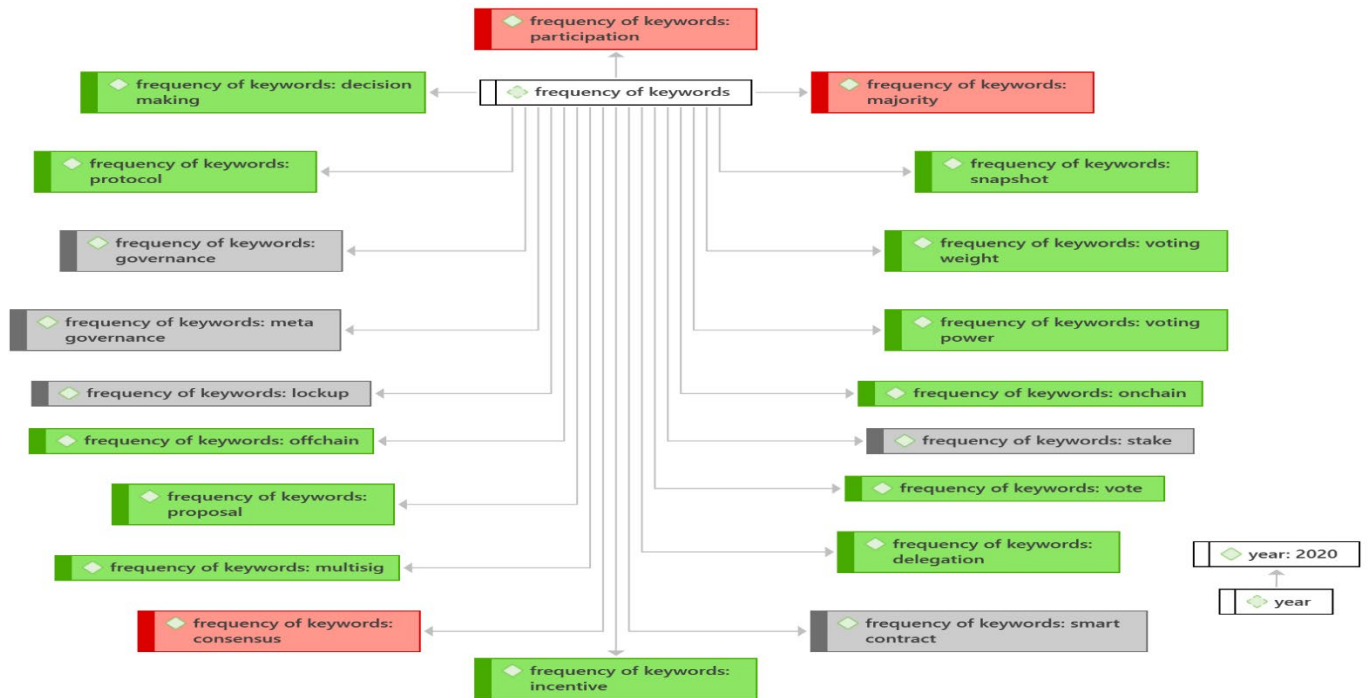
When talking about the year of 2019 (figure 13), the sentiment analysis of keyword frequency related to DAO governance models was as follows: The keywords "Multisig", "Vote", "Proposal", "Offchain", "Onchain", "Voting Power", "Voting Weight", "Snapshot", "Protocol", and "Decision Making" were all associated with positive sentiments. On the other hand, the terms "Stake", "Lockup", and "Governance" were regarded with a neutral sentiment, indicating their standard status within the discourse of DAO governance models.

Figure 13. Keyword frequency and their sentiment in year 2019



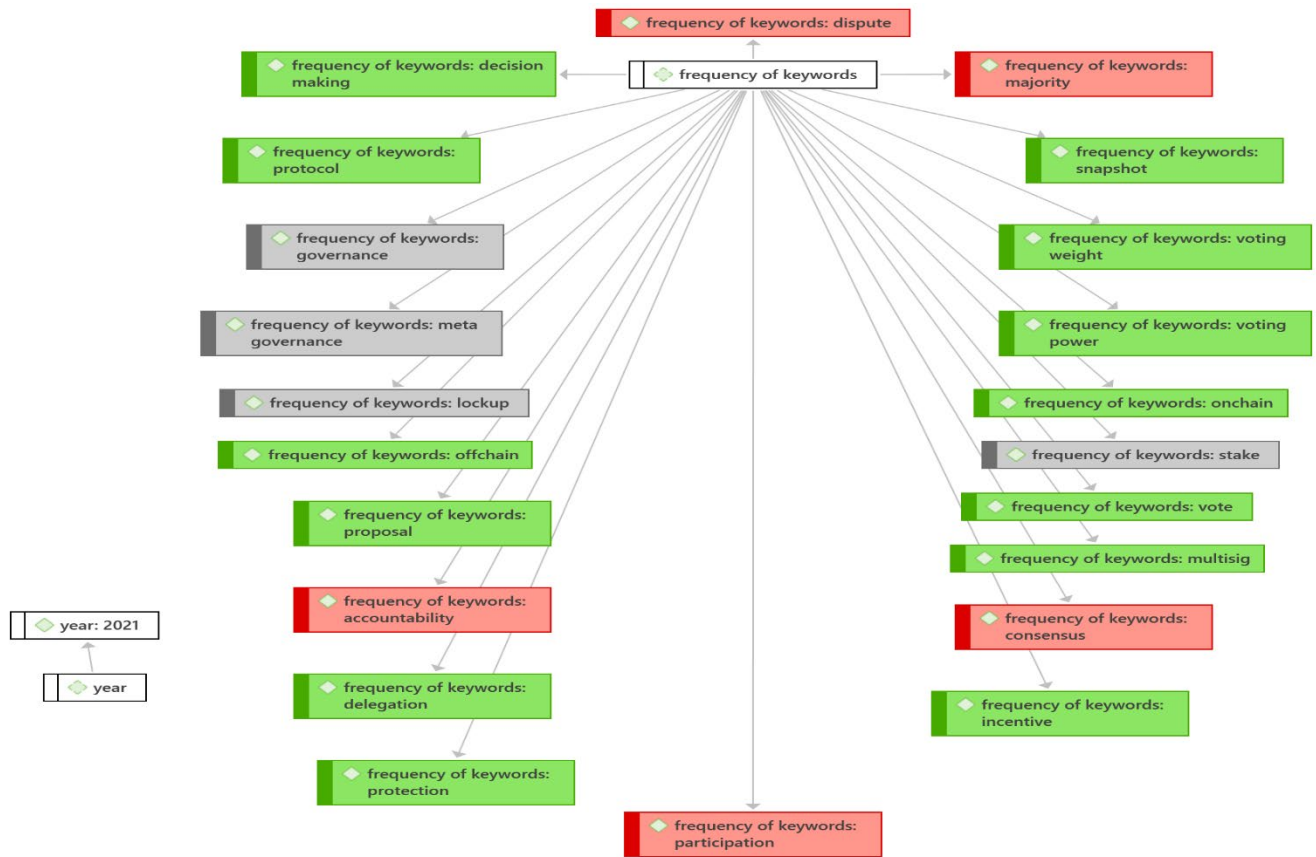
In the year 2020 (figure 14), the sentiment associated with the frequency of keywords in the context of DAO governance models presented a diverse picture: The terms "Incentive", "Delegation", "Multisig", "Vote", "Proposal", "Offchain", "Onchain", "Voting Power", "Voting Weight", "Snapshot", "Protocol", and "Decision Making" were all viewed positively. Conversely, "Participation" and "Consensus", and "Majority" surfaced with negative sentiments, hinting at possible challenges or issues in these areas. Meanwhile, the terms "Smart Contract", "Stake", "Lockup", "Meta Governance", and "Governance" held a neutral sentiment.

Figure 14. Keyword frequency and their sentiment in year 2020



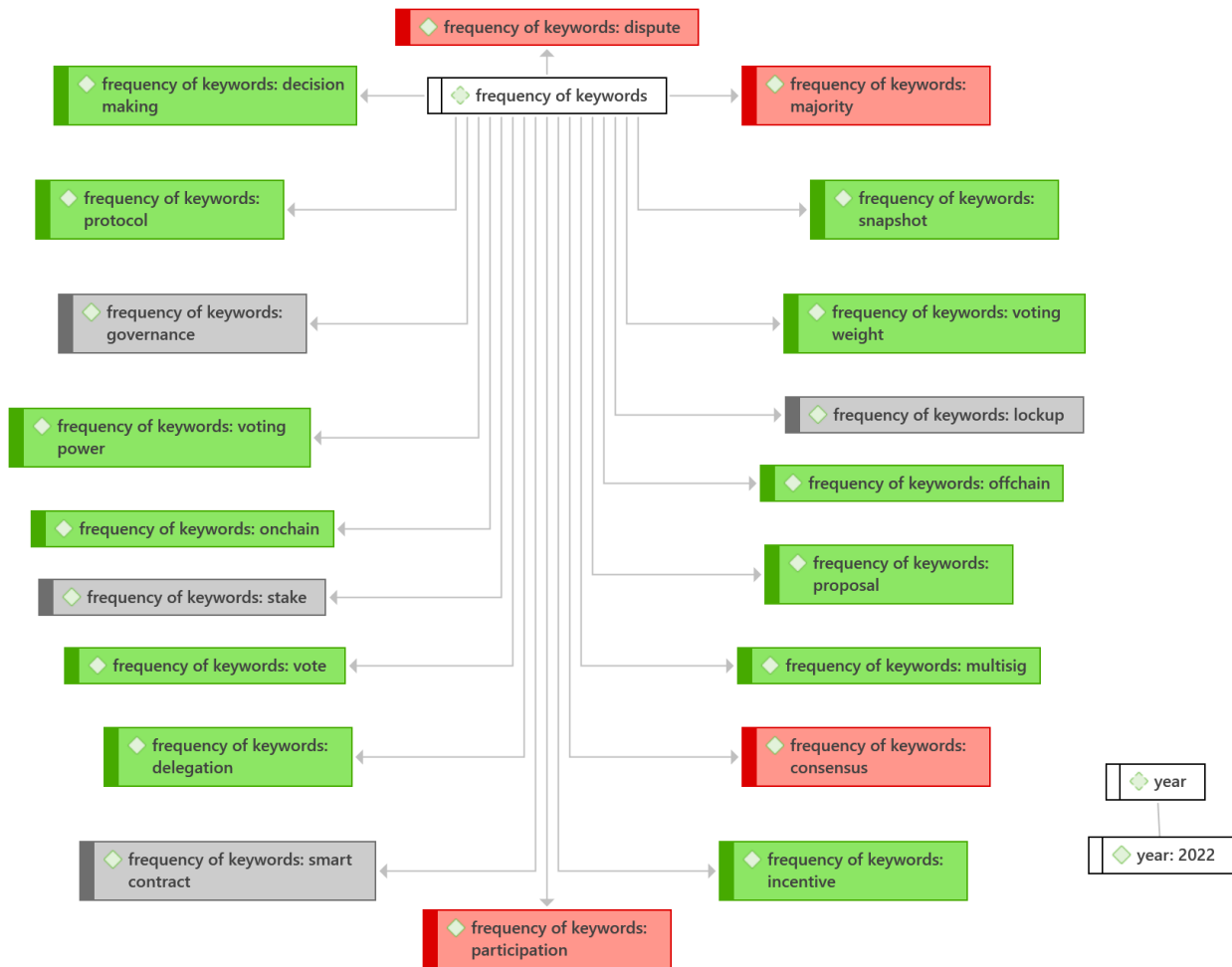
Throughout the year 2021 (figure 15), the keywords "Incentive", "Protection", "Delegation", "Multisig", "Vote", "Proposal", "Offchain", "Onchain", "Voting Power", "Voting Weight", "Snapshot", "Protocol", and "Decision Making" were associated with a positive sentiment. On the other hand, the terms "Dispute", "Participation", "Consensus", "Accountability", and "Majority" garnered a negative sentiment but terms "Stake", "Lockup", "Meta Governance", and "Governance", were met with a neutral sentiment.

Figure 15. Keyword frequency and their sentiment in year 2021



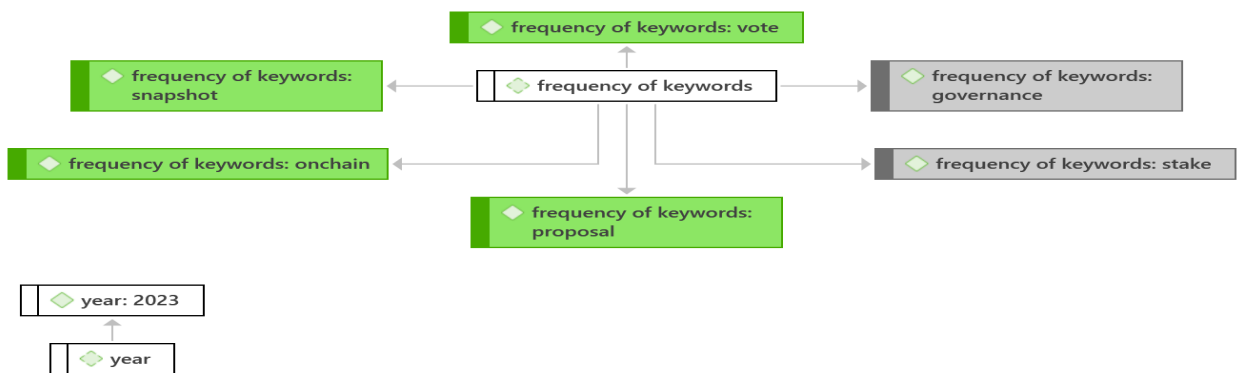
In 2022 (figure 16) , terms "Incentive", "Delegation", "Multisig", "Vote", "Proposal", "Offchain", "Onchain", "Voting Power", "Voting Weight", "Snapshot", "Protocol", and "Decision Making" all carried a positive sentiment. On the other hand, the terms "Dispute", "Participation", "Consensus", and "Majority" garnered a negative sentiment ,but terms "Smart Contract", "Stake", "Lockup", and "Governance", however, were met with a neutral sentiment.

Figure 16. Keyword frequency and their sentiment in year 2022



Finally, in year of 2023 (figure 17) the sentiment analysis of keyword frequency related to DAO governance models was as follows: "Vote", "Proposal", and "Onchain" were associated with a positive sentiment and "Stake" and "Governance" maintained a neutral sentiment.

Figure 17. Keyword frequency and their sentiment in year 2023



5 Discussion

These findings give us intriguing insights into the perception of various aspects of DAOs. The scarce mention of "accountability" and its negative sentiment raise concerns, as accountability is a crucial component of any democratic system. It suggests a potential gap in the practical implementation of DAOs, which may not be providing stakeholders with the level of accountability they anticipate or desire. The term "consensus" showed a leaning towards negative sentiment, which is surprising given that consensus is central to the operation of a DAO which indicates that there might be issues in reaching agreement within DAOs, or a lack of understanding about the consensus mechanism amongst stakeholders. Despite this, "decision making" and "delegation" were largely perceived positively which could suggest that stakeholders value the unique decision-making processes in DAOs. It is noteworthy and encouraging for DAO perception, indicating that the concept is being well-received and that stakeholders appreciate the empowerment these mechanisms offer.

The term "dispute" eliciting a mixture of sentiments is an intuitive outcome, given the complex nature of dispute resolution within decentralized systems like DAOs. Unlike traditional organizations, where hierarchical structures and established protocols often dictate the dispute resolution process, but DAOs lack centralized authority to mediate conflicts due to being decentralized and autonomous. The frequent mention of the term "governance" and its neutral and positive sentiments underscore its significance in the context of DAOs. The prevalent positive sentiment indicates a generally favorable view of the governance mechanisms within DAOs, because it gives all stakeholders ability to participate in governance regardless of their hierarchy or role. Neutral sentiments, on the other hand, might imply a degree of uncertainty, or a state of waiting to see how governance structures evolve over time because governance process is often experimental, and therefore, subject to ongoing refinement.

The positive associations with the term "incentive" suggest a general approval of the methods used within DAOs to motivate engagement and active contribution from its participants. Incentive structures within DAOs often include token rewards for participation, or rights to future profits. These are designed to encourage individuals to actively participate in decision-making processes and other organizational activities, thereby fostering a sense of communal ownership and democratic governance. However, the contrasting sentiments regarding "participation" warrant further exploration. While the presence of incentives is positively acknowledged, the actual act of participation appears to evoke mixed feelings among stakeholders which might suggest that there may be obstacles that restrict the attractiveness of these incentives or reduce their effectiveness. These barriers to participation could range

from technical difficulties, such as the understanding and usage of blockchain technology or navigating the DAO's platform, to structural issues like governance models that still favor larger token holders or contributors, thus inhibiting equal participation.

A neutral sentiment of the keyword “lockup” might reflect the understanding that while this mechanism can restrict immediate liquidity, it's beneficial for the long term health of the ecosystem. The word "majority" carries more negative sentiment which could reflect fears about potential centralization of power and that can lead to a direct “attack” of democratic ideals that DAOs bring. “Meta governance” exhibiting an equal distribution of positive, neutral, and negative sentiments could reflect an ongoing evolution because this concept involves governance over the governance process itself, and its mixed reception may reflect the complexities and potential uncertainty it introduces. The largely positive reception of "multisig" highlights its role in enhancing security and trust within DAOs and can be seen as useful guard for mistakes or against malicious activities. The terms "offchain" and "onchain" received mostly positive or neutral sentiments, which could be a reflection of stakeholders' appreciation for the potential of these methods to enhance the governance operations of DAOs.

The balanced sentiments around the term "proposal" suggest that the mechanism is seen as effective but at the same time it may indicate that some stakeholders are dissatisfied with the process of proposal making. The term "protection" received very few mentions, which could imply either a lack of consideration or a satisfactory level of protection in DAOs. "Protocol" and "smart contract", fundamental components of blockchain systems, received predominantly positive sentiment which could indicate that stakeholders appreciate the role these play in underpinning DAO operations and governance, same with “snapshot” concept. The term "stake" presented balanced sentiments, potentially signifying differing perspectives on the fairness of stake-based governance mechanisms. Stakeholders with larger stakes may view the system positively, while those with smaller stakes may view it negatively due to perceived inequity. The term "vote" and its derivatives, "voting power" and "voting weight", were generally viewed positively, which is encouraging, as voting is the essence of DAOs' democratic governance.

We will use our next section to compare and discuss the keyword frequency throughout the years. In the year 2017 (figure 11), the positive sentiment associated with words like "multisig," "vote," "proposal," and "voting weight" indicate that stakeholders respond positively to active participation methods in the decision-making process of DAOs which support Hypothesis 1A that clear accountability mechanisms and stakeholder participation are effective in ensuring compliance within the DAO. The negative sentiment towards "dispute" might indicate that the presence of conflicts or disputes could

potentially harm the reputation or operation of a DAO which could be argued that it reinforces Hypothesis 1B that having clear and enforceable mechanisms for dispute resolution is critical in maintaining alignment with the DAO's governance principles and values. At the same time, positive sentiment related to "vote" and "voting weight" suggests a correlation between the quality of a DAO's voting system and its perceived effectiveness in governance.

In 2018 (figure 12), there is a positive sentiment toward "offchain" and "onchain," suggesting an increased acceptance of advanced technologies in DAO governance as that wasn't present in 2017. Similar scenario occurred with the words "delegation" and "voting power" which suggests that in 2018, there could be a growing acceptance of proxy voting and delegation within DAOs, possibly to streamline decision-making processes and could also provide an indication of the future trajectory of DAO governance models. The negative sentiment towards "consensus" could suggest challenges in reaching agreement within DAOs. This could have replaced the term "dispute" that had a negative sentiment in 2017, indicating that the disputes might be centered around consensus building. The appearance of the term "incentive" with positive sentiment in 2018 indicates the growing importance of economic incentives in promoting participation within DAOs but the sentiment towards "lockup" remains neutral, suggesting that lockup periods alone may not be sufficient to incentivize participation. Other sentiment remained consistent in comparison to previous years, indicating stability and importance.

The positive sentiment towards terms like "multisig," "vote," "proposal," "voting power," "voting weight," "protocol," and "onchain/offchain" remained consistent in 2019 (figure 13), which could suggest a continued emphasis on these topics. The evolution of governance model in DAOs and its acceptance is represented with positive sentiment of the word "Snapshot" which wasn't present in previous years. This indicates an increasing use of snapshot voting, a gasless voting technique that helps to overcome some of the limitations of on-chain voting, and exhibits adaptability of governance models in DAOs. The terms "stake," "lockup," and "governance" continued to exhibit neutral sentiment, similar to previous years, but in 2019 there were no negative sentiment regarding the governance model, which could hint an attitude shift. As in previous years, in 2020 (figure 14) "multisig," "vote," "proposal," "voting power," "voting weight," "protocol," "onchain/offchain," and "snapshot" still carry a positive sentiment which suggests a continued emphasis on these topics. Notably, "participation" and "consensus" carry a negative sentiment, indicating possible difficulties in engaging the community and reaching an agreement in DAOs. It might suggest that while technical mechanisms for participation remain important, getting stakeholders to engage could be a growing challenge. The term "meta governance" shows a neutral sentiment, which

wasn't present in previous years which could reflect a shift towards more complex, layered governance models, including the use of other DAOs to govern a DAO's resources or decisions. The term "majority" continues to show negative sentiment as in earlier years, indicating ongoing concerns about the concentration of power in the decision-making process of DAOs.

Topics with positive sentiment that were mentioned in the previous years continued to carry the sentiment in 2021 (figure 15) which shows how important they are in the aspects of DAO governance. Similar to 2020, the negative sentiment towards "participation" and "consensus" suggests that while technical mechanisms for participation are in place, engaging the community and reaching agreement still remain significant challenge. The term "dispute," which was last seen with a negative sentiment in 2017, reappears in 2021, suggesting that conflict resolution is again becoming a notable issue within DAO governance. The term "accountability" makes its first appearance with a negative sentiment which suggest concerns related to holding parties responsible for their actions within a DAO, but at the same time the first mention of "protection" with positive sentiment happens in which might suggest that safeguarding measures provided by DAO system are seen as trustworthy. While protection and accountability might seem similar in a traditional organizational structure, the way they manifest in a DAO can vary significantly due to the unique characteristics of decentralized systems. As with all previous years, the term "majority" attracts a negative sentiment, indicating enduring concerns about the centralization of decision-making power within DAOs.

The data from 2022 (figure 16) demonstrates continuity in certain key aspects of DAO governance (such as voting mechanisms, incentive structures, and delegation), alongside persisting challenges (such as participation, consensus, and dispute resolution). Unlike 2021, "accountability" and "protection" are not prominent in 2022 which could suggest a normalization of these concerns within the discourse around DAO governance. Compared to previous years, fewer keywords are observed in 2023(figure 17). One of the reason is small time period of the whitepaper in the current year but it also could potentially suggest a more focused approach around DAO governance.

Moving forward, our analysis and discussion will draw on the three theories we have selected, considering their possible relevance to the subject of our research. The first one is Institutional theory which suggests that following established rules and norms helps organizations and individuals gain acceptance and maintain order in society (Kostova et al., 2008) making it relevant as it enables an understanding of how structures, and rules, as reflected in the DAO whitepapers, shape the behavior of the entities within these organizations. Furthermore, according to Gailmard (2014), the Principal-agent

theory addresses dilemmas concerning decision-making situations in which one party (the agent) is able to make decisions on behalf of another party (the principal). Principal-Agent theory can be applied to the relationship between the stakeholders and the DAOs in which the stakeholders are the 'principals,' and the DAOs (or those governing them) can be seen as 'agents.' This theory will help in understanding how the principals ensure that their interests are well represented and how they manage any potential conflicts of interest. Finally, Social Contract Theory is about a mutual understanding among individuals to adhere to specific societal rules (Rosenfeld, 1984), and in our case, DAOs and their stakeholders, similar to how citizens and governments agree on rules in society. This theory is a helping tool for assessing if the governance rules outlined in the whitepapers are fair and work well in real situations. The application of these three theories will thus provide a comprehensive framework for analyzing the alignment (or lack thereof) between the stated governance principles and actual practices in DAOs as reflected in the whitepapers.

Incorporating the Institutional theory, Principal-agent theory, and Social Contract Theory, we can analyze the “Governance and Decision Making” theme. According to the Institutional theory, when it comes to words “Decision making”, “Dispute”, “Delegation”, “Offchain” , “Onchain” , “Protocol”, there's a positive sentiment which means that these things are seen as effective and beneficial in achieving goals and managing issues . In the case of Institutional theory, the positive sentiment indicates that these practices align with those rules and norms, contributing to their success. Applying Principal-agent theory to keywords like “Meta governance”, “Governance”, and “Smart contract”, we find a neutral sentiment. This neutrality suggests these terms are seen as standard components in governance and decision-making. As per the Principal-agent theory, these neutral sentiments could be interpreted as an alignment with the anticipated roles, and agreements of the governing bodies and related parties .Looking at it from the perspective of the Social Contract Theory, the keywords “Consensus” and “Accountability” have a negative sentiment which means that there are difficulties or problems in reaching agreements and taking responsibility in their governance model. Overall, this group of keywords within the Governance and Decision Making theme leans most towards positive sentiment, followed by neutral sentiment and then negative sentiment.

Applying each of the three theories independently, the analysis of the sentiment numbers within the “Participation and Voting” theme can be understood as follows: According to the Institutional Theory, the keywords “Proposal”, “Vote”, “Voting power”, and “Voting weight” have a positive sentiment. They can be seen as traditional tools that people use when it's time to make choices and as that, they are seen

in a good light because they align with already established methods, which makes them an accepted part of the process. Applying the Principal-Agent Theory, the keyword “Stake” leans towards neutral sentiment which suggests that stakeholders have a vested interest in the outcomes, but their relationship may not elicit strong positive or negative sentiments. This indicates that while stakeholders have substantial investments and interests in the outcomes of a DAO's actions, their relationships with the agents executing those actions don't necessarily evoke intense positive or negative feelings. Considering the Social Contract Theory, the keywords “Participation” and “Majority” lean towards negative sentiment. This indicates that there might be challenges associated with the quality of individuals' active involvement in the governance processes and it suggests a gap between the expected level of participation and the actual engagement of individuals within the model. The keyword “Majority” express a negative sentiment within the theme which suggests that there may be some concerns related to the concept of majority rule within the governance framework and highlights the need for fair representation in decision-making processes. Overall, the sentiment analysis reveals a generally positive perception in the context of participation and voting. However, the sentiment towards stakeholders' involvement is more neutral, while the sentiment towards active participation and the percentage required for proposal to pass is negative, highlighting potential areas for improvement.

Incorporating the three theories separately, the analysis of the sentiment within the “Dispute Resolution and Protection” theme can be understood as follows: According to the Institutional Theory, the keywords “Protection”, “Snapshot” and “Multisig” have a positive sentiment which means that these concepts align with accepted ways of resolving conflicts and providing security within the governance system. They represent established methods that protect individuals and maintain, hopefully, long term stability in the institution`s framework. From the perspective of the Social Contract Theory, the keyword “Dispute” leans towards negative sentiment. This suggests that there may be challenges related to the resolution of disputes within the governance context. The theory emphasizes the importance of a mutually agreed-upon contract or agreement among individuals with the governing authority, and the negative sentiment associated with disputes may indicate a deviation from the expected cooperation. Overall, the sentiment analysis reveals a generally positive perception in the context of dispute and protection. Positive sentiments towards 'Protection', 'Snapshot', and 'Multisig' suggest that the existing mechanisms in DAOs effectively mitigate the risks typically inherent in Principal-agent theory in way that it reduce the possibility of fraudulent activities that may happen in organization, strengthening the relationship between them and ensuring the principals objectives are met. However, it is noteworthy that

there are no sentiments leaning towards neutrality in this theme, there is a clear distinction between positive and negative sentiments.

Taking each of the three theories into consideration independently, the analysis of the sentiment data inside the "Incentives and Lockup" theme can be understood as follows: From the perspective of the Institutional Theory, the keyword "Incentive" leans towards a positive sentiment which suggests that incentives play a crucial role in encouraging desirable behaviors within the governance framework and shape the organizations objectives. Considering the Principal-agent Theory, the keyword "Lockup" is associated with a neutral sentiment which implies that lockup mechanisms are perceived as standard mechanism and it implies that while stakeholders may not have an overwhelmingly positive sentiment towards it, they accept it as part of the structure designed to safeguard the long-term interests of the DAO. Considering the Social Contract Theory, the sentiment associated with the keyword "Lockup" can be further explored. In the context of incentives and lockup, lockup mechanisms can be seen as a means for token holders to show their commitment to the rules established within the blockchain system . Overall, the incorporation of these three theories provides insights into the governance and decision-making dynamics related to incentives and lockup because we have positive sentiment towards incentives, neutral sentiment towards lockup, and negative sentiment towards the majority which ultimately reflects the complex interplay between three different theories.

Aiming to address the queries raised in section 1, related to the attitudes, challenges, and prospects of the governance model in DAOs, we've turned our discussion in the following direction. Stakeholder attitudes towards DAOs showed a divergent trend, with some elements of their governance models receiving a warm response, while others didn't fare as well. Decision-making procedures and dispute resolution mechanisms, for example, evoke a predominantly positive sentiment, whereas the features tied to social contracts were met with a more negative reception. These findings underscore opportunities for DAOs to recalibrate their governance structures to better meet the needs and expectations of their communities. As for the challenges, our findings spotlight the tension between democratic ideals and efficient governance within DAOs. Ensuring stakeholder participation, an essential feature of DAOs, while maintaining effective decision-making poses a significant dilemma because in a way it questions the essence of decentralized governance. Therefore, the development of innovative solutions that reconcile these aspects is paramount for the future of DAOs. The prospects for DAOs were also examined in this thesis. A prominent finding was the positive sentiment towards terms that are generally newer, such as 'offchain' , 'onchain' and 'snapshot' concepts, indicating a growing acceptance

and understanding of these operational procedures which could imply the necessity for forthcoming evolutionary ideas.

The persistent positive sentiment throughout the years around "vote" and "proposal" suggests that DAO whitepapers often prioritize stakeholder participation. This is in line with Hypothesis 1A, as effective whitepapers consistently lay out clear mechanisms for stakeholder participation, particularly around voting and proposal-making processes. The term "dispute" emerges with a negative sentiment in later years, indicating a growing need for clear and enforceable mechanisms for dispute resolution. This evolution could suggest that whitepapers that explicitly address dispute resolution in their governance model are better equipped to handle conflicts, aligning with Hypothesis 1B. However, the evolving sentiments and frequency of other keywords such as "stake," "consensus," and "majority" suggest ongoing experimentation and evolution in DAO governance practices which could indicate a potential misalignment between governance principles outlined in the whitepapers and those practiced within DAOs, underlining the need for effective dispute resolution mechanisms. To sum up, the keyword analysis from 2017 to 2023 supports given hypothesis. It shows that successful DAOs often have strong rules for responsibility and encourage their members to participate and as organization become more complicated, those that have clear ways to resolve conflicts in their plans tend to keep up better with changes in how they are run.

To provide a more comprehensive response to our research question - "How do the governance principles and values reflected in DAO whitepapers align with the actual decision-making and governance practices within the DAO?" - we delve into the implications of our findings. Our analysis showed that the principles and values expressed in DAO whitepapers do exhibit alignment with the actual practices in key governance areas, such as decision-making and dispute resolution in a way that they outline decision-making processes as democratic and consensus-driven. Respectively, our sentiment analysis of these practices within DAOs revealed a generally positive sentiment, indicating their successful realization in practice. The same alignment was observed in dispute resolution, where the mechanisms detailed in whitepapers found favorable application in reality, resonating well with the community. However, our research also brought to light discrepancies between the governance principles expressed in whitepapers and their real-world execution, particularly regarding participation, voting, and social contracts. For instance, while DAO whitepapers strongly advocate for widespread participation and fair voting practices, the sentiment analysis pointed to a more neutral perception of these elements. This neutrality might be a reflection of barriers to effective participation or unequal distribution of voting power, thereby

indicating a gap between the ideal principles and actual practices. In addition, the analysis revealed a noticeable disparity in the perception of social contracts which suggests that while DAO whitepapers might convey a compelling vision of self-governing communities built on mutual trust, the practical implementation of these ideals in real-world settings appears to fall short of stakeholder expectations.

6 Conclusion

In the context of our hypotheses, a thoughtful evaluation of our results guide us to conclude that under the lens of the Principal-Agent Theory, the positive sentiments towards words like "Vote" and "Proposal" are critical. Whitepapers that encourage stakeholders' engagement and explicitly describe accountability procedures are essential elements of a successful DAO governance model. These whitepapers serve not just as guiding documents, but as assurance mechanisms for stakeholders (the principals). They provide reassurances that their interests are being adequately represented by the DAOs (the agents), thereby enabling them to control potential conflicts of interest. This finding supports our Hypothesis 1A, which predicts a correlation between the clarity of governance structures in whitepapers and the degree of alignment between principles and practices within DAOs. Our findings also support Hypothesis 1B, signifying a strong link between the presence of transparent, enforceable dispute resolution mechanisms in a DAO and the harmony between governance practices and principles described in the whitepaper. Both the Institutional Theory and the sentiment analysis conducted in this study confirm this finding. For instance, the keyword "Dispute" was associated with a negative sentiment, suggesting that the absence of clear dispute resolution procedures could trigger conflicts within the DAO ecosystem.

The relevance of the Social Contract Theory, which emphasizes mutual agreement and adherence to a common set of rules, is further highlighted here. Deviations from such mutually agreed-upon rules can trigger disputes, causing disruptions in the harmony of DAOs. It, therefore, supports our hypothesis suggesting that DAO whitepapers, which provide explicit details about dispute resolution mechanisms, are more likely to foster governance models that closely mirror the principles and values described in the whitepaper. To sup up, application of institutional, agency, and social contract theories, and our sentiment analysis hints at generally positive perceptions in governance and decision-making. Neutral views are associated with participation and voting, and unfavorable sentiments in social contract. Meanwhile, dispute resolution and protection score favorably as well. Further research is necessary to explore the implications of these findings in a broader perspective.

Furthermore, reflecting on the findings of our research, it's evident that there has been a notable evolution in the frequency of certain keywords within the DAO governance discourse over the years. A particular emphasis on terms related to core aspects of blockchain governance, such as “offchain”, “onchain” and “snapshot” was observed, suggesting an increasing emphasis on technical elements. This shift perhaps mirrors the growing sophistication and acceptance of these concepts over time. However, the recurrence of terms like “participation” and “voting power” indicates a continued emphasis on democratic principles within DAOs. Interestingly, these more traditional governance-related keywords have shown mixed sentiment, reflecting the complex challenges DAOs face in balancing technical innovation with democratic inclusivity and trust within their communities.

In response to our research question - "How do the governance principles and values reflected in DAO whitepapers align with the actual decision-making and governance practices within the DAO?" - we can conclude: The principles and values in DAO whitepapers generally align with actual practices in areas like decision-making and dispute resolution, while differences show up in areas like participation, voting, and social contracts.

To conclude our exploration into the attitudes, challenges, and prospects of DAO governance models has shed light on several key facets. The divergent attitudes of stakeholders towards different components of DAO governance highlighted areas for improvement, specifically within social contracts, underlining the need for DAOs to fine-tune their structures to better meet community expectations. Moreover, our work uncovers a unique challenge for DAOs - the balancing act between preserving democratic participation and enabling efficient decision-making. The analysis further indicates a growing acceptance of emerging operational practices within the DAO space, hinting at the evolution of DAO governance as a progressive and dynamic process. This research not only contributes to our understanding of DAO governance attitudes, but it also poses relevant questions and paves the way for future inquiry into reconciling the democratic ideals with practical governance within DAOs. In light of our findings, we anticipate that DAOs and their governance models will continue to evolve, facing new challenges, adapting to them, and in end be responsible for shaping the future of decentralized governance. Further research can look into examining the specific implications of these sentiments in different governance contexts, exploring how they impact decision-making outcomes, and stakeholder engagement. Additionally, considering other theories and perspectives can offer a more comprehensive understanding of governance models and their decision-making.

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