DAO Research Trends: Reflections and Learnings from the First European DAO Workshop (DAWO)

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Abstract. Decentralized Autonomous Organizations (DAOs) represent an innovative approach to organizational structures, characterized by decentralized governance and the use of blockchain-based smart contracts. Despite their potential, DAOs face unresolved challenges, including the centralization of power, effective governance mechanisms, and legal ambiguities. This article synthesizes insights from recent studies and discussions presented in July 2024 at DAWO24, the first European DAO Workshop, which brought together researchers from diverse fields to explore these issues at the ZHAW School of Management and Law, Winterthur, Switzerland.[1] The article is divided into four sections, each addressing key aspects of DAO development. After a short introduction of DAOs, Section 2 focuses on governance mechanisms, examining how stakeholder influence the distribution of voting power, and how the application of DAO principles can enhance or undermine decentralization. It also highlights vulnerabilities such as bribery, coalition attacks, and the complexities of integrating DAO practices into open-source software development. Section 3 discusses the development of tools and frameworks essential for DAO functionality, emphasizing the importance of democratic collaboration tools, decentralized application deployment, and metrics for measuring autonomy and decentralization. Section 4 evaluates the value of DAOs in various sectors, including creative industries, cyber-physical systems, and startups, identifying both opportunities and challenges in their implementation. Section 5 examines the legal and regulatory dimensions of DAOs, addressing the evolving landscape of legal frameworks and the need for new legal theories and mechanisms to accommodate the unique characteristics of DAOs. The article concludes by emphasizing the importance of continued interdisciplinary research to address these challenges, optimize DAO design, and advance the field toward more effective and equitable digital organizations.

Keywords: Decentralized Autonomous Organization, Governance, Blockchain

[1] https://dawo24.org/

1 Introduction

Decentralized Autonomous Organizations (DAOs) have emerged as a novel form of organizational structure, but their definition remains fluid in literature. Initial attempts to define DAOs, such as Vitalik Buterin's (2014) description of a DAO "as an entity that lives on the internet and exists autonomously, but also relies heavily on individuals to take on certain tasks that the autonomous entity cannot do itself", emphasize their autonomous operation on the internet, supplemented by human intervention for tasks beyond automation. Over time, scholars like Hassan and De Filippi (2021) and Santana and Albareda (2022) further refined the concept, emphasizing DAOs' reliance on blockchain-based, self-executing rules, decentralized governance, and open communities. More recent interpretations, such as those from the World Economic Forum (Gogel et al., 2023) and the Ethereum community (2024), underscore the transparency, community-oriented governance, and the role of smart contracts in ensuring that decisions and operations are visible and collectively controlled. Overall, DAOs are recognized for their transformative organizational models, harnessing decentralized decision-making and governance tokens to manage organizational functions (Wright, 2021). By eliminating centralized control and enabling collective decision-making, DAOs offer a more democratic, transparent, and efficient alternative to traditional hierarchical structures (Morrison et al., 2020). This model leverages the collective intelligence of participants, aiming to minimize the need for central authority and promote equitable governance (Fenwick et al., 2019). It is precisely these DAO features that prompt important questions concerning the compatibility with current economic and regulatory frameworks (Guillaume & Riva, 2023), the fairness and inclusivity of contemporary decision-making processes (Vergne, 2020; Hsieh & Vergne 2023), and the feasibility of implementing such structures for communities using the current technical toolset (Fritsch et al., 2021; Lustenberger et al., 2024).

DAOs confront significant challenges and unresolved questions that are pivotal for their adaptation and their further development as alternative organizational structures. In a recent effort by several prominent DAO researchers, these challenges have been compiled, highlighting the need for interdisciplinary collaboration (Tan et al., 2023). DAWO24, the first European DAO Workshop, represents a concrete response to this call for more interdisciplinary research, as outlined by Tan et al. (2023) in their paper on "Open problems in DAOs". At DAWO24 in July 2024 at the ZHAW School of Management and Law, Winterthur, Switzerland, this interdisciplinarity was fostered by giving researchers a platform to present their current research to an international audience of DAO academics, coming from different research fields, ranging from legal, philosophical, political science, economic, computer science, finance, and communication. DAWO24 provided an opportunity to collaboratively delve into workshop sessions, offering a critical forum for exploring the complex nature of DAOs and blockchain governance. Discussions at the workshop spanned a wide range of topics related to DAOs, enabling new research opportunities to be explored and to match common research interests.

This article synthesizes the critical topics and research questions in recent studies on DAOs presented and discussed at the DAWO24. By highlighting aspects such as

governance structures, stakeholder influence, technical infrastructure, and legal implications, this article seeks to provide a comprehensive understanding of the current questions DAOs impose and gives recommendation on which topics future research should focus on. Addressing these issues is essential for optimizing the design and implementation of DAOs, thereby advancing the field towards more effective and equitable digital organizations. Hence, in section 2, we will discuss different authors analyzing governance mechanisms, in section 3 we will look at various scholars developing tools and frameworks to better understand DAOs. Section 4 will examine researcher focusing on the value of DAOs, while section 5 will explore studies concerned with the legal and regulatory aspects of DAOs. The final section concludes by emphasizing the importance of continued research to overcome the current challenges and realize the full potential of DAOs.

2 Analyzing Governance Mechanisms in DAOs

Understanding governance in DAO requires a comprehensive analysis of how various stakeholders influence decision-making processes and the overall effectiveness of these mechanisms (Zhao et al., 2022; Schädler et al., 2023). Central to this investigation is the influence of early investors, team members, and venture capitalists (Fritsch et al., 2024). The concentration of governance tokens among a few influential individuals often undermines the decentralized ethos of DAOs, leading to a disparity in decision-making power (Axelsen et al., 2022). These evolving governance structures of DAOs present a complex and multifaceted landscape, as highlighted by several researchers presenting at DAWO24.

For example, Saggese et al. (2024) emphasize the need to understand how different contributors and stakeholders influence voting outcomes across various proposal categories, which is essential for developing more equitable governance structures and achieving the true spirit of decentralization. To advance this understanding, it is important to explore how to prevent power centralization, ensure fair voting power distribution, balance stakeholder influence, and evaluate alternative governance models like quadratic voting. However, implementing quadratic voting in digital governance is challenging, particularly in token-based systems where wealth disparities can skew voting results. To overcome this, Srinivasan et al. (2024) propose ConVo, an enhanced quadratic voting system that incorporates Sybil resistance through biometrics-based Proof-of-Personhood and adjusts vote weight based on how long participants hold their convictions, possibly creating a fairer and more manipulation-resistant voting process.

In parallel, Gorzny (2024) explores the intersection of DAOs with open-source software (OSS) development, highlighting that while both fields value transparency and decentralization, DAOs could provide unique advantages for OSS projects. DAO principles, such as decentralized decision-making and incentivized participation, could enhance OSS governance, leading to more resilient and collaborative development environments. Examining the effectiveness of DAO governance in OSS, the challenges of integrating DAO practices, and the impact on innovation and scalability could provide valuable insights for improving OSS governance.

Addressing the vulnerabilities inherent in DAOs, Feichtinger et al. (2024) categorize risks such as bribery, coalition attacks, and code weaknesses, which are often overlooked in traditional audits. Addressing these overlooked vulnerabilities is essential for ensuring the viability of DAOs. Furthermore, voting mechanisms in DAOs are susceptible to attacks like Sybil attacks. Lenzi's (2024) proposed voting mechanism aims to counter these vulnerabilities using Bayesian design to prevent unfair advantages and maximize collective utility. Suggestions for additional critical research include validating the effectiveness of this mechanism across various DAO contexts, exploring its integration with other security measures, and balancing decision-making efficiency with security. Further, the author suggests applying principles from behavioral economics to create more resilient governance structures within DAOs.

The classification and categorization of DAO proposals present another important challenge that needs to be addressed. Therefore, Ziegler et al. (2024) have developed a framework using Large Language Models (LLMs) to categorize proposals with high accuracy. This framework enables automated analysis and large-scale studies of governance trends. However, refining this categorization framework, enhancing its granularity, and incorporating contextual factors that might influence the proposal success or failure could optimize proposal design and decision-making processes and potentially impact governance outcomes and community engagement within DAOs.

Further, strategic voting in DAOs, where participants vote based on anticipated outcomes rather than personal preferences, undermines the ideal of decentralization, as Rossello (2024) reveals. Influential blockholders[2] and majority voters can centralize power and manipulate outcomes, raising questions about the true nature of decentralization in DAOs. To counteract this, it is vital to examine how blockholders and other centralizing forces compromise decentralization, explore mechanisms to discourage strategic voting, and assess the effects of such voting on the financial stability and community trust within DAOs. To deepen this approach, the study suggests exploring the development of incentive structures that reward honest voting and to consider alternative voting methods to maintain balanced influence among participants.

Boss (2024) provides a broader perspective by examining the heterogeneity in governance structures among DAOs, focusing on the degrees of decentralization, autonomous functioning, and organizational structure. The findings reveal that while some centralizing mechanisms can increase efficiency, they often undermine the democratic principles of DAOs and require safeguards. The study concludes that DAOs should be viewed as a diverse landscape rather than a singular organizational model, while further research could conduct large-scale studies to explore the dynamics of decentralization and autonomous functioning across different DAO models to refine their definitions and governance frameworks. Finally, Allen et al. (2024) address the challenge of signaling quality in a pseudonymous, global environment through the application of costly signaling theory. Effective signaling mechanisms are crucial for attracting resources and talent, and distinguishing high-quality DAOs from less credible ones. The

[2] According to Rossello (2024), a blockholder in a DAO is a token holder with significant voting power who can strategically influence outcomes, often by casting decisive votes at critical moments.

development of robust signaling strategies requires collective action and may involve new protocols or regulatory frameworks. They imply upcoming research to focus on identifying the most effective signaling mechanisms for various types of DAOs, exploring the impact of public regulation on signaling processes, and understanding how unique data and environmental factors specific to Web3 might be leveraged to enhance signaling.

Overall, trends in DAO governance research emphasize the need for more equitable and decentralized decision-making processes, the integration of innovative voting mechanisms, and the exploration of how DAOs can enhance collaborative efforts in diverse areas such as open-source development. In addition, there is a growing focus on developing strategies to strengthen the integrity and transparency of DAOs, ensuring that they remain true to their decentralized principles while effectively addressing challenges such as concentration of power and security risks.

3 Developing Tools and Frameworks for DAOs

The advancement of DAOs relies heavily on the development of tools and frameworks that facilitate effective governance, transparency, and scalability (Lustenberger et al., 2024). This section presents several key areas of research featured at DAWO24 in this area and structures the different directions into a cohesive discussion, highlighting both the progress made and the questions that remain.

Central to the success of DAOs is the development of democratic collaboration tools to enhance decision-making and document creation within DAOs, as highlighted by Finanser and Talmon (2024), who explore methods like metric spaces, iterative voting, and coalition formation. These approaches are designed to improve the collaborative capabilities of DAOs, ensuring that diverse perspectives are effectively represented. As DAOs continue to grow, it is critical to identify the most effective collaboration tools that support transparency and inclusivity across large and diverse organizations, while balancing consensus-building with efficiency and scalability. Further, it is also important to explore new voting methods to increase consensus without causing delays or deadlocks. The technical infrastructure that supports the deployment of Ethereum-based decentralized applications (DApps) within DAOs also demands attention. For this, Fernández-Blanco et al. (2024) present an open-source framework designed to automate and accelerate the deployment of Ethereum-based decentralized applications (DApps), particularly for scenarios requiring customized test environments like DAOs. The framework leverages Docker and bash scripts to create networks of Ethereum and IPFS nodes, simplifying the deployment process to a single command, thereby addressing inefficiencies in current methods. The study concludes that this tool significantly reduces the complexity and time required to set up realistic test environments for DApps. Expanding the framework's adaptability to a broader range of use cases, applying it in resource-constrained environments, and further enhancing its scalability and integration with other decentralized technologies are important directions to pursue.

Measuring autonomy within DAOs presents another significant challenge. Sahm and Giaglis (2024) have introduced the Autonomy Level Indicator (ALI), a standardized

metric designed to provide a clear and consistent measure of autonomy. This advancement aims to help researchers and practitioners evaluate and compare different DAO designs. However, the complexity and inconsistent definitions of autonomy require further investigation into the most critical aspects to measure and how to quantify them effectively. Additionally, it is necessary to explore whether ALI can be standardized across the industry and to understand the impact of different levels of autonomy on governance outcomes.

Integrating complexity science into DAO frameworks offers a promising approach to addressing inefficiencies and centralization issues. Ballandies et al. (2024) suggest that complexity science can provide new perspectives on decentralization and emergent properties, potentially leading to more effective and decentralized systems. Future research should explore how principles of collective intelligence and self-organization can be applied to DAO design, and critically analyze the potential benefits and limitations of novel mechanisms like futarchies and idea markets. Understanding how these principles affect DAO governance and comparing their effectiveness to traditional hierarchical models will be critical for advancing the field. Evaluating the distribution of control within DAOs is another crucial aspect of governance. Papangelou et al. (2024) propose a probabilistic framework that incorporates complexity and entropy analyses to refine decentralization metrics. This approach aims to offer a more precise measure of decentralization, but it requires further refinement and validation, particularly for large-scale DAOs. Enhancing these metrics to account for the complexities of extensive DAOs and understanding their relationship with governance outcomes, as well as their ability to predict the success or failure of governance models, are key areas for further exploration.

Finally, assessing the business value and organizational structures of DAOs is crucial for understanding their potential in different sectors. Küng and Giaglis (2024) offer a framework for evaluating the business value of DAOs from an open systems perspective, highlighting the challenges and opportunities associated with different DAO structures. To ensure the long-term viability of DAO business structures in real-world applications, it will be crucial to investigate the factors that influence stakeholder participation and collaboration in DAOs, categorize different DAO business models, assess their impact on business outcomes, and address challenges related to scalability, governance, and community engagement.

To summarize, current trends in DAO research emphasize the development of frameworks and tools to improve overall efficiency, scalability, and transparency within decentralized organizations. Researchers are focused on enhancing collaborative decision-making processes, automating key functions, and establishing standardized metrics to better evaluate DAO performance and autonomy. Additionally, there is a growing interest in integrating complexity science and assessing the business value of DAOs to ensure they can effectively operate and scale in diverse real-world applications.

4 Evaluating the Value of DAOs

The emergence of DAOs has introduced transformative potential and significant challenges within various sectors, including the creative and cultural industries (Potts & Rennie, 2019), cyber-physical systems (CPS) (Skowroński, 2019), and blockchain startups (Ahluwalia et al., 2020). This section integrates key insights from recent research on DAOs' impact and potential on value creation, while highlighting critical areas for future exploration.

The research by Tenorio-Fornés and Lupova-Henry (2024) emphasizes that in the context of creative and cultural industries, DAOs not only offer a promising solution to address the precarious employment conditions faced by creative professionals but also, they have the potential to promote economic democracy and mitigate the issues of centralized control that are prevalent in traditional platforms. Their advocacy for value-sensitive design approaches suggests that aligning DAO design with the values of creative communities could enhance fairness and inclusivity. However, open research questions persist regarding how DAOs can be effectively designed to meet the specific needs of creative communities, which economic models best support fair compensation, and how DAOs can mitigate the precarious nature of work in traditional platforms. Additionally, understanding how DAOs can foster meaningful community engagement and ensure significant participation in governance and decision-making remains an important area for further study.

Similarly, in the realm of cyber-physical systems (CPS), Nabben et al. (2024) explore the challenges of implementing decentralized governance where physical processes intersect with digital control systems. Their research highlights the complexities of integrating blockchain technology with CPS, particularly regarding real-time data processing, autonomous decision-making, and the alignment with legal and regulatory frameworks. Future research should address how to develop governance models that can adapt to the dynamic requirements of CPS, improve resilience and reliability, and ensure effective decentralized identity management and access control. Additionally, ethical considerations concerning the autonomy and accountability of AI-driven CPS require further exploration, especially as these systems become integral to critical infrastructure and public services. Key questions include identifying the most effective decentralized governance frameworks for managing scalability, security, and real-time processing in CPS.

Shapiro (2024) extends the potential of DAOs into the realm of global digital governance, proposing a grassroots architecture aimed at replacing centralized digital platforms with a decentralized global democracy. The proposed architecture includes a blocklace-based protocol stack[3] that supports grassroots platforms, enabling local communities to form digital economies and exercise sovereign democratic governance. The study concludes that this architecture offers a scalable foundation for a global digital democracy, which could significantly alter the current digital landscape dominated by

[3] According to Shapiro (2024) 'blocklace' is a generalization of the blockchain, designed as a partially-ordered data structure where each block can have multiple signed hash pointers to preceding blocks, unlike the linear and sequential nature of a traditional blockchain.

centralized platforms. Future research should explore the practical implementation of this architecture, assess its scalability, and investigate its impact on global digital governance.

In the startup ecosystem, Merk (2024) examines the trend of startups transitioning to DAOs, revealing motivations driven by financial and stewardship objectives. Startups view DAO structures as a way to improve ownership and governance while preserving existing rights, thereby balancing innovation with control. This transition is influenced by internal goals and external factors such as market conditions, legal frameworks, and social norms. Future research should investigate the long-term effects of transitioning to DAOs on individual startups and the broader DAO ecosystem. This includes examining changes in governance dynamics, the role of community involvement, and the impact on investment and talent attraction. Additionally, understanding the legal and regulatory challenges associated with these transitions will be essential to ensure that moving to a DAO is both sustainable and beneficial.

Finally, Oarda (2024) introduces the concept of Optimal Smart Contracts as a solution to the principal-agent problem in economic transactions, utilizing AI-driven Oracles and blockchain technology within DAOs. This approach promises to increase transparency and trust, potentially leading to Pareto optimality across industries. However, the feasibility and broader adoption of these contracts in real-world scenarios require further validation, particularly in how DAOs can facilitate their widespread use.

The research on DAO presented in this section highlights their transformative potential across various sectors, from creative industries to cyber-physical systems and startups, while also underscoring the significant challenges they face. Central themes include the need for optimized governance frameworks, the integration of blockchain technology with existing systems, and the exploration of new economic models that align with decentralized principles. Future research is essential to address these challenges, focusing on the practical implementation of DAOs, their impact on industry dynamics, and the legal and regulatory implications of their widespread adoption.

5 Exploring Legal and Regulatory Dimensions of DAOs

The legal status of DAOs remains a significant challenge, as jurisdictions around the world struggle to establish appropriate regulations for these entities (Wright, 2021). This lack of clear legal frameworks complicates the operation of DAOs, especially when they function across different countries (De Filippi et al., 2022; Choi et al., 2022).

The evolving landscape of legal frameworks for DAOs has garnered significant attention across various jurisdictions, as highlighted by Pietrowska et al. (2024) comprehensive analysis of legal structures in Switzerland, Liechtenstein, and the UAE. Their research reveals that each jurisdiction offers distinct advantages and challenges, providing specific recommendations for legal entities such as Associations, Cooperatives, and Foundations based on DAO objectives. Understanding these frameworks is critical for ensuring compliance and operational success in a decentralized environment. There is a need to expand this analysis to other regions and assess the long-term implications of legal choices on the development of DAOs.

In Turkey, the lack of specific DAO regulations has led Karadeniz (2024) to propose the application of general partnership rules under Turkish law, while also suggesting that the Association could serve as a temporary solution until more suitable regulations are established. Similarly, Schillig (2024) argues for the creation of a new legal theory tailored specifically to DAOs, one that builds on existing corporate law but addresses the unique characteristics of these organizations. The current legal framework surrounding DAOs is still evolving, particularly regarding liability. Traditional liability mechanisms may not fully address the complexities inherent in DAOs, such as decentralized governance, participant anonymity, and automated decision-making through smart contracts. Napieralska and Kępczyński (2024) have examined how these traditional mechanisms might be adapted to fit the decentralized nature of DAOs. Their research underscores the need for new legal frameworks capable of handling these complexities while protecting both DAO participants and external parties.

Furthermore, there is a need to address criminal and administrative responsibilities within these frameworks. In addition to liability concerns, blockchain-based dispute resolution (BBDR) platforms also face regulatory challenges, and Kamalova's (2024) research emphasizes the importance of aligning BBDR platforms with existing legal standards to boost user confidence and ensure enforceability. Designing legal frameworks that integrate these platforms into established systems is crucial, with key areas for exploration including the impact of legal structures on DAO governance, adapting legal theories to accommodate DAOs, and ensuring BBDR platforms meet regulatory requirements.

In summary, the legal status of DAOs continues to be a significant challenge for jurisdictions around the world. The complexity of DAO operations, especially across borders, highlights the urgent need for tailored legal frameworks that address the unique characteristics of decentralized governance, participant anonymity, and smart contract automation. Research underscores the importance of developing legal structures that ensure compliance, protect stakeholders, and integrate innovative dispute resolution mechanisms, all while accommodating the evolving nature of DAOs within the global legal landscape.

6 Conclusion

The first European DAO Workshop 2024 has been important in advancing our understanding of Decentralized Autonomous Organizations and highlighting current trends in DAO research. The discussions at DAWO24 identified several key areas critical to the continued evolution of DAOs. One of the central themes at DAWO24 was the analysis of governance mechanisms within DAOs. As these organizations grow and diversify, the complexities of decentralized decision-making become increasingly challenging. The workshop emphasized the need for robust governance frameworks that balance power, ensure transparency, and effectively resolve conflicts, thereby maintaining inclusivity and fairness within DAOs. Furthermore, participants at DAWO24 underscored the need for scalable, secure, and user-friendly technical frameworks that support the deployment of decentralized applications (DApps) and improve the overall

functionality and sustainability of DAOs. The evaluation of the value that DAOs bring to both participants and society at large was also a critical topic of discussion. DAWO24 underscored the importance of establishing comprehensive metrics and frameworks to accurately assess the impact and effectiveness of DAOs, thereby justifying their adoption and continued development. Finally, the workshop explored the legal and regulatory dimensions of DAOs. Given that DAOs operate across multiple jurisdictions, the challenge of developing cohesive legal standards that accommodate their decentralized nature is paramount. DAWO24 participants delved into the potential for legal recognition of DAOs and discussed how regulatory frameworks could be adapted to foster innovation while ensuring stakeholder protection.

In summary, the results and discussions at DAWO24 have highlighted the need for further research and innovation in these areas. In particular, the importance of more interdisciplinary research has been emphasized, given that DAOs are inherently an interdisciplinary phenomenon. In this context, it should be noted that the European DAO Workshop 2024 and this article aimed to specifically promote cross-disciplinary collaboration to further develop DAO research.

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