BAR Brazilian Administration Review

ANPAD

Research Article

Decentralized Autonomous Organizations (DAOs): Field of Research and Avenues for Future Studies

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How to cite: Wegner, D., Zuquetto, R. D., & Grisi, F. C. (2024). Decentralized Autonomous Organizations (DAOs): Field of research and avenues for future studies. *BAR-Brazilian Administration Review, 21*(2), e230183.

DOI: https://doi.org/10.1590/1807-7692bar2024230183

Keywords:
systematic literature review; DAO; technology; blockchain; collaboration

JEL Code:
M100

Received:
December 12, 2023.
This paper was with the author for one revision.

Accepted:
April 20, 2024.

Publication date:
May 20, 2024.

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ABSTRACT

Objective: this study aims to review the literature on DAOs in business administration and propose a framework for DAOs compared to the key features of market, hierarchy, and network governance forms and avenues for future research. **Methods:** we performed a systematic literature review in Scopus and Web of Science databases and identified 69 articles on DAOs published in or before March 2024 in the field of business and management. **Results:** we describe the main characteristics, opportunities, and challenges for DAOs. Our study also discusses how DAOs can be further explored and how they may or may not fit in different governance and organizational forms. **Conclusions:** we conclude by offering several guidelines to researchers who want to comprehend the phenomena of DAOs and contribute to theory and practice in business administration.

INTRODUCTION

A curious and strange idea comes to the mind of some basketball fans on an internet forum: they want to buy a basketball team that competes in the National Basketball Association (NBA), the world's most prestigious and wealthiest league of basketball. The only problem is that there are no millionaires among these passionate fans, and the group does not have enough money in their pocket to buy a team, much less an NBA team. To solve this problem, they agreed to create a decentralized autonomous organization (DAO) whose rules are public and transparent and whose decisions are made democratically by all token owners. This organizational model allows the collaboration of people who have never met before but whose interests and goals are similar. Since the rules and decisions are transparent and registered on the blockchain, opportunism and misconduct are reduced, and strangers can feel comfortable collaborating for a common purpose. This story refers to Krause House, a DAO that describes itself as "a community of hoop fanatics just crazy enough to buy an NBA team" (Krause House, 2023). Like Krause House, several DAOs have been created by communities of people to support specific causes.

The discussion about DAOs has not just gained momentum among practitioners. In the last few years, many scientific studies on the topic have been produced (Santana & Albareda, 2022). While most of these articles have been published in fields like technology and computer science, researchers and business administration practitioners also aim to understand how DAOs may change business models and organizations. Their promises of radical democracy (Bellavitis et al., 2022) and reducing transaction costs and agency problems (Liu & Shang, 2022) challenge traditional organizational forms and offer new ways to stimulate collaboration among individuals (Wang et al., 2023) and foster decentralization. Decentralization management is not a new topic in the field of organizational studies. For decades, scholars have discussed how decentralization may be implemented and how it may affect business performance (Hales, 1999; Mookherjee, 2006). However, digital technologies have enabled organizations to implement decentralization at various levels. For instance, technologies like blockchain and artificial intelligence have been celebrated due to their potential to allow fast and decentralized decisions, even to decentralize entire organizations, as in the case of DAOs (Ellinger et al., 2023; Zhao et al., 2022). While such technologies allow for new forms of decentralization, their promises must be critically assessed to understand whether they effectively contribute to genuine decentralization in organizations or create new power imbalances.

Due to the growing interest in the topic and the need to translate the concepts and features of DAOs to the fields of organizational science and business management, this study aims to answer the following research question: How has the research on decentralized autonomous organizations (DAOs) evolved in business administration, and what are the key features of DAOs compared to market, hierarchy, and network governance forms? To answer this question, we performed a systematic literature review on DAOs in business administration and proposed a framework that compares this form to market, network, and hierarchies.

Our review contributes to the field of business administration in several ways: first, we summarize the extant literature and describe its main focal topics. Second, we inform researchers about the most relevant studies published on the topic, including which seminal studies may help others enter the field of research. Third, we contribute by defining DAOs based on the characteristics described by the literature. We conclude our study by discussing DAOs compared to the market, hierarchy, and network governance forms and with recommendations for future studies, indicating how business researchers can shed new light on DAOs and analyze their impact on organizational models, the economy, and society.

LITERATURE REVIEW

DAOs: Concepts and characteristics

The concept of a DAO was initially coined by communities of software programmers and developers on internet blogs (Hassan & De Filippi, 2021). Although plenty of conceptions exist, most include similar aspects to characterize DAOs. In this section, we explore the concepts and main characteristics of DAOs before we present our own, which will synthesize previous ones and aim to guide future studies in business administration. Table 1 provides eight concepts describing what DAOs are and their main characteristics.

Table 1. The concept of DAO.

Papers	DAO Concept
Mehar et al. (2020, p. 6)	"The concept behind a distributed autonomous organization (DAO) is to program the required rules and decision-making apparatus of an organization into code, eliminating the need for governing roles. The DAO leverages the incorruptible digital ledger of Blockchain, and the digital currency and smart contracts of Ethereum to build an organization without the oversight of managers. Corporations at their very core are a set of complex agreements that are executed by managers and employees of the corporation, and the DAO mimics the entire system but replaces humans with its respective technology and code."
Wang et al. (2019, p. 1)	"The so-called Decentralized Autonomous Organization [DAO, sometimes labeled as decentralized autonomous corporation (DAC)], which is a new organization form that the management and operational rules are typically encoded on blockchain in the form of smart contracts, and can autonomously operate without centralized control or third-party intervention." DAO is a blockchain-powered organization that can run on its own without any central authority or management hierarchy. In a DAO, all the management and operational rules are recorded on blockchain in the form of smart contracts, and the distributed consensus protocols and Token Economy Incentive are utilized [25] to realize organizations' self operation, self-governance, and self-evolution."
Zamani and Giaglis (2018, p. 9)	"Cryptocurrencies together with DLT and smart contracts provide the infrastructure for the development of corporations that are fully digital and distributed and, for the first time in history, even entirely autonomous. Cryptocurrencies provide the payment method for transactions, DLT provides verification and validation of these transactions, while smart contracts can be the mechanisms that trigger transactions, essentially setting the entire corporation in motion when certain conditions are met. DACs aren't an entirely new concept; they first appeared on a conceptual level in 2011 (The Economist, 2014). However, coupled with other technological advancements, such as autonomous agents, the possible applications of DACs may be endless, as there can be 'pre-programmed' businesses (Aron, 2014)."
Hassan and De Filippi (2021, p. 2)	"A DAO is a blockchain-based system that enables people to coordinate and govern themselves mediated by a set of self-executing rules deployed on a public blockchain, and whose governance is decentralised (i.e., independent from central control). The DAC concept was used mostly informally in online forums and chats by early cryptocurrency enthusiasts, using both 'decentralized' and 'distributed' autonomous corporations interchangeably. While some argue that Bitcoin is effectively the first DAO (Buterin, 2013; Hsieh et al., 2018), the term is today understood as referring not to a blockchain network in and of itself, but rather to organisations deployed as smart contracts on top of an existing blockchain network."
Zhao et al. (2022, p. 4)	"The term DAO refers to a scalable and self-organizing community supported by blockchain-enabled coordination mechanisms (Singh & Kim, 2019) to govern its corresponding DApp."
Hsieh et al. (2018, p. 2)	"... as non-hierarchical organizations that perform and record routine tasks on a peer-to-peer, cryptographically secure, public network, and rely on the voluntary contributions of their internal stakeholders to operate, manage, and evolve the organization through a democratic consultation process (Dietz et al., 2016; Van Valkenburgh et al., 2015)."
Zalan (2018, p. 10)	"a DAO is truly autonomous, in that what the organization does or will do is determined purely by code (Maas, 2017). Thus, together with programmable money (cryptocurrencies) and programmable contracts (smart contracts), a DAO may become a building block of new economic governance (Davidson et al., 2018)."

Note. Developed by the authors.

A feature commonly mentioned is that DAOs refer to non-hierarchical organizations (Zhan et al., 2023) based on a somehow democratic consultation process (Hassan & De Filippi, 2021). The concept is related to other concepts such as "decentralized applications (DApps), decentralized autonomous corporations (DAC), and decentralized autonomous societies (DAS)" (Covarrubias & Covarrubias, 2021, p. 17). There are no formal leaders or positions that allow some members to exert command or control over others (Jiménez, 2019; Krishnan, 2020). Krishnan (2020) stresses that DAOs are decentralized because there is neither a clear leader nor a hierarchy or headquarters.

Although these characteristics are not usual in traditional hierarchy-based organizations, they do not make a DAO an innovation. Several organizations have tested business models with democratic decision-making processes, horizontal relationships, and flat structures (Forcadell, 2005). What makes a DAO utterly different from traditional organizations is that rules are encoded in software, and the participants themselves control DAOs through a voting system (Liu & Shang, 2022). These self-executing rules are transparent and registered on a public blockchain. Therefore, a DAO is based on smart contracts that run the entire organization automatically according to the codified rules (Lacity, 2022). All the routine tasks follow these rules and are performed and recorded on the peer-to-peer blockchain network. Liu and Shang (2022) argue that smart contracts bring self-organization to a new level. 'Token economy incentives' allow organizations to self-operate, self-govern, and self-evolve (Wang et al., 2019).

Davidson et al. (2018) go further and argue that a DAO may become a building block of new economic governance. They suggest that DAOs are a new form of running businesses that challenge current organizational forms since they reduce or eliminate transaction costs. Organizations are a nexus of agreements and contracts executed by managers and employees, and a "DAO mimics the entire system but replaces humans with its respective technology and code" (Mehar et al., 2020, p. 6). Myalo (2019) even refers to DAOs as a technoutopian organizational form that changes our premises about firms and organizations. However, while DAOs can promote pro-democracy groups and initiatives, they can also promote terror organizations and criminal syndicates. These groups can trade anonymously globally, hold assets that a government cannot easily confiscate, and disseminate censorship-resistant propaganda (Krishnan, 2020).

METHOD

We adopted a systematic literature review (SLR) to limit and make any bias visible (Petticrew & Roberts, 2008). Our SLR followed the procedures adopted by

Senyo et al. (2019) and Senyo et al. (2018). We started with (1) a definition of criteria for literature inclusion and exclusion, (2) searched in the databases for literature, (3) refined the literature found, (4) analyzed the selected articles, and (5) presented the findings. These procedures allowed us to extract the relevant information from the articles and identify similarities and differences between them. To answer the overall research question, we formulated several supporting sub-questions:

RQ1: What are the positive and negative impacts of DAOs described in the extant literature?

RQ2: What are the challenges DAOs may face and the opportunities this new form of organization generates?

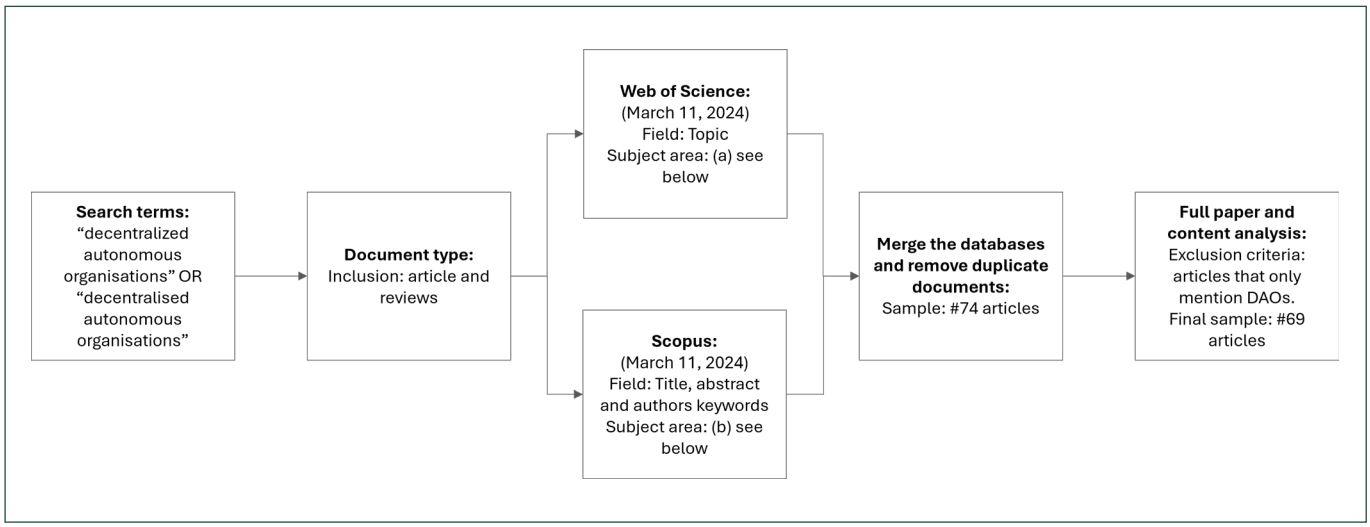
RQ3: What are the key features of DAOs compared to market, hierarchy, and network governance forms?

Procedures

Our scope was limited to papers from peer-reviewed journals (document-type: article and review article). We defined our key search terms as 'decentralized autonomous organization' and 'decentralised autonomous organisation.'

We searched for articles on the Web of Science (WoS) and Scopus databases whose topic (title, abstract, and/or keyword) included the terms, in the following subject list: WoS: management, business, business finance, economics, information science, multidisciplinary sciences, operations research management science, computer science — information systems, industrial engineering, environmental sciences, environmental studies, and interdisciplinary social sciences; Scopus: social sciences, business, management and accounting, economics, econometrics and finance, and environmental science. Subject areas are listed in Figure 1 as inclusion/exclusion criteria. This search was performed on March 11, 2024, and returned 62 peer-reviewed articles on Scopus and 24 on the WoS database, for a total of 86. In the second step, we combined both databases and identified 74 unique articles.

In the fourth stage, we read the full paper and summarized each by identifying the following information: (a) research gap, (b) research question or objective, (c) DAO concepts, (d) DAO characteristics, (e) central theories used in the paper, (f) method, (g) results, (h) directions for future research, and (i) DAO examples. This data were extracted in several columns of a table to compare papers and provide an overview of the topics in the results, discussion, and direction for future research sections of this paper. For example, using the data extracted from the paper, it was possible to identify which theories are the most relevant in the DAOs' management research field. In this stage, we removed five papers that mention DAOs without them being the main topic as per exclusion criteria. The analysis resulted in a comprehensive map of the literature on DAOs. It allowed for thematic analysis in terms of identifying the articles' concepts and features of DAOs, the main results produced by DAOs, and the challenges and risks they face.



Source: Developed by the authors. a. Management, business, business finance, economics, information science, multidisciplinary sciences, operations research management science, computer science — information systems, industrial engineering, environmental sciences, environmental studies, and interdisciplinar social sciences. b. Social Science, Business Management and Accounting, Economics, Econometrics and Finance, Environmental Science.

Figure 1. Flowchart describing sample selection.

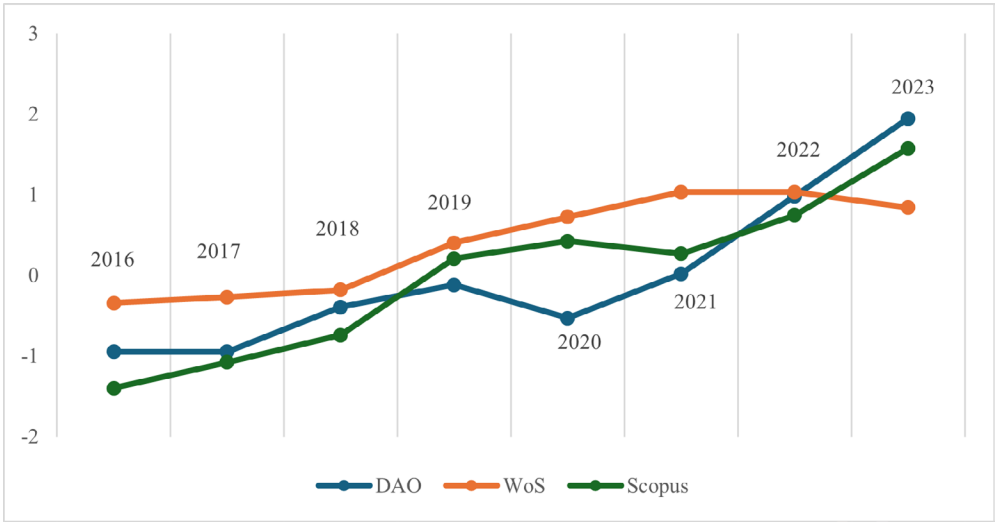
After analyzing the 69 articles, we concluded our analysis with a summary of the research on DAOs. The analysis also opens several new directions for research. We present the main results of our SLR and the directions for future research that emerge from the analysis.

RESULTS

The results section is structured into three subsections. First, we present a general overview of the articles. Next, we present findings of the extant literature on DAOs, followed by the challenges and opportunities for DAOs according to the reviewed articles.

General overview of the articles

The papers in our sample were published between 2016 and 2024. The first article in the sample (Narendra et al., 2016) focuses on collaboration networks called virtual enterprises (VE). Although the term 'decentralized autonomous organization' is mentioned as a keyword in this article, it does not effectively analyze DAOs. Therefore, Zamani and Giaglis (2018) can be considered the first article that directly addresses the topic. The paper highlights the role of blockchain in building innovative business models, including those of decentralized organizations. Immediately after the publication of this seminal article, several others advanced the field and consolidated the concept. Figure 2 shows the normalized number of articles published from the first one in 2016 until 2023. We used a z-score — standard score $(X-\mu)/\sigma$ — to normalize the data, avoid scale bias, and provide better data visualization (Hair et al., 2010) and compared with WoS and Scopus using the same filters except for the research terms. The data show that only in 2019, 2020, and 2021 the z-score of publications on DAO were lower than all publications in the same research fields of Scopus. Only in 2023 were the publications on DAO higher in the WoS database than the average publications in the same research fields. This means that DAO is growing in interest in the research areas considered in our sample; if it grows consistently, only future analysis can provide further insights.



Source: Developed by the authors.

Figure 2. Normalized scientific production by year (2016 to 2023).

Since the field is still embryonic, the sampled articles have been published in several journals. Only three outlets published more than one article: *IEEE Transactions on Computational Social Systems* (three articles), *Annals of Corporate Governance* (two articles), and *Internet Policy Review* (two articles). Table 2 presents the sample's top ten articles with the most citations. We ordered the table by WoS citation count and present Scopus citation count; we did not sum both citations to avoid duplication of citation numbers. These articles can help other researchers enter the field and identify the core concepts and discussions of DAOs.

Table 2. Most-cited articles in the sample (March 2024).

Authors	Article	Journal	WoS Citations	Scopus Citations
Mehar et al. (2020)	Understanding a revolutionary and flawed grand experiment in blockchain: The DAO attack	*Journal of Cases on Information Technology (JCIT)*	121	193
Wang et al. (2019)	Decentralized autonomous organizations: Concept, model, and applications	*IEEE Transactions on Computational Social Systems*	110	Ni
Zachariadis et al. (2019)	Governance and control in distributed ledgers: Understanding the challenges facing blockchain technology in financial services	*Information and Organization*	104	156
Zamani and Giaglis (2018)	With a little help from the miners, distributed ledger technology and market disintermediation	*Industrial Management and Data Systems*	57	77
Murray et al. (2021)	Contracting in the smart era: The implications of blockchain and decentralized autonomous organizations for contracting and corporate governance	*Academy of Management Perspectives*	57	74
Hassan and De Filippi (2021)	Decentralized autonomous organization	*Internet Policy Review*	53	96
Zhao et al. (2022)	Task management in decentralized autonomous organization	*Journal of Operations Management*	23	27
Reyes (2019)	If Rockefeller were a coder	*George Washington Law Review*	11	8
Hsieh et al. (2018)	Bitcoin and the rise of decentralized autonomous organizations	*Journal of Organization Design*	1	97
Zalan (2018)	Born global on blockchain	*Review of International Business and Strategy*	Ni	53

Note. Developed by the authors. Ni = Not indexed in the database.

Findings of the extant literature on DAOs

In this section, we explore the findings of previous studies on DAOs and describe examples analyzed by these studies. The main topics addressed by the sampled articles have been categorized as (a) transaction costs, (b) hierarchy and disintermediation, (c) democracy and voting mechanisms, (d) security and traceability, and (e) regulation.

The extant literature argues that the potential of DAOs to affect transaction costs is twofold. Transaction costs can be reduced by lowering agency and security costs and increasing automation (Kutsyk et al., 2020). Theoretical papers suggest that DAOs can help reduce transaction costs in supply chains (e.g., Van Nguyen et al., 2023) and every corporate function, from financing to talent and resource management, can be replicated on blockchains and change the whole functioning of organizations (Zalan, 2018). However, there are still no empirical studies analyzing such effects. On the contrary, other authors argue that transaction costs can increase when reconciliation of potential disagreements arises from smart contract execution, which may require specialized arbitration (Murray et al., 2021). DAOs can have a high implementation cost due to the need to deal with several external agencies, solve common challenges, and establish shared governance over software (Lacity, 2022).

Because DAOs are decentralized, there is theoretically no hierarchy, and intermediation can be eliminated. In practice, intermediaries may not be entirely eliminated, and there may be costs to identify intermediaries with varying degrees of accuracy, reliability, security, speed, and price. Additionally, the costs of secure execution may increase due to the need to monitor network concentration to avoid a 51% attack by some members, which could harm the DAO and direct it toward goals divergent from those defined at its creation (Murray et al., 2021). Hsieh et al. (2018) argue that DAOs may replace centralized intermediaries that require complex coordination, such as asset ownership tracking, trade financing, digital identity provision, and supply chain traceability. New types of intermediaries will likely arise to play new roles in mediating blockchain-based economic transactions (Zamani & Giaglis, 2018).

Democracy and voting mechanisms are also explored in the literature. While democracy is a topic widely addressed by the literature on co-operatives (e.g., Davis, 2001) and other forms of heterarchical organizations (Woods & Gronn, 2009), DAOs promise to implement it at a higher level. Some authors argue that the democratic nature of DAOs comes from their reputation, voting, and tokenization principles (Saurabh et al., 2022). The article by Ding et al. (2022) proposes

that DAOs may adopt governance strategies that follow various voting mechanisms: direct voting, representative voting, quadratic voting, conviction voting, and the futarchy mechanism.

The security and traceability of decisions and activities are another focus in the extant literature. DAOs use blockchain technology that can improve security in several ways. Myalo (2019) conducted a comparative analysis of ICOs (initial coin offerings), DAICOs (distributed automated ICO), IEOs (initial exchange offerings), and STOs (security token offerings). DAICOs improve the security of ICOs by increasing the quality of investors and providing joint management of funds and project roadmaps; more security increases traceability. In a simulation, Fernando et al. (2021) demonstrated how the tracing of drugs on a multi-chain platform can be used to create a DAO. This highlights the potential to improve supply chains and make them more secure, transparent, and efficient. Andolfatto (2024) argues that since a DAO operates simultaneously on several computers worldwide, it is almost impossible to shut it down, which means it offers a security benefit to its users.

Finally, law and regulation may accelerate, stagnate, or weaken the development of DAOs. Schuppli and Jafari (2021) propose blockchain-based vending machines to bridge digital and physical markets. They found that the model is not viable from a personal legal perspective due to little to no recourse for purchasing counterfeit goods and the lack of consumer protection. From a public legal perspective, states face challenges in levying and collecting taxes, while criminal offenders may not be brought to court.

Table 3 summarizes the literature findings regarding the positive and negative impacts of DAOs on transaction costs, hierarchy and disintermediation, democracy, security and traceability, and law and regulation:

Table 3. Positive and negative impacts of DAOs.

Impact	Positive Impact	Negative Impact	References
Transaction costs	(1) Reduce TCs by controlling and monitoring managerial incentives. (2) Reduce TCs by automating processes. (3) Reduce information costs since it is available for everyone (asymmetry issues). (4) Reduce traceability costs. (5) Every corporate function can be replicated on blockchains and reduce TCs.	(1) Increase in the beginning by involving more external partners and reaching agreements on pain points and shared governance over software. (2) Increase via inflexibility, demanding specialized arbitration. (3) Because intermediaries are not eliminated, it increases costs to identify available options with varying degrees of accuracy, reliability, security, speed, and price. (4) Increase costs to monitor a 51% attack.	Kutsyk et al. (2020) Zhan et al. (2023) Liu and Shang (2022) Fernando et al. (2021) Lacity (2022) Murray et al. (2022) Zalan (2018) Murray et al. (2021) Kim and Sarin (2018) Augustin et al. (2023)
Hierarchy and disintermediation	(1) Replace centralized intermediaries such as asset ownership tracking, trade financing, digital identity provision, and supply chain traceability.	(1) Intermediaries are not eliminated since new types will arise to play roles in mediating blockchain-based economic transactions.	Hsieh et al. (2018) Murray et al. (2021) Zamani and Giaglis (2018)
Democracy and voting mechanisms	(1) Promote pro-democracy groups based on reputation, voting, and tokenization principles. (2) Strategic voting — vote on shared goals — to improve operational performance.	(1) Promote terror organizations and criminal syndicates that trade anonymously. (2) Decision-making is biased by token price and not project value. (3) Voting on operational decisions may worsen operational performance.	Saurabh et al. (2022) Krishnan (2020) Myalo (2019) Zhao et al. (2022) Chen et al. (2020) Jirásek (2023)
Security and traceability	(1) Increase security. (2) Increase traceability of goods.	(1) Some DAOs had security issues (e.g., TheDAO).	Liu and Shang (2022) Myalo (2019) Kaal (2020a)
Law and regulation	(1) Workers, as well as investors, may easily join or leave DAOs.	(1) Fundraising success depends on country legislation, which may vary by state and limit scalability. (2) Private laws may not assure consumer protection. (3) Public laws may not collect taxes or prosecute criminal offenders.	Myalo (2019) Schuppli and Jafari (2021)

Note. Developed by the authors.

Transaction costs are the main research topic on DAOs, with nine papers providing positive and negative impacts related to the topic. The next most relevant are related to democracy, which includes the voting system used since the vote rules will define if a DAO is democratic. Next, three papers discuss hierarchy and disintermediation, which indicate that the DAO can change power imbalances while avoiding intermediaries that may capture part of the value generated by the network. Three papers discuss security and traceability since blockchain technology offers the inner characteristic of the immutability of transactions. Finally, two papers explore law and regulation of DAOs, a topic that may increase as more DAO projects become relevant in a comprehensive market.

While the extant literature suggests several benefits and opportunities for using DAOs, it also highlights the limits and doubts arising from this new form of organization. The following section explores the opportunities and challenges for DAOs mentioned in the reviewed papers.

Opportunities and challenges for DAOs

The extant literature discusses the challenges that DAOs may face and describes the opportunities this new form of organization may generate. Based on the literature review, this section presents the main challenges for new and existing DAOs. The papers highlight the following topics: (1) the governance of DAOs, (2) the role of democracy, (3) hierarchy, (4) transaction costs, and (5) security problems.

Five papers analyze and discuss the challenges of governing DAOs. Lacity (2022) raises important questions regarding DAO governance: Who holds the decision rights? How does the community agree on and coordinate software upgrades? Who decides what should happen if a crisis like a major hack emerges? What governance should be on-chain (such as voting rights managed by a smart contract) vs. off-chain, such as by an open-source community? The author argues that there are trade-offs between centralized and decentralized governance structures.

Three papers discuss the role of democracy in DAOs. Democracy is still a challenge in the field of management and organization studies. How to be a democratic and decentralized organization is an important question, and DAOs may help change the answer radically if implemented with this purpose in mind. Therefore, they offer an opportunity for organizations that want to flatten relations or adopt democratic forms of decision-making. Bellavitis et al. (2022) dive into the different forms of democracy that may emerge in DAOs. The simplest forms consist of 'one token, one vote' and 'one person, one vote.' However, the authors describe other forms, such as quadratic voting, conviction voting, holographic consensus, and liquid democracy. Jirásek (2023) argues that decentralization and democracy are still challenging in DAOs. He analyzed an empirical case (KlimaDAO) and concluded that members had concerns regarding the relatively low level of decentralization. The core team held significant control over decision-making, but there were efforts to decentralize the governance progressively and include all members.

Several papers analyze hierarchy in the context of DAOs. The role of hierarchy in shaping strategy formulation, implementation, coordination, and innovation has long been a crucial topic in the field of management. In traditional organizations, leaders typically dictate organizational strategies, which are then implemented by functional units. However, in the absence of a leader and a formal hierarchy, how do DAOs address these fundamental aspects? Uskov and Casalino (2012) demonstrate that DAOs challenge the conventional notion of hierarchy and emphasize the significance of a network-based approach, which holds implications for the future of organizations.

Security and legal issues are discussed in various articles. Wang et al. (2019) show that DAOs still face many challenges regarding security. Moreover, there are legal challenges because DAOs have conflicts with current corporation and securities laws (De Filippi et al., 2022). Other challenges include performance, privacy, and flexibility issues. Kim and Sarin (2018) show that over the last two years, more than 50,000 blockchain-based projects have materialized on GitHub. However, the authors also highlight that most projects have an average life span of 1.22 years and a survival rate of just 8%.

Table 4 summarizes the main opportunities and challenges for DAOs described in the sampled articles:

Table 4. DAOs: Opportunities and challenges.

Impact	Opportunities	Challenges	Authors
Democracy	(1) In a DAO, the data are open, real-time synchronized, and built by multiple parties working together. This will change the way decisions are made.	(1) The development of high-level innovation pillars for such a complex context may not be able to capture all elements and relationships. Making decisions will be more challenging.	Liu and Shang (2022) Zhan et al. (2023) Jirásek (2023)
Governance	(1) Network-level decisions can be made more easily.	(1) Distributed governance: the balance of integrity and autonomy, decision rights, control mechanisms, and incentive structures. There is a significant risk of members exploiting a DAO's well-established reputation and community trust for personal gains.	Lacity (2022) Zachariadis et al. (2019) Li and Chen (2024)
	(1) A DAO may become a building block of new economic governance.	(1) How do DAOs solve the universal problem of organizing activities and resources? What are the implications?	Davidson et al. (2018) Hsieh et al. (2018)
	(1) Distributed governance: the balance of integrity and autonomy, decision rights, control mechanisms, and incentive structures.	(1) DAOs challenge the underlying assumptions for the firm's existence, which relies on hierarchical governance to coordinate global trade and investment.	Zachariadis et al. (2019) Zalan (2018)
Hierarchy	(1) DAOs are truly autonomous in that what the organization does or will do is determined purely by code.	(1) DAOs have no centralized authority that assigns tasks to each member.	Maas (2017) Lumineau et al. (2021)
Security and regulation	(1) Confidence in DAOs can grow with the increase of new cases worldwide.	(1) DAOs have conflicts with the current corporation and securities laws. Other challenges include performance, privacy, and flexibility issues.	Wang et al. (2019) Kim and Sarin (2018) Laptev and Feyzrakhmanova (2021) Li and Chen (2024)
Entrepreneurship and employment	(1) Blockchain and smart contracts offer new opportunities for digital entrepreneurship.	(1) There is still a lack of regulation on jobs and employment in DAOs.	Ilyushina and MacDonald (2022) Kaal (2023)

Note. Developed by the authors.

After the systematic literature review, we present our definition of a DAO for further exploration. According to the current literature, we propose that a DAO is (a) an autonomous organization, (b) potentially non-hierarchical and democratic, (c) composed of anonymized individuals who follow a protocol, (d) supported by smart contracts and transparent rules, (e) encoded in software and registered on the blockchain, (f) governed by token holders that define its goals and directions through a consultation process that may follow different models of democracy.

DISCUSSION

The research on DAOs is concentrated in the computer science and technology fields, which look at the phenomenon from a technological perspective. One major issue is that, although several studies look for DAO as a governance mode (Covarrubias & Covarrubias, 2021; Kaal, 2020b; Lumineau et al., 2021; Uskov & Casalino, 2012; Zachariadis et al., 2019), it focuses on the network approach, which indicates that DAO uses a network mode of governance, which could not be further from the true. Lacking a more critical view of DAO concerning other governance modes or missing the comparison between market and hierarchies beyond networks governance (Thompson et al., 1991) or other modes, such as community-based, market-based, or state-based governance (Bourceret et al., 2021), may be detrimental to understand DAO from a technological or organizational perspective fully.

We understand governance as the rules guiding behavior (Bourceret et al., 2021). As DAOs can be created by one or a group of actors, their governance is subjected to the intention of these actors. We ask for caution from authors who strongly affirm that DAO is a network organizational form (Uskov & Casalino, 2012) or even a collaborative one (Laptev & Feyzrakhmanova, 2021). Although several studies affirm that DAO allows the collaboration of people who have never met before, this statement is prone to the governance mode chosen. One issue with this statement is that collaboration in DAO can go from a fundraising project (Bellavitis et al., 2022), where collaboration means to fund the same project, to the alleged coordination of complex production (Corballis & Soar, 2022), in which collaboration means to develop a new product or service. The poor definition of collaboration in DAO studies can prevent us from understanding in which contexts DAOs are helpful.

Contracts are central to any governance mode; they are central to the entire social structure. An author states that blockchain, the technology central to DAOs, is a distinct governance mechanism concerning contractual and relational governance, and in the same

paper says that "... blockchains is achieved through prescripted codes and algorithms, such as smart contracts" (Lumineau et al., 2021, p. 506); there is a misunderstood about what law means, since code is law in blockchain (Mehar et al., 2020) and means "a body of rules prescribing external conduct and considered justifiable" (Hart et al., 1960, p. 271), and about what is a contract, defined as the law that limits what the parties are expected to do (Coase, 1937). The reviewed papers do not explain how DAOs fit in any governance modes that are not network-related. However, we first attempt to elucidate this issue and provide guidance for future researchers who can discuss our proposition and redirect the research on DAO in the organizational field. Table 5 summarizes our comparison between DAOs and the other governance forms.

Table 5. Key features of DAOs concerning market, hierarchy, and network governance forms.

Key Features	Forms			DAO
	Market	Hierarchy	Network	
Normative basis	Contract	Employment contract	Complementary strengths	Smart contract
Methods of conflict resolution	Laws and regulations	Supervision	Reciprocity	Hard fork
Flexibility	High	Low	Medium	Very low
Commitment among parties	Low	High	Medium	Dependent on the project
Means of communication	Prices	Routines	Relational	Routines
Emphasis	Individual	Individual	Collective	Varies
Strategy	Competition	Cooperation	Coopetition	Coopetition
Relation among parties	Independent	Dependent	Interdependent	Interdependent
Power	Market share	Hierarchical job position	Reciprocity	Dependent on the rules encoded

Note. Developed by the authors.

The smart contract is the normative basis of DAOs. The contract is unnegotiable after creation, which makes it one of the most important aspects of DAO implementation. After a smart contract runs autonomously, there is no negotiation, it is not possible to undo the transaction, and it may not even be possible to identify the persons to renegotiate. Only a hard fork of the entire blockchain structure can change it, which needs the agreement of all participants, making it very low or not flexible. While the smart contract is created and changed in a network approach, since it depends on the network to be revised, the conflict resolution, even for contract changes, uses the code as law, similar to a market conflict resolution.

The code regulates the DAO's flexibility, meaning how fast it can change. In general, DAOs use the network to propose and approve changes. While this mode mimics a network approach, it can be highly flexible as a market approach or very low if the code imposes a high percentage of votes for change approval.

Some DAOs allow voting to decide which projects move forward but not which projects enter the DAO, meaning that parties are interdependent. Still, in some DAO layers, they may hide dependence relations. Finally, the power inside a DAO depends highly on the rules encoded. A one-token-one-vote system mimics a market share power model, while a one-person-one-vote is a more democratic voting system. In the same way, the level of consensus, the percentage of votes a project needs to be approved, can be as low or as high as DAO creators or the community decide. If the consensus percentage is too low, the need and relevance of voting lose purpose, and if a high percentage of votes is necessary to reach consensus, it may lead to no project's approval, meaning that consensus may be an exciting dimension of DAOs to be explored in market, hierarchy, and network governance forms.

DAOs use routines to establish communication among partners since participation is anonymous and consensus is accomplished by a voting system, like a hierarchy form with communication routines. Although the emphasis of the DAO is on the individual, the purpose of the network may not be achieved if there is no collective purpose. This means that decentralization tries to give power to each individual. Nonetheless, they must have a common goal in a network.

This leads to the DAO strategy and relations among parties that operate using a network approach. The participants will need to cooperate in developing some projects, while in other projects, they will compete for the network's attention. On the other hand, each DAO participant is independent of the others to make their own choices or to vote; however, they are dependent

on others to make the project move forward, creating an interdependent form like a network.

While the power distribution of a DAO is dependent on the rules encoded in the software, if a transparent decision-making model is adopted, it can reduce information asymmetry and increase efficient market prices (Perez Riaza & Gnabo, 2023).

Based on this discussion, we adopted the definition of DAO as potentially democratic, mainly because DAOs can be used as a centralized initiative or market share power relation up to an inclusive one, depending on the governance mode chosen. However, the power distribution in DAOs is more related to a hierarchy form since it is strengthened by the set of rules established by the network, and its change depends on this group of participants. The main strength of a DAO is in the transparency and traceability of the blockchain technology, but it is also what makes it rigid, for good or bad.

In the next section, we provide a set of directions for future research.

DIRECTIONS FOR FUTURE RESEARCH

The number of studies on DAOs has rapidly increased in the last few years. This growing interest raises new questions and opportunities for future research. We propose several directions for research organized into three subsections: theory, method, and context. We follow the recommendations proposed by the sampled articles but also articulate other suggestions based on gaps we have identified in the studies.

Research directions regarding theory

The field of study on DAOs in business administration is still in its infancy. The reviewed studies describe and examine a limited number of empirical cases (Myalo, 2019; Zichichi et al, 2023); others reflect on DAOs without proposing an overall theory or model (Kaal, 2020b; Wang et al., 2023). Although this represents a weakness in the extant literature, it also allows us to propose directions for future research. For instance, empirical studies may follow the transactions cost theory (Williamson, 1979) to confirm the supposed benefits of DAOs and the difficulties they may face that increase transaction costs. There are also no studies using agency theory (Eisenhardt, 1989; Shapiro, 2005) to understand how DAOs solve agency problems or whether new problems emerge that require new solutions. Entrepreneurship theories have also been completely neglected by the extant literature on DAOs. Future studies could examine the challenges for entrepreneurs who want to build DAOs and which entrepreneurial capabilities are required to build, attract, and engage communities around DAOs.

We also did not find studies dealing with the ethical aspects of DAOs. While there is still no evidence that DAOs have been used for objectives detrimental to society, there is no imperative that people use them to harm others. Future studies could address questions like how to avoid the risk of DAOs being used by terrorists or groups that harm others. How can technology be used to detect the DAOs being used for perverse objectives? How can DAOs prevent members from manipulating their partners and getting increased power to concentrate decisions that the community of members should take?

Another direction for research refers to the topic of democracy and decentralization. We encourage researchers to empirically analyze DAOs to verify whether and how they effectively include participants in democratic processes and whether there are shortcomings and challenges to such a system. Goldberg and Schär (2023) suggest that future research looks at different voting systems to understand how they work, their weaknesses, and the effects of centralizing voting rights. Jirásek (2023) recommends future studies analyze whether progressive decentralization is an alternative in DAOs and how it affects members' commitment and participation. Augustin et al. (2023) recommend that researchers analyze how DAO members' beliefs and ideologies influence their participation in decision-making and how it guides democracy inside DAOs. In this regard, theories on collaborative governance (Ansell & Gash, 2008; Emerson et al., 2012) can also be used to verify whether DAOs may play a role in integrating multiple stakeholders in decision-making processes that affect society and public policies.

Research directions regarding methods

A methodological challenge to studying DAOs is the anonymity of members and the fact that most DAOs only exist online or do their business in online forums. Researchers must deploy different research methods to collect data and capture the actions of DAOs. This means researchers should adopt non-conventional research methods; for instance, netnography (Kozinets & Gretzel, 2022) could help understand how communities decide on creating DAOs and how governance happens in day-to-day decisions. Such a method can also help overcome the challenges of studying an online phenomenon whose participants may be completely anonymous. Experiments can also help scholars understand the effects of different kinds of incentives on the behavior of DAO participants and their engagement in decision-making processes. Moreover, exper-

iments may also allow for a deeper comprehension of the impact of distinct governance systems on DAO development.

The extant literature also does not present evidence on the continuity of DAOs and how they change over time. This shortcoming offers several opportunities for future studies. On the one hand, researchers could produce longitudinal case studies and track DAOs changes regarding governance, democracy, and participation, as well as the challenges they face as the number of members grows. Process studies (Langley, 1999; Langley et al. 2013) are also welcome to unveil the critical events that characterize DAOs creation and evolution over time. Such temporal studies would offer a fresh comprehension of entrepreneurs' difficulties in making DAOs effective.

Finally, while the extant literature has advanced in comprehending DAOs characteristics, features, and weaknesses, we have found only a few studies that offer prescriptive orientation to those who want to implement DAOs. Amend et al. (2023) used design science research to develop a DAO to facilitate the cooperation of smallholders in developing countries. Therefore, methods like design science research (Lacerda & Dresch, 2020) and action research (Eden & Huxham, 1996; Shani & Coghlan, 2021) can offer practical guidance and detailed descriptions of processes undertaken by entrepreneurs to build DAOs and the difficulties they had to overcome.

Research directions regarding context

Concerning context, there is room for exploring the use of DAOs in several empirical fields. Blockchain has widely been studied in supply chains, but we have not identified studies about DAOs in this context. Van Nguyen et al. (2023) propose that researchers explore how DAOs can support the governance of supply chains, reduce transaction costs, and improve sustainability. DAOs can also play a relevant role in agribusiness and may, therefore, be studied to understand how they can help develop transparent food production systems or hinder the commercialization of food produced in deforested areas or whose production caused a negative social impact.

Spychiger et al. (2023) analyzed how DAOs can be used in project management. The study followed an exploratory approach and showed that DAOs offer interesting new mechanisms for managing simple projects. Future studies can advance this comprehension by implementing DAOs in real project management settings and analyzing the advantages and challenges of their use in this context.

Future studies should consider how DAOs emerge in different parts of the world. For instance, DAOs may have an important role in developing countries with weak institutional environments, allowing cooperation among people who would otherwise not trust each other. In addition, the characteristics of DAOs could be used to foster cooperation toward the UN Sustainable Development Goals. Relevant research questions in this direction could answer how DAOs stimulate people around the globe to reduce poverty and improve water and forest protection.

The field of public administration also presents a research context to be explored. Studies could address the potential use of DAOs to improve the efficiency and effectiveness of public services and include citizens in decision-making processes. Diallo et al. (2018) suggest that blockchain technology and DAOs can be used in the e-government system, improving transparency in government daily operations.

CONCLUSION

This study aimed to review the literature on DAOs in the fields of business, management, and economics and offers several contributions. First, we summarize the extant literature and describe its main focal topics. By doing so, we show how the research of DAOs evolved in the area of our sample and how researchers have been addressing the phenomena. Second, we inform researchers about the most relevant studies published on the topic and which seminal studies may help others enter the field. Third, we contribute by defining DAOs based on the characteristics described by the literature. Our concept proposes that DAO is (a) an autonomous organization, (b) potentially non-hierarchical and democratic, (c) composed of anonymized individuals who follow a protocol, (d) supported by smart contracts and transparent rules, (e) encoded in software and registered on the blockchain, (f) governed by token holders that define its goals and directions through a consultation process that may follow different models of democracy. We conclude our study by presenting a framework of DAOs compared to market, hierarchy, and network governance modes and several recommendations for future studies, indicating how business researchers can shed new light on DAOs and analyze their impact on organizational models, the economy, and society.

The present study shows that the research on DAOs is still in its infancy. There is room for empirical research that shows how DAOs operate in practice, while theoretical papers that discuss how DAOs impact the organizational field are also required. Likewise, we realized that the extant literature is entirely silent regarding eth-

ical issues that may arise from creating DAOs and their impact on organizations. We invite scholars and practitioners to address these topics and help advance our comprehension of the opportunities and challenges DAOs offer our research community. Moreover, a critical assessment of DAOs is also necessary. The extant literature has mostly shown a positive assessment of DAOs' potential to decentralize decision-making and foster collaboration among individuals in a democratic and participative fashion. We have found no critics of the risks that DAOs may represent to society and the tactics some members may use to exploit the community and reach their interests.

Before concluding, we also must recognize some limitations. First, our study focused only on articles published in the field of business and management. Although this was a previously defined delimitation, we know this decision may have excluded articles indexed in other fields that could offer relevant contributions to the discussion. Second, we focused only on articles and reviews published in indexed scientific journals, excluding articles published in conference proceedings. Future studies can expand our review by including articles published in other research fields or using the snowballing technique to enlarge the sample and reach a broader comprehension of DAOs.

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