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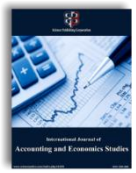

Decentralized Autonomous Organizations As Emerging Economic Entities in Accounting and Governance Frameworks

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Abstract

Decentralized Autonomous Organizations (DAOs) represent a new form of economic organization, leveraging smart contracts and blockchain technology to manage financial operations, governance, and decision-making. This structure eliminates the need for centralized intermediaries. From an accounting and economic perspective, this article investigates DAOs, offering a comprehensive examination of their architecture, voting methods, governance procedures, smart contract vulnerabilities, and the legal environment. The article proposes a five-tiered DAO structure, demonstrating how each layer contributes to operational efficiency, transparency, and decentralized responsibility. The study emphasizes the importance of smart contract auditing tools in ensuring reliable financial transactions. According to the data presented in the study, applying traditional accounting principles to token-based transactions, decentralized decision systems, and DAO treasuries poses significant challenges such as token valuation, revenue recognition, and the absence of standardized reporting formats. The study explains how DAOs act as economic coordinators, using real-world case studies such as MakerDAO, Gitcoin DAO, and Uniswap DAO. Additionally, the research highlights the issues DAOs face regarding valuation and compliance. This article concludes with a policy-focused examination of regulatory gaps and offers suggestions for future research directions in the areas of financial integration, legal categorization, and the sustainability of DAOs. Through the integration of institutional and economic theory with the technical structure of DAOs, this research advances our understanding of DAOs as novel forms of finance and governance.

Keywords: *Decentralized Autonomous Organizations, Blockchain, Smart contracts, Auditing, Accounting Transparency, Decentralized Finance*

1. Introduction

Decentralized Autonomous Organizations (DAOs) represent an innovative organizational structure that uses blockchain technology and smart contracts to operate independently of centralized authority [1]. Unlike traditional organizations that depend on legal contracts and hierarchical systems, DAOs carry out operations through transparent, programmable rules encoded on distributed ledgers. These rules automate functions such as budgeting, proposal management, and treasury operations. By removing intermediaries and executing decisions via community governance, DAOs aim to increase efficiency, accountability, and transparency [2].

From an accounting and economic standpoint, DAOs introduce structural changes that challenge conventional standards and institutional models. They rely on token-based incentives and decentralized financial mechanisms that disrupt established methods of valuation, financial reporting, and auditability [3]. Operations are governed entirely by code, eliminating traditional oversight structures. This raises questions around the classification of digital assets, the documentation of decentralized decision-making, and the creation of new audit methodologies that can accommodate blockchain-based ecosystems.

This paper examines DAOs as programmable economic entities and investigates their relationship with accounting and economics. It describes a five-layer DAO architecture, scrutinizes governance models (on-chain, off-chain, and hybrid), and evaluates voting mechanisms and their implications for financial oversight. The study also analyzes smart contract vulnerabilities, auditing techniques, and assesses the financial and economic dimensions of DAO operations. In addition, it explores practical applications and legal frameworks to

clarify the operational mechanisms of DAOs and concludes by proposing strategies for their sustainable integration into formal economic systems.

While existing literature explores DAO governance and technical structures, there is a lack of focused research on how DAOs challenge conventional accounting standards, financial reporting norms, and economic coordination mechanisms. This paper addresses that gap by offering a structured, interdisciplinary analysis combining technical, accounting, and institutional economic perspectives, supported by real-world case studies.

2. Decentralized Versus Centralized Organization: Accounting, Governance, and Economic Differences

Decentralized Autonomous Organizations (DAOs) offer a unique approach to structuring, administering, and functioning institutions. They employ blockchain-based smart contracts for self-governance, functioning without centralized authority or traditional accounting frameworks [4]. In a traditional organization, board members, chief executive officers, auditors, and finance departments perform specific roles. These organizations employ disciplined methodologies for decision-making, budgeting, payroll, and financial reporting [2], [5]. They also adhere to rules, taxation, and accounting principles such as IFRS or GAAP. Regular audits of accounts provide transparency and precision. Conversely, DAOs are ruled by code and function in a decentralized manner. On-chain and off-chain voting methods enable anonymous token holders to influence governance. Self-executing smart contracts embed their regulations and functionalities. All DAO transactions are stored on a public blockchain. These records often lack structured financial reporting, which complicates auditing and regulatory compliance.

DAOs reduce operational costs and enable faster, borderless participation in governance. However, they also face critical accounting and economic challenges, including token price volatility, smart contract vulnerabilities, governance centralization risks, and uncertain legal and tax treatment. These complexities directly affect transparency, accountability, and structured financial reporting. Table 1 provides a detailed comparison between traditional organizations and DAOs, illustrating the differences in accounting practices, governance control, financial monitoring, tax compliance, and economic value estimation.

Table 1: Comparison of Traditional Organizations and DAOs

Characteristics	Traditional Organizations	Blockchain-enabled DAOs
Framework	- Hierarchical top-down management Structure - Defined levels of reporting.	– Decentralized and democratic token-based governance. – Blockchain-based flat organization structure. – Distributed decision-making power among token holders.
Decision control	- Decision made by the governing body and executives - Follows legally approved procedures, - Faster as only as fewer people are involved.	- Token-based based community-driven. - Token holders vote on proposals. - Open to all eligible participants holding governance tokens.
Operating protocol and regulations	- Legal agreements and organization policies - Human enforcement of rules. - Changes to rules and regulations need the approval of the governing body.	- Smart contact executes predefined rules atomically when the present condition occurs. - Rule modification requires community agreement. - No need for intermediaries.
Accounting Reports	- Finance reporting is quarterly or annually as per accounting standards. - Reports audited by external agencies. - Delayed financial reporting.	- Unstandardized formats for financial statements. - Transactions are recorded immutably and transparently on-chain. - Real-time access to financial data.
Accounting and ledger system	- Auditable centralized accounting and finance management software. - Centralized control over financial and accounting data. - Uses a standardized chart of accounts and needs professional experts.	- Distributed and public blockchain stores transactions - No standard ledger format. - Challenges in traditional accounting and auditing. - No central control. - Smart contract automates record keeping.
Financial Monitoring	- Periodic auditing by internal and external professionals. - Auditing as per accounting standards and government-defined standards. - Delayed audit reports due to centralized control. - Expensive due to consulting firms and human involvement.	- Immutable and transparent transactions on public ledger. - Smart contracts execute transactions. - Governance decisions are visible to every participant. - Real-time and community audit-driven audit. - Costs are lower due to automation.
Reward Mechanisms	- Salary, bonuses, and benefits determined by HR or governing body. - Incentives based on hierarchical levels or performance appraisals - Stock, equity options, or profit sharing.	- Members are rewarded for participation and contribution using tokens or crypto assets. - Smart contracts automate payments upon approval. - No fixed payouts, rewards merit-based. - Voting allows community-led decisions.
Financial Realization	- Revenue is recognized based on established accounting standards. - Tied to billing cycles and invoices - Subject to audit verification. - Involves a centralized financial system.	- Unclear, no standardized framework for revenue recognition. - Income is recognized immediately as the transaction happens on-chain. - Common revenue sources include token sales, staking fees, and protocol revenue.
Economic Value Estimation	- Assets value using accounting principles based on historical cost or current market value. - Auditors assess and confirm asset value.	- DAOs hold tokens and crypto assets valued by the current market price. - Valuation is automated and highly dynamic.
Fund Management	- Managed by finance departments with standard procedures. - Investment decisions taken by top management. - Rely on traditional banking, loans, and credits.	- No centralized treasury management team. - Community managed through voting. - Risk of misallocation due to whale domination. - Real-time visibility of funds increases transparency.
Tax Compliance System	- Subject to national and international tax regulations.	- Most DAOs are not recognized as legal entities.

	- Penalties for non-compliance by authorities.	- Some DAOs choose to register as legal entities to comply with government regulations. - Members responsible for self-reporting
Juridical Compliance System	- Established under corporate laws of a specific jurisdiction. - Legally protected by law.	- Most DAOs lack legal recognition. - Some register as LLCs or use legal wrappers.
Budget Allocations System	- Includes salaries, rents, and day-to-day operation costs. - Budget planning is centralized and hierarchical.	- Automation reduces operational costs. - Fund distribution and allocation community community-driven.
Legal Adherence Practices	- Bound by national and international laws. - Requires registering as a legal entity.	- Often lacks the status of a recognized legal entity. - Most often operate globally beyond the reach of a single jurisdiction. - Few comply with tax laws.

While DAOs offer transparency through blockchain records and automated governance, they present significant accounting challenges. The absence of standardized financial statements, periodic reporting cycles, and centralized financial oversight limits the applicability of traditional frameworks such as IFRS and GAA. Valuing crypto assets held by DAOs remains complex due to extreme volatility and the lack of uniform pricing models. Auditors must interpret smart contract behavior, treasury flows, and protocol incentives using on-chain tools rather than conventional ledgers [6]. As a result, DAO accountability may depend more on continuous assurance systems than on quarterly audits, demanding a shift toward blockchain-native accounting and compliance frameworks.

3. Literature review and background

The entrance of programmable blockchains, particularly Ethereum, has significantly advanced decentralized autonomous organizations (DAOs). DAOs employ smart contracts to govern and control digital communities and assets without centralized authority. The 2016 launch of "The DAO" profoundly impacted the DAO ecosystem. It gathered approximately $150 million in Ether, but a programming mistake led to an exploit and the subsequent Ethereum hard fork [7]. This incident exposed early DAOs' technical and legal vulnerabilities and encouraged extensive academic study on governance, security, and resilient organizational behaviour over time. DAO governance structures, modular smart contract platforms, and security audits have significantly improved. Examples include Snapshot and Gnosis Safe, which provide hybrid governance models combining transparency with operational security, while MakerDAO and Compound introduced features like time-locked voting and multi-signature treasury management. These improvements reflect a commitment to rectifying early fundamental problems and expanding DAO applications.

By early 2025, over 2,000 DAOs managed assets exceeding $34 billion, focusing on areas such as DeFi, digital identity, grant finance, and social coordination [8]. Even with growing adoption, academic literature consistently highlights concerns regarding accounting, financial reporting, and legal recognition. DAOs operate within varied regulatory environments, making compliance with tax, asset valuation, and liability problematic. DAOs fundamentally challenge traditional accounting norms [9]. They lack centralized reporting, conventional charts of accounts, and authoritative control. Although DAO transactions are transparent and irreversible, converting them into structured financial statements remains difficult. Researchers propose blockchain-compatible accounting frameworks and hybrid reporting models, yet real-time audits, traditional balance sheets, and standardized tax filings are largely unavailable.

Economically, DAOs organize capital algorithmically, rather than through trust-based relationships. Tokenomics links governance to incentives, often diverging from conventional notions of fairness and remuneration. Issues like token hoarding, low voter participation, and governance centralization undermine stability and equitable participation. Behavioural economics research suggests that mechanisms such as quadratic or conviction voting could mitigate these risks. Legal recognition for DAOs remains nascent. While Wyoming has introduced specific DAO legislation, the legal status of most DAOs remains ambiguous in other jurisdictions. This regulatory uncertainty limits the adoption and development of financial accountability tools compliant with national laws. The table below outlines relevant literature on smart contract security, governance models, economic coordination, and financial auditability. Notably, few accounting and economics research studies comprehensively integrate these diverse.

While existing literature provides valuable insights into DAO design, governance, and technical risks, most studies focus on operational architecture and legal theory. Few contributions engage directly with accounting-specific challenges such as token valuation, periodic reporting, or audit trail construction. Moreover, many works overlook behavioral dynamics like voter fatigue or agency problems arising from token concentration. This review aims to synthesize current findings while highlighting gaps in accounting integration and interdisciplinary analysis. Table 2 lists major DAO studies along with their findings and relevance to accounting and economics.

Table 2: Summary of Key Literature on DAOs

Contributors	Year	Research Area	Research Findings	Accounting and economic study relevance
Wright & De Filippi **[10]**	2015	Smart contracts and the law	Investigation into how smart contracts are a threat to conventional legal systems	Fundamentals of smart contracts and DAO governance
Mehar et al. **[11]**	2019	DAO attack	Examined vulnerabilities that resulted in the The DAO breach	Identifies safe DAO design lessons
Rouhani & Deters **[12]**	2019	Smart contract flaws	Examined typical smart contract faults	Notifies risk mitigation and audit sections
Kaal **[13]**	2020	DAO legal models	Proposed legal designs for DAO recognition	Legal vs. traditional model comparison
Hassan & Kyriakou**[4]**	2021	Governance framework	Determined decision-making structure failure modes	Facilitates the examination of governance frameworks
Buterin	2021	Quadratic Voting	Proposed fair quadratic voting	Directs equity models and token voting
Hassan & De Filippi [14]	2021	DAO governance theory	Provided a structured overview of DAOs	Supports governance framework analysis
Jingtao Li et. al. [15]	2022	Governance and architecture	Exposed multidimensional architecture, decision power, incentives, legal and ethical issues.	Facilitates governance-based audit metrics.
Feichtinger et al.[16]	2023	Governance, equity & concentration	Exposed centralization of voting power and flaws in governance practices	Adds empirical governance risk insights.

Kumar et al. [17]	2024	Corporate governance via DAOs	Integrated ethics and agency theory into DAO governance.	Institutional and economic theory alignment
Wei et al. [18]	2025	LLM-enabled audit automation	Described SmartAuditFlow: a dynamic AI-based audit system	Enhance audit and assurance sections

The reviewed literature highlights two key trends: rapid innovation in smart contracts and DAO governance structures, and growing legal exploration of decentralized frameworks. However, most studies remain focused on technical and legal dimensions, offering limited engagement with accounting-specific challenges such as token valuation, revenue recognition, and audit trail construction. Despite the transparency enabled by blockchain, few works propose concrete models for integrating DAO operations with financial reporting standards like IFRS or GAAP. Behavioral dynamics such as token concentration, voter apathy, and incentive misalignment are noted but rarely examined through the lens of agency theory or institutional economics. This study addresses these gaps by offering a structured framework that bridges blockchain governance, accounting practices, and economic coordination models, supported by real-world case studies.

4. Smart Contracts and Blockchain As Tools for Trustless Accounting

DAOs operate under governance mechanisms that prioritize community involvement and decentralized decision-making. Traditional corporate structures depend on centralized boards and executives, whereas DAOs utilize on-chain, off-chain, or hybrid governance models [19]. Voting mechanisms, whether token-based or reputation-weighted, determine the outcome of proposals related to protocol changes, funding, and partnerships. While these mechanisms are designed to align stakeholder interests with DAO operations, they are also susceptible to issues such as voter apathy, collusion, and disproportionate influence by token-rich participants [20]. These behavioral risks reflect agency problems in decentralized systems, where rational disengagement or dominance by a few may distort democratic intent. The underlying blockchain infrastructure supporting such governance logic is illustrated in Figure 1.

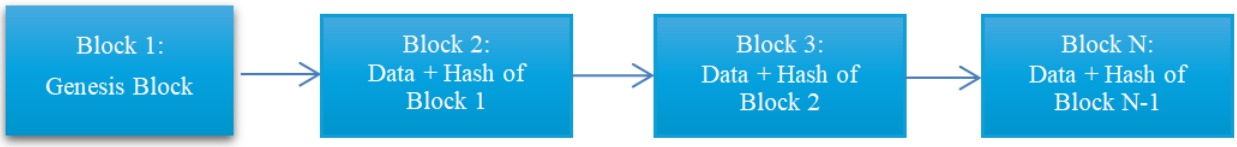

Fig. 1: Blockchain Structure

Smart contracts, recorded on a blockchain, execute predefined actions in response to specific conditions. Within DAOs, they manage proposals, disburse funds, and facilitate voting processes [21]. Once a proposal is approved, the contract autonomously transfers funds and updates the treasury without manual intervention. For example, a member may submit a funding request [2], [22], which is reviewed and voted on using platforms like Snapshot or Tally. If approved, the transaction may undergo a brief waiting period for security purposes before execution. The smart contract then finalizes the action and immutably records the result on-chain. Figure 2 illustrates this execution flow. From an accounting perspective, this process automates key financial decisions while generating a verifiable audit trail that supports continuous assurance.

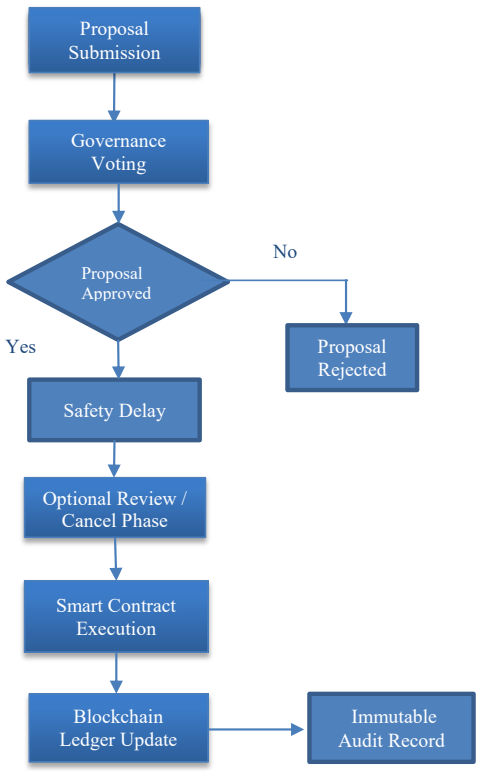

Fig. 2: Smart contract execution flow

Blockchain allows a new accounting approach in which every monetary transaction is not only approved by the participants but also recorded in real time and made visible to the public. Every blockchain transaction contains a sender, a recipient, and a third, unchangeable record; this is comparable to the idea of triple-entry accounting [23]. This method enhances auditability and reduces the risk of errors or fraud by offering an immutable financial record. However, blockchain-based accounting is not without limitations. The data structure of blockchain transactions does not inherently conform to traditional financial statements, such as income statements or balance sheets. Elements like revenue, costs, and liabilities often require off-chain interpretation and manual classification to meet IFRS or GAAP standards.

It is also important to recognize that smart contracts are not flawless [24]. The 2016 DAO hack demonstrated how code vulnerabilities can lead to substantial financial losses [25]. As such, independent smart contract audits are essential to ensure that deployed code is secure, functional, and aligned with intended governance logic [22]. Despite these risks, smart contracts empower DAOs to perform tasks that are difficult for conventional systems. They can automatically enforce spending limits, provide access to financial data, and ensure that transactions occur only with community approval. These features contribute to more transparent, reliable, and efficient resource management, provided that robust data tracking and analytical tools are in place. While DAOs have not yet replaced traditional accounting frameworks, they lay the groundwork for innovative record-keeping systems and new models of financial accountability in decentralized environments.

5. Operational Architecture of DAOs: A Five-Layer Framework

A new form of organization, known as a decentralized autonomous organization (DAO), uses blockchain technology and smart contracts to operate without a central authority [19]. As previously discussed, these technologies enable transparent and secure recording of actions. DAOs build on this infrastructure by embedding decision-making logic into code, allowing systems to automatically execute collective decisions. Unlike traditional organizations, which depend on managers or hierarchical chains of command, DAOs adhere to predefined rules encoded in smart contracts. These rules govern how members submit proposals, vote, and manage shared resources. Since all transactions and decisions are immutably recorded on the blockchain, the process requires no centralized approval mechanism and remains publicly accessible [26].

From an accounting and economic standpoint, DAOs introduce several structural and operational shifts. They reward members with digital tokens, reduce administrative overhead, and provide open, real-time access to financial data. The immediate recording of transactions and proposals enables novel forms of financial monitoring and auditing. These features are particularly relevant to public funding, scientific research, social coordination, and decentralized finance [2], [27]. However, DAOs also raise new concerns regarding tax obligations, financial reporting practices, and regulatory compliance. Since DAOs are neither centrally nor jointly administered, they challenge traditional assumptions about responsibility, control, and accountability in economic systems. Studying the internal architecture of DAOs and its implications for auditing, financial transparency, and decentralized decision-making is essential in the digital era.

Modern DAOs are increasingly conceptualized through a five-layer architecture that organizes their technical and operational components. This layered approach allows for a systematic understanding of how blockchain infrastructure, smart contracts, governance, treasury operations, and accountability mechanisms interact [2], [17], [27]. A visual representation of this five-layer DAO framework is provided in Figure 3.

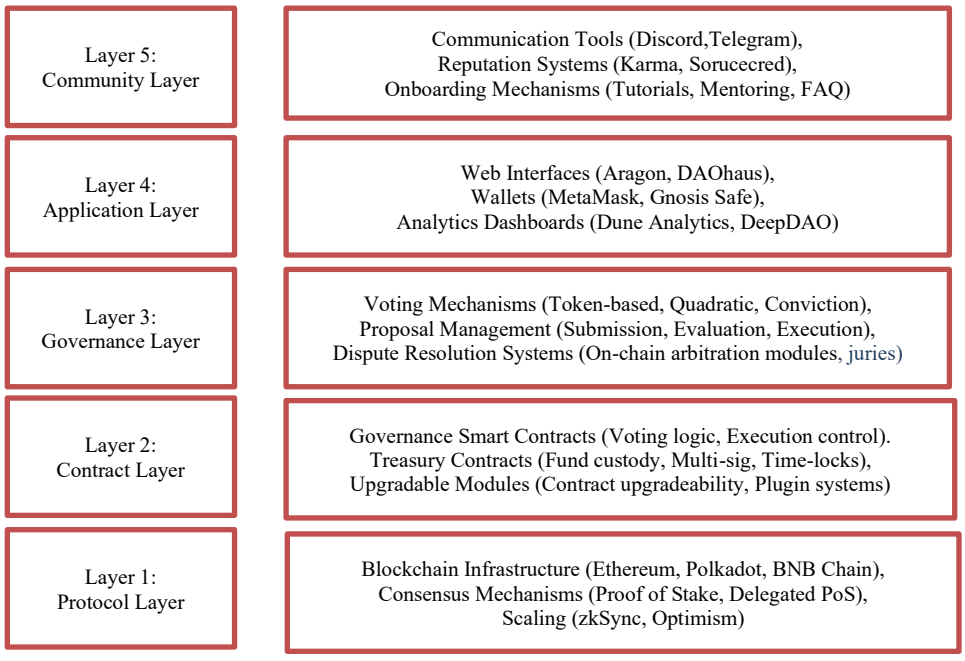

Fig. 3: Five Layer Framework of DAO

a) Layer 1: Protocol Layer

The protocol layer forms the foundation and backbone of decentralized autonomous organizations. It ensures that all events and operations are securely and immutably recorded on a distributed ledger [2]. This layer includes the consensus mechanism used to validate

transactions and maintain blockchain integrity. It also supports solutions to enhance blockchain scalability. From an accounting perspective, permanently recorded transactions create a complete audit trail for financial operations and decision-making processes.

b) Layer 2: Contract Layer

This layer encompasses self-executing smart contracts that automate core DAO functionalities. These software-encoded agreements manage proposal processing, fund allocation, protocol updates, and treasury control. Key contract types include governance contracts (for voting and rule enforcement), treasury contracts (for managing funds via time-locked vaults or multi-signature wallets), and upgrade modules that allow secure organizational evolution [12].
Because this layer automates financial controls, including budget approval, fund distribution, and financial policy enforcement, accountants no longer need to engage with individuals for manual approvals. By applying pre-established rules to each transaction, smart contracts significantly reduce the likelihood of error and increase financial efficiency. From an economic perspective, this automation reduces administrative expenses and enables the implementation of preprogrammed incentives to align member conduct with collective goals.

c) Layer 3: Governance Layer

This layer defines the procedures for proposing, negotiating, and executing decisions within the DAO. It incorporates various voting protocols and dispute-resolution mechanisms, shaping the extent of decentralization and participant engagement.
From an accounting perspective, governance traceability enhances compliance monitoring, internal oversight, and resource allocation. Governance systems also influence stakeholder power, economic coordination, and long-term sustainability.

d) Layer 4: Application Layer

This interface layer enables communication between users and the technical backend. It allows members to monitor accounting data, manage their roles, view activity, and submit proposals. The application layer supports structured interaction, secure financial control, and identity verification [28].
For accounting purposes, this layer offers real-time financial reporting, interactive ledger displays, and role- and permission-based access control. It enables interested parties to independently verify financial activities. From an economic standpoint, user-friendly interfaces promote greater inclusion and involvement, especially in budget discussions and collective decision-making, which boosts DAO's utility and legitimacy.

e) Layer 5: Community Layer

The Community Layer represents the human and social component of DAO. This system comprises communication, reputation systems to recognize contributions, and onboarding processes for new members. This layer simplifies reaching consensus, involving the community, and providing the "soft governance" needed to maintain active engagement.
In accounting, this layer might affect how budget priorities are established since community feedback can determine which initiatives receive funding. It also instills a sense of societal responsibility. From an economic perspective, this stratum is comparable to the informal institutions seen in traditional economies. Social capital, reputation, and cooperation are the main factors that determine a decentralized organization's long-term survival and member retention.

6. On-Chain and Off-Chain Governance in DAOs: Foundation for Financial Accountability

A governance system is crucial to the success, operation, and sustainability of a DAO. Effective governance assures participants, developers, and stakeholders that the DAO will function efficiently, maintain security, and adapt to evolving needs. Governance also determines the distribution of decision-making power among stakeholders [27], [29]. In decentralized autonomous organizations, governance comprises the procedures for initiating, debating, approving, and implementing proposals. Unlike traditional hierarchical institutions, DAO governance follows one of three models: on-chain, off-chain, or hybrid. Understanding these models is essential to evaluating financial accountability, auditability, and economic coordination within DAOs. The choice of governance mechanism directly affects capital allocation, budget oversight, and stakeholder confidence.

6.1 On-Chain

A DAO's on-chain governance system enables members to vote on decisions related to blockchain operations and protocol updates. This model utilizes smart contracts and blockchain technology to ensure decentralized and transparent decision-making [30]. In addition to automating fund disbursements, smart contracts enforce treasury constraints and maintain a thorough audit trail. There are several important advantages that the on-chain governance system offers to the members, including confidence, safety, and accountability among the participants [27]. This ensures that the decision-making process is both transparent and fair. On-chain operations are much quicker than off-chain.
In terms of accounting, on-chain governance offers a superior audit trail. As transactions are immutable, time-stamped, and immune to manipulation, continuous assurance can potentially replace more traditional periodic audits. From an economic perspective, it enhances capital efficiency, reduces administrative burden, and allows for programmable incentives. However, disadvantages also exist, including low voter participation, concentrated voting power, and rigid execution.

6.2 Off-Chain

In the off-chain model, proposal formulation, discussion, and agreement occur outside the blockchain, often on community forums such as Discord, Telegram, or Discourse, before being submitted for on-chain voting. Social debate and consensus-building are critical to this approach [27] [31]. Compared to on-chain models, off-chain governance offers greater flexibility and encourages broader participation, as it avoids gas fees and allows more open discussion. However, it lacks on-chain immutability, limiting transparency.

Off-chain governance [2], however, is challenging to audit from an accounting perspective. Conversations are dispersed, and the final on-chain operations may not align with the intentions expressed in informal channels. This complicates cross-verification and increases the need for linking recorded actions to discussions. While encouraging community engagement and inclusion from an economic perspective, off-chain governance may also result in ineffective coordination and delayed decision-making.

6.3 Hybrid Governance Frameworks

The hybrid model integrates the advantages of both on-chain and off-chain systems, resulting in a more equitable governance framework. This method enables members to vote on ideas, submit proposals, and suggest protocol modifications. Off-chain deliberations occur on social platforms, and the implementation of proposals needs endorsement from reputable individuals [8].
This approach employs blockchain-built smart contracts to facilitate community-driven decision-making while guaranteeing transparency. Despite the inherent complexity of auditing, hybrid techniques provide a well-rounded foundation. To handle the distinctions between off-chain intent and on-chain execution, cross-layer validation necessitates the development of new tools and standards. Nevertheless, these are currently the most practical forms of DAO governance, enabling both efficiency and legitimacy

7. Voting Mechanisms in DAOs: Implications for Financial Governance

Voting mechanisms serve as the fundamental framework for governance within a DAO. It grants members the authority to make decisions on how to manage the organization, allocate funds, and alter regulations. DAOs are mostly dependent on smart contracts in order to function. [6] After reaching an agreement among the participants via voting, smart contract programs will automatically carry out the proposal execution. The mechanism by which proposals are submitted, debated, and refined plays a crucial role in shaping member engagement, the quality of decisions made, and the overall sustainability of the system. The choice of voting mechanism is influenced by the DAO's design, governance framework, degree of decentralization, and security considerations [27]. Table 3 investigates various voting mechanisms employed by DAOs, inspecting their strengths, limitations, and economic implications.

Table 3: DAO Voting Mechanisms and Their Economic Impact [27], [32]

Voting Method	Core Characteristics	Strengths	Limitations	Accounting Implications	Economics Implications
Token-Based Voting	1 token = 1 vote	Easy to use, clear records	Centralization, low turnout	Transparent; matches ownership	Capital-efficient, favors wealth
One-Token One-Vote	Token count equals vote count	Simple, widely accepted	Dominance by large holders	Fully auditable	Reflects investment, limits fairness
Majority Voting	>50% support needed	Quick, intuitive	Whale control, voter fatigue	Easily auditable thresholds	Efficient but not always equitable
Supermajority Voting	Requires higher approval (66–75%)	Building trust reduces risk	A high quorum may block good proposals	Threshold verifiable	Supports stable governance
Quadratic Voting	Extra votes cost more	Reduces vote buying	Complex, harder to audit	Requires detailed tracking	Promotes fairness, supports minorities
Reputation-Based Voting	Based on user contributions	Merit-based, Sybil-resistant	Hard to measure fairly	Needs transparent scoring	Rewards engagement, discourages speculation
Delegated Voting	Vote given to trusted members	Increases participation	Can lead to centralization	Delegation tracking required	Trust-based, efficient, but fragile
Holographic Consensus	Based on forecasting markets	Encourages informed decisions	Complex and technical	Hard to model and audit	Aligns incentives with outcomes
Time-Lock Voting	Vote weight increases with lock time	Long-term alignment	Excludes short-term members	Requires lock-time logging	Strengthens commitment to DAO goals
Ranked-Choice Voting	Proposals ranked by preference	Encourages consensus	Technical complexity	Full vote tracking needed	Increases democratic legitimacy

DAO voting methods balance efficiency, fairness, and inclusion differently. When choosing a DAO governance approach, especially for large populations or significant financial assets, careful consideration must be given to its implications for governance effectiveness, financial accountability, and economic design [19], [23]. Transparent and user-friendly processes can reduce operational risk and enhance auditability. Conversely, methods that prioritize equity or long-term commitment may gain credibility but could introduce implementation complexities. A solid understanding of these diverse voting models in decentralized systems ultimately boosts confidence, fosters growth, and strengthens collective decision-making within DAOs.

8. Smart Contract Vulnerabilities and Auditing in DAOs

DAOs control operations and finances via smart contracts. These code-based agreements automate proposals, financial management, voting, and system enhancements. Since smart contracts are irreversible, design errors can cause permanent damage, such as treasury fund loss, unauthorized access, or governance failure [12], [22], [24]. Understanding smart contract vulnerabilities and implementing rigorous audits are critical to ensuring operational integrity. In accounting and economics, these vulnerabilities represent internal control deficiencies, while auditing provides digital assurance for financial transparency, governance integrity, and economic resilience.

8.1 Common Smart Contract Flaws

A trustworthy and secure program, smart contracts are essential components of decentralized autonomous organizations and play an important role in their operations. Due to the fact that these contracts serve as the foundation of decentralized autonomous organizations (DAOs), any defects or errors might result in the loss of funds. It is essential for decentralized autonomous organizations (DAOs) to carry out exhaustive audits and tests in order to reduce the likelihood of these attacks and guarantee the security of their operations. In simple terms, contract vulnerability is an issue in the code that arises during the development of a contract.

Smart contracts inherently contain several potential flaws. Exploiting these vulnerabilities can severely harm a DAO. A notable flaw is the reentrancy attack, which occurs when a smart contract transfers execution flow to an external contract [29], [31]. As a result, the external contract is able to reenter the original contract and manipulate its state before the execution is completed. A famous example of this attack is the 2016 DAO hack. A timestamp attack occurs when smart contract logic relies on a timestamp value for critical operations. Attackers can manipulate this timestamp value to influence decision-making processes. Integer overflow or underflow happens when a variable overflows or underflows its valid limit.

Front-running attack happens when attackers find a pending transaction in the memory pool. Attacker submits an identical transaction with higher gas fees to be executed first [33]. This allows the attacker to manipulate operations. A syntax error is a mistake in smart contract code that prevents it from executing as planned. Gas griefing is an attack in which an attacker intentionally alters gas limits or costs to disrupt normal operation [34]. A denial-of-service (DoS) attack overloads the network to prevent normal use by legitimate users. In **oracle** manipulation attacks, an attacker alters the information provided by an oracle to influence the behavior of the smart contract. A flash loan exploit involves borrowing and repaying a large amount of money within a single transaction to manipulate prices or extract funds. Table 4 presents smart contract vulnerabilities associated with financial risks and prevention strategies.

Table 4: Common Smart Contract Vulnerabilities in DAOs: Financial Risks and Mitigation Strategies [35], [36]

Attack type	**How it works**	**Economic Consequences**	**Prevention Approach**
Reentrancy attack	Attacker repeatedly calls a function before completing the state.	Loss of funds through repeated payments	Completing execution before external calls, restrict gas forwarding to external calls.
Timestamp Dependence	Attackers alter the timestamp to influence contract operations.	Allows unfair advantage in reward distribution or lotteries	Use block numbers to keep track of timestamp, external oracles for precise timing.
Integer Underflow and Overflow	Variable value drops below the limit or exceeds the maximum limit.	May permit unauthorized payments and economic manipulation.	Perform limit checks, input validation, and use audit tools.
Front-running attack	After seeing a transaction, the attacker uploads their own with greater gas expenses.	Because of price front-running, merchants and users lose money.	Introduce transaction privacy or zero-knowledge proofs.
Gas Griefing	In order to prevent or disrupt certain tasks, the attacker uses additional gas.	Genuine individuals might not be able to access money or carry out tasks.	Avoid limitless loops, restrict gas per operation, and divide large tasks.
Oracle Manipulation	Attacker tampers with external data feeds used by the contract.	Results in wrong decisions	Use decentralized, trusted oracles, and implement data sanity checks.
Front Loan Exploit	Borrowing and repaying large amounts in one transaction to exploit contract logic.	Can manipulate prices or drain liquidity instantly without collateral.	Use Oracle price safeguards; apply slippage controls and proper validation.
Denial of Service attack	Attackers disrupt contract functions or access by exploiting logic flaws.	Prevents users from interacting or withdrawing funds.	Avoid logic that depends on external addresses or fixed loops; limit user input size.

8.2 Smart Contract Auditing in DAO Settings

Given the severity of smart contract vulnerabilities, auditing becomes a crucial line of defense in DAO ecosystems. The term smart contract auditing refers to the process of analyzing, assessing, and validating the code of a smart contract to identify potential dangers, flaws, and violations of safety regulations [18], [22], [24]. This is done to ensure that the smart contract functions as intended, follows the most efficient method, and minimizes risks related to its operation, security, and effectiveness. By identifying and fixing security problems, auditing helps prevent future defects, attacks, or the unlawful acquisition of assets or highly confidential information. It is a significant component of the safety guarantee. Two primary auditing approaches are used: manual code review and automated analysis. Manual audits are conducted by specialized firms or developers who examine each line of code for logic errors, access control issues, or potential exploit paths. This is particularly important for high-value contracts and system upgrades. In parallel, DAOs utilize automated tools for vulnerability scanning, simulation testing, and continuous monitoring. These tools can identify weaknesses such as reentrancy risks or gas inefficiencies before contract deployment, enhancing financial and operational reliability.

9. Accounting and Economic perspective

When it comes to organizing governance and economic activity, Decentralized Autonomous Organizations (DAOs) provide a novel approach by using blockchain-based ledgers, smart contracts, and programmable rules. Unlike conventional enterprises, which depend on formal contracts and centralized administration [2], [10], DAOs operate through decentralized code and community-driven decision-making. This innovation not only increases transparency and reduces coordination costs but also challenges conventional economic theories and accounting standards. This section presents an integrated perspective on DAOs from accounting and economic standpoints, aiming to uncover new possibilities and long-term gaps in financial management, reporting, value generation, and policy alignment.

9.1 Accounting Viewpoint on DAOs

DAO performs all the financial operations on-chain, recording all transactions, fund distributions, and proposal execution results on a transparent public ledger [37]. This mechanism allows transparent treasury and governance decisions, identical to a form of triple-entry bookkeeping. These solutions naturally provide more openness than traditional financial systems by providing an unchallengeable audit trail and cryptographic signatures with each transaction.

However, integrating conventional accounting practices into DAOs presents major challenges. The significant token price volatility causes discrepancies in asset and liability calculations. Token price volatility complicates asset and liability calculations. Since DAOs often hold treasuries in volatile cryptocurrencies, fair value assessments under standard accounting rules are difficult [1]. The recognition of income and expenditure is likewise unclear. Models for protocol fees, staking rewards, and yield farming income are not conventional. Similarly, grants, liquidity incentives, and token rewards do not fit traditional cost categories.

Auditing DAOs requires both technical and accounting skills. While transactions are traceable on-chain, the legality and intent must be interpreted through smart contract logic, which is not naturally human-readable. Without a central accountant or chief finance officer,

verification relies on external audits, automated tools, and real-time monitoring systems. Many DAOs employ specialized accounting dashboards and smart contract scanners for continuous assurance. These innovative technologies provide real-time validation of treasury flows, budget utilization, and adherence to governance rules.

9.2 Economic Perspective on DAOs

From an economic perspective, DAOs represent a new type of organization that eliminates centralized authority by automating group decision-making through programming. In traditional economic theory, firms exist to reduce transaction and coordination costs [38]. By directly integrating governance and financial functions into smart contracts, DAOs offer a comparable yet decentralized solution. This architecture can reduce trust-related costs, align stakeholder incentives, and minimize agency problems.

DAO economics are closely linked to tokenomics [39]. Token distribution determines governance rights, participation incentives, and revenue-sharing structures [40], [41]. Mechanisms such as reputation scoring, quadratic voting, and staking are used to reduce manipulation and encourage constructive behavior. These mechanisms encourage continuous engagement while balancing stakeholder influence. In contrast, these systems are not flawless. Voter apathy, wealth concentration, and speculation can threaten legitimacy, reinforce plutocracy, and undermine long-term planning [17].

Many DAOs finance research, open-source development, and community initiatives through pooled funds. These models demonstrate the potential of DAOs to coordinate around public goods and collaborative projects. However, public goods DAOs face persistent challenges such as free riding, misaligned incentives, and governance fatigue. Addressing these issues requires careful token economic design and institutional innovation.

10. Regulatory Challenges and Institutional Alignment for DAOs

DAOs blend digital innovation with legal uncertainty. Even though they perform many of the same functions as traditional entities, most governments do not formally recognize them as businesses, cooperatives, or investment funds. This lack of legal status raises important questions concerning liability, taxation, financial disclosures, and regulatory compliance [8], [42]. In the absence of clear legal frameworks, the consequences of contract failure, treasury mismanagement, or user harm remain ambiguous.

A lack of formal recognition also affects financial reporting practices, auditor relationships, and asset classification for DAOs [41]. As a result, standardized financial statements and third-party certifications are uncommon in the DAO ecosystem. From an economic standpoint, this regulatory ambiguity increases operational risk, deters institutional engagement, and discourages broader capital investment [43].

Some jurisdictions have begun to experiment with legal recognition. Wyoming, for example, allows DAOs to register as limited liability companies (LLCs) with governance encoded in smart contracts. However, these frameworks are still evolving and remain largely untested in courts [44]. Similarly, discussions are underway in jurisdictions like Switzerland and the European Union regarding DAO taxation and compliance, though no global consensus yet exists on their treatment under securities, anti-money laundering (AML), or data protection laws.

Integrating DAOs into established economic and financial ecosystems demands new institutional frameworks that simultaneously maintain decentralization, provide legal clarity, ensure financial transparency, and enable robust fiduciary oversight. DAO developers must proactively collaborate with policymakers and standard-setters to create new, accountable regulations. Until broader legal standards emerge, DAOs will continue to operate in a legal gray area, offering innovation and transparency but facing institutional fragility.

11. Applications of DAOs in the Financial Sector and Practical Use Cases

Decentralized Autonomous Organizations are reshaping operations across diverse sectors, extending far beyond their core technical architecture. This section explores key areas where DAOs are finding practical application and examines the unique accounting, economic, and operational implications within each domain.

a) Treasury/Investment Management

DAOs facilitate decentralized investment and treasury management [2], [10]. Projects like The LAO and MetaCartel Ventures enable communities to pool resources and vote on blockchain-based investments, particularly in early-stage enterprises. Auditable smart contracts automate fund transfers, eliminating the need for traditional fund managers. While these technologies significantly improve accountability, they complicate accounting, especially regarding the fair pricing of volatile crypto-assets, the classification of returns, and the transparent exposition of portfolio allocations. Overall, DAOs expand access to venture capi**tal** by enabling global capital formation and participation.

b) Credit and Lending

Platforms like MakerDAO and Aave utilize collateral to enable borrowing or interest earning [45]. Token holders can vote on critical governance issues, including interest rate changes, liquidity incentives, and collateral eligibility, with all decisions recorded on-chain. Under this framework, lending DAOs maintain immutable records of loans, interest payments, and collateral ratios. However, traditional accounting systems often struggle to accurately recognize income, liabilities, and fair market values in such volatile and novel contexts [51]. While decentralized credit systems lower entry barriers and reduce bank dependence, they remain exposed to market volatility and risks stemming from protocol misconfiguration [46].

c) Insurance and Risk Metallization

Decentralized risk coverage is provided by DAOs such as Nexus Mutual and InsurAce. Members contribute capital, review claims, and vote on payouts, effectively replacing traditional underwriters with community governance. Financial transparency is enhanced through automated monitoring of premiums, coverage, and claim disbursements. Nevertheless, key accounting challenges persist in reserving, loss modeling, and the assessment of contingent liabilities [2]. DAOs offer a cost-effective alternative for mutual insurance, but their long-term survival critically depends on maintaining sufficient capital buffers and effective fraud-prevention incentives.

d) Decentralized Exchange Governance

On DAO-governed exchanges like Uniswap and Curve, community members collectively decide listing rules, pricing models, and core protocol improvements. To foster long-term commitment, token voting often incorporates mechanisms such as vote-locking or delegation. Treasury flows, including trading fees and liquidity incentives, are transparently visible on-chain. However, classifying these flows as operational income, protocol incentives, or equity-like transfers presents significant accounting challenges. While DAOs encourage

transparent and inclusive trading environments, the concentration of voting power among large token holders may challenge governance fairness and participation equity.

e) Public Goods and Crowdfunding

DAOs are increasingly instrumental in promoting public goods and facilitating large-scale crowdsourcing [8], [11]. Gitcoin DAO, for instance, utilizes quadratic funding to enable community-matched incentives for open-source developers. Similarly, ConstitutionDAO famously raised nearly $47 million from hundreds of contributors for a collective auction bid. DAOs enhance the transparency of donation flows and project payments, but they complicate budgeting, particularly regarding contribution categorization and donor intent. Ultimately, decentralized governance and token-based incentives support scalable, trustless coordination mechanisms for public goods financing [2], [8],

12. Case Studies of DAO Implementations: Accounting and Economic Insights

This section examines the operational models of MakerDAO, Gitcoin DAO, and Uniswap DAO to evaluate accounting integrity and economic coordination, aiming to contextualize DAO theory and structure. Each DAO's framework highlights both the challenges and advancements in financial reporting, governance, and incentive alignment.

a) MakerDAO: Credit Issuance and Stablecoin Management

Users employ crypto assets as collateral to generate DAI, a decentralized stablecoin, within the MakerDAO framework [45]. The accounting architecture is defined by fully on-chain collateral management, programmatic interest accrual, and autonomous liquidation processes. All treasury transactions are recorded on the blockchain, enhancing auditability. Ongoing challenges include assessing the fair value of collateral in volatile markets, recognizing protocol income, and maintaining appropriate risk reserves. MakerDAO demonstrates effective capital generation devoid of intermediaries; however, it remains susceptible to liquidity shocks, governance centralization, and interest rate volatility, particularly during market downturns [47].

b) Gitcoin DAO: Decentralized Grant-Making and Public Goods Funding

Gitcoin DAO provides financial support for public goods. It emphasizes support for community-backed developers and open-source initiatives through quadratic financing [19]. Gitcoin introduces complexities in its accounting processes related to incoming and outgoing payments. Its co-matching mechanism renders contributions more comparable to conditional grants than traditional donations. Traceable disbursements pose challenges to budget control and expenditure tracking. Gitcoin demonstrates the potential of algorithmically reinforced democratic funding to address free-rider problems associated with public goods. Sustainability relies on continuous inflows, a credible donor reputation, and effective fund distribution processes.

c) Uniswap DAO: Decentralized Exchange Governance

The Uniswap DAO governs a prominent decentralized exchange, enabling UNI token holders to determine protocol modifications, fee structures, and grant distributions [48]. Trading costs contribute to the DAO's treasury, which governance decisions allocate or reinvest. The accounting implications involve classifying these fees as revenue, retained reserves, or redistribution mechanisms, as well as determining the reporting framework for decentralized grant expenditures. Uniswap functions as a self-regulating marketplace, thereby minimizing costs and promoting liquidity. However, the governance token model raises concerns regarding voting power concentration and the potential for agenda-setting by large holders, particularly when substantial token ownership influences key decisions.

13. Conclusion

This study examined emerging governance forms, including decentralized autonomous organizations (DAOs), and their profound implications for accounting, economic coordination, and institutional design. DAOs fundamentally challenge hierarchical organizations through their code-based governance. By leveraging blockchain technology and smart contracts to automate treasury management, lending, voting, and auditing, DAOs are effectively redefining financial accountability and economic partnership. A primary finding is that DAOs introduce significant accounting challenges. While on-chain record-keeping offers the potential for enhanced triple-entry accounting and continuous assurance through real-time financial transparency, critical complexities in asset valuation, revenue recognition, auditability, and legal classification persist. From an institutional and economic standpoint, DAOs demonstrate the capacity to reduce coordination costs, align incentives, and facilitate decentralized public goods distribution, thereby opening programmatic markets for labour, credit, investment, and governance. However, critical limitations, including voter apathy, potential governance centralization among large stakeholders, and token economic speculation, often constrain the efficacy and fairness of DAO-based systems. Thus, a comprehensive understanding of DAOs requires not only technological research but also robust economic theory concerning incentives, institutional efficiency, and long-term sustainability.

Crucially, persistent regulatory ambiguity remains a significant barrier to broader DAO adoption. The absence of statutory clarity concerning entity identification and tax treatment severely limits their seamless integration into traditional financial systems. To foster innovation, accountability, transparency, and regulatory compliance, policymakers, accounting standard-setters, and DAO practitioners must collaborate effectively. Future research should thus delve deeper into DAO-specific accounting models that accurately reflect their decentralized nature, assessing their impact on economic success, governance effectiveness, and systemic risks. Furthermore, the curricula in accounting, economics, and public policy must evolve to adequately incorporate blockchain and decentralized governance concepts. The development of DAO-native audit tools, robust valuation methodologies, and tailored compliance layers is imperative for the successful institutionalization of decentralized governance.

In conclusion, the ongoing evolution of DAOs presents a profound challenge to established financial theory, accounting principles, economic policy, and traditional organizational governance paradigms. As a technological and institutional frontier that inherently encourages transparency, reduces friction, and enables global collaboration, DAOs demand rigorous study, creative regulatory approaches, and responsible design to realize their full potential.

References

[1] A. Wright and C. P. of L. at B. N. C. S. of Law, “The Rise of Decentralized Autonomous Organizations: Opportunities and Challenges,” Stanf. J. Blockchain Law Policy, Jun. 2021, Accessed: Jun. 07, 2025. [Online]. Available: https://stanford-jblp.pubpub.org/pub/rise-of-daos/release/1

[2] S. Wang, W. Ding, J. Li, Y. Yuan, L. Ouyang, and F.-Y. Wang, “Decentralized Autonomous Organizations: Concept, Model, and Ap-plications,” IEEE Trans. Comput. Soc. Syst., vol. 6, no. 5, pp. 870–878, Oct. 2019, doi: 10.1109/TCSS.2019.2938190.

[3] B. Nguyen Thanh, H. X. Son, and D. T. H. Vo, "Blockchain: The Economic and Financial Institution for Autonomous AI?," J. Risk Financ. Manag., vol. 17, no. 2, p. 54, Jan. 2024, doi: 10.3390/jrfm17020054.

[4] Y. Faqir-Rhazoui, J. Arroyo, and S. Hassan, "A comparative analysis of the platforms for decentralized autonomous organizations in the Ethereum blockchain," J. Internet Serv. Appl., vol. 12, no. 1, p. 9, Dec. 2021, doi: 10.1186/s13174-021-00139-6.

[5] D. Wegner, R. D. Zuquetto, and F. C. Grisi, "Decentralized Autonomous Organizations (DAOs): Field of Research and Avenues for Future Studies," BAR - Braz. Adm. Rev., vol. 21, no. 2, p. e230183, 2024, doi: 10.1590/1807-7692bar2024230183.

[6] C. Bellavitis and P. P. Momtaz, "Voting governance and value creation in decentralized autonomous organizations (DAOs)," J. Bus. Ventur. Insights, vol. 23, p. e00537, Jun. 2025, doi: 10.1016/j.jbvi.2025.e00537.

[7] R. Morrison, N. C. H. L. Mazey, and S. C. Wingreen, "The DAO Controversy: The Case for a New Species of Corporate Govern-ance?" Front. Blockchain, vol. 3, p. 25, May 2020, doi: 10.3389/fbloc.2020.00025.

[8] C. Bellavitis, C. Fisch, and P. P. Momtaz, "The rise of decentralized autonomous organizations (DAOs): a first empirical glimpse," Venture Cap., vol. 25, no. 2, pp. 187–203, Apr. 2023, doi: 10.1080/13691066.2022.2116797.

[9] A. Alawadi, N. Kakabadse, A. Kakabadse, and S. Zuckerbraun, "Decentralized autonomous organizations (DAOs): Stewardship talks but agency walks," J. Bus. Res., vol. 178, p. 114672, May 2024, doi: 10.1016/j.jbusres.2024.114672.

[10] A. Wright and P. De Filippi, "Decentralized Blockchain Technology and the Rise of Lex Cryptographia," SSRN Electron. J., 2015, doi: 10.2139/ssrn.2580664.

[11] M. I. Mehar et al., "Understanding a Revolutionary and Flawed Grand Experiment in Blockchain: The DAO Attack," J. Cases Inf. Technol., vol. 21, no. 1, pp. 19–32, Jan. 2019, doi: 10.4018/JCIT.2019010102.

[12] S. Rouhani and R. Deters, "Security, Performance, and Applications of Smart Contracts: A Systematic Survey," IEEE Access, vol. 7, pp. 50759–50779, 2019, doi: 10.1109/ACCESS.2019.2911031.

[13] W. A. Kaal, "Decentralized Autonomous Organizations: Internal Governance and External Legal Design," Ann. Corp. Gov., vol. 5, no. 4, pp. 237–307, 2021, doi: 10.1561/109.00000028.

[14] S. Hassan and P. De Filippi, "Decentralized Autonomous Organization," Internet Policy Rev., vol. 10, no. 2, Apr. 2021, doi: 10.14763/2021.2.1556.

[15] Y. Liu, Q. Lu, G. Yu, H.-Y. Paik, and L. Zhu, "Defining blockchain governance principles: A comprehensive framework," Inf. Syst., vol. 109, p. 102090, Nov. 2022, doi: 10.1016/j.is.2022.102090.

[16] R. Feichtinger, R. Fritsch, Y. Vonlanthen, and R. Wattenhofer, "The Hidden Shortcomings of (D)AOs – An Empirical Study of On-Chain Governance," in Financial Cryptography and Data Security. FC 2023 International Workshops, vol. 13953, A. Essex, S. Mat-suo, O. Kulyk, L. Gudgeon, A. Klages-Mundt, D. Perez, S. Werner, A. Bracciali, and G. Goodell, Eds., in Lecture Notes in Computer Science, vol. 13953. , Cham: Springer Nature Switzerland, 2024, pp. 165–185. doi: 10.1007/978-3-031-48806-1_11.

[17] K. Saurabh, N. Rani, and P. Upadhyay, "Towards novel blockchain decentralised autonomous organisation (DAO) led corporate gov-ernance framework," Technol. Forecast. Soc. Change, vol. 204, p. 123417, Jul. 2024, doi: 10.1016/j.techfore.2024.123417.

[18] Z. Wei, J. Sun, Z. Zhang, Z. Hou, and Z. Zhao, "Adaptive Plan-Execute Framework for Smart Contract Security Auditing," 2025, arXiv. doi: 10.48550/ARXIV.2505.15242.

[19] J. Han, J. Lee, and T. Li, "A review of DAO governance: Recent literature and emerging trends," J. Corp. Finance, vol. 91, p. 102734, Apr. 2025, doi: 10.1016/j.jcorpfin.2025.102734.

[20] I. Bashir, Mastering Blockchain, Second Edition. Packt Publication, 2018.

[21] S. K. Panda and S. C. Satapathy, "An Investigation into Smart Contract Deployment on Ethereum Platform Using Web3.js and Solidity Using Blockchain," in Data Engineering and Intelligent Computing, vol. 1407, V. Bhateja, S. C. Satapathy, C. M. Travieso-González, and V. N. M. Aradhya, Eds., in Advances in Intelligent Systems and Computing, vol. 1407. , Singapore: Springer Singapore, 2021, pp. 549–561. doi: 10.1007/978-981-16-0171-2_52.

[22] R. V. Patil, I. S. Borse, M. P. Patil, A. H. Khadke, G. M. Poddar, and S. R. Patil, "Ensuring Trust in Blockchain Enabled Business Pro-cesses using Smart Contract Audits," in 2025 International Conference on Inventive Computation Technologies (ICICT), Kirtipur, Ne-pal: IEEE, Apr. 2025, pp. 1248–1254. doi: 10.1109/ICICT64420.2025.11004761.

[23] D. Cagigas, J. Clifton, D. Diaz-Fuentes, and M. Fernandez-Gutierrez, "Blockchain for Public Services: A Systematic Literature Re-view," IEEE Access, vol. 9, pp. 13904–13921, 2021, doi: 10.1109/ACCESS.2021.3052019.

D. He, Z. Deng, Y. Zhang, S. Chan, Y. Cheng, and N. Guizani, "Smart Contract Vulnerability Analysis and Security Audit," IEEE Netw., vol. 34, no. 5, pp. 276–282, Sep. 2020, doi: 10.1109/MNET.001.1900656.

[24] D. Šimůnek, "Decentralized Autonomous Organizations and Trust: Approach to Trust in DAO in the Context of Existing Trust Theo-ry," presented at the Hradec Economic Days 2023, J. Maci, P. Maresova, K. Firlej, and I. Soukal, Eds., Apr. 2023, pp. 703–714. doi: 10.36689/uhk/hed/2023-01-066.

[25] K. Shah, D. Lathiya, N. Lukhi, K. Parmar, and H. Sanghvi, "A systematic review of decentralized finance protocols," Int. J. Intell. Netw., vol. 4, pp. 171–181, 2023, doi: 10.1016/j.ijin.2023.07.002.

[26] R. Patil, S. K. Swarnkar, D. Y. Bhadane, G. M. Poddar, M. P. Patil, and R. C. Sonawane, "Exploring governance frameworks and deci-sion processes in blockchain-based decentralized autonomous organizations," Int. J. Basic Appl. Sci., vol. 14, no. 1, pp. 166–180, May 2025, doi: 10.14419/h0y6dw98.

[27] N. Augustin, A. Eckhardt, and A. W. De Jong, "Understanding decentralized autonomous organizations from the inside," Electron. Mark., vol. 33, no. 1, p. 38, Dec. 2023, doi: 10.1007/s12525-023-00659-y.

[28] R. Feichtinger, R. Fritsch, Y. Vonlanthen, and R. Wattenhofer, "The Hidden Shortcomings of (D)AOs -- An Empirical Study of On-Chain Governance," 2023, arXiv. doi: 10.48550/ARXIV.2302.12125.

[29] S. Sheikh and I. Sifat, "Built to last, not to scale: The long run of decentralised autonomous organisations," J. Innov. Knowl., vol. 9, no. 3, p. 100513, Jul. 2024, doi: 10.1016/j.jik.2024.100513.

[30] T. Lloyd, D. O'Broin, and M. Harrigan, "The On-Chain and Off-Chain Mechanisms of DAO-to-DAO Voting," in 2024 IEEE Interna-tional Conference on Blockchain (Blockchain), Copenhagen, Denmark: IEEE, Aug. 2024, pp. 649–655. doi: 10.1109/Blockchain62396.2024.00095.

[31] Q. Ding, W. Xu, Z. Wang, and D. K. C. Lee, "Voting Schemes in DAO Governance," World Sci. Annu. Rev. Fintech, vol. 01, p. 2350004, Jan. 2023, doi: 10.1142/S2811004823500045.

[32] S. S. Kushwaha, S. Joshi, D. Singh, M. Kaur, and H.-N. Lee, "Systematic Review of Security Vulnerabilities in Ethereum Blockchain Smart Contract," IEEE Access, vol. 10, pp. 6605–6621, 2022, doi: 10.1109/ACCESS.2021.3140091.

[33] A. Bouichou, S. Mezroui, and A. E. Oualkadi, "An overview of Ethereum and Solidity vulnerabilities," in 2020 International Sympo-sium on Advanced Electrical and Communication Technologies (ISAECT), Marrakech, Morocco: IEEE, Nov. 2020, pp. 1–7. doi: 10.1109/ISAECT50560.2020.9523638.

[34] J. J. De Leon, C. Zhang, C.-S. Koulouris, F. Medda, and Rahul, "Smart Contract Security in Decentralized Finance: Enhancing Vulner-ability Detection with Reinforcement Learning," Appl. Sci., vol. 15, no. 11, p. 5924, May 2025, doi: 10.3390/app15115924.

[35] D. Dhillon, Diksha, and D. Mehrotra, "Smart Contract Vulnerabilities: Exploring the Technical and Economic Aspects," in Blockchain Transformations, S. M. Idrees and M. Nowostawski, Eds., in Signals and Communication Technology. , Cham: Springer Nature Swit-zerland, 2024, pp. 81–91. doi: 10.1007/978-3-031-49593-9_5.

[36] C. Santana and L. Albareda, "Blockchain and the emergence of Decentralized Autonomous Organizations (DAOs): An integrative model and research agenda," Technol. Forecast. Soc. Change, vol. 182, p. 121806, Sep. 2022, doi: 10.1016/j.techfore.2022.121806.

[37] S. Bonnet and F. Teuteberg, "Decentralized Autonomous Organizations: A Systematic Literature Review and Research Agenda," Int. J. Innov. Technol. Manag., vol. 21, no. 04, p. 2450026, Jun. 2024, doi: 10.1142/S0219877024500263.

[38] U. W. Chohan, "The Decentralized Autonomous Organization and Governance Issues," SSRN Electron. J., 2017, doi: 10.2139/ssrn.3082055.

[39] W. Ma, C. Zhu, Y. Liu, X. Xie, and Y. Li, "A Comprehensive Study of Governance Issues in Decentralized Finance Applications," ACM Trans. Softw. Eng. Methodol., p. 3717062, Feb. 2025, doi: 10.1145/3717062.
[40] J. (Rowena) Gan, G. Tsoukalas, and S. Netessine, "Decentralized Platforms: Governance, Tokenomics, and ICO Design," Manag. Sci., vol. 69, no. 11, pp. 6667–6683, Nov. 2023, doi: 10.1287/mnsc.2021.02076.
[41] O. Rikken, M. Janssen, and Z. Kwee, "Governance impacts of blockchain-based decentralized autonomous organizations: an empirical analysis," Policy Des. Pract., vol. 6, no. 4, pp. 465–487, Oct. 2023, doi: 10.1080/25741292.2023.2270220.
[42] S. Li and Y. Chen, "Governing decentralized autonomous organizations as digital commons," J. Bus. Ventur. Insights, vol. 21, p. e00450, Jun. 2024, doi: 10.1016/j.jbvi.2024.e00450.
[43] O. Rikken, M. Janssen, and Z. Kwee, "Governance challenges of blockchain and decentralized autonomous organizations," Inf. Polity, vol. 24, no. 4, pp. 397–417, Dec. 2019, doi: 10.3233/IP-190154.
[44] E. W. Ellinger, T. Mini, R. W. Gregory, and A. Dietz, "Decentralized Autonomous Organization (DAO): The case of MakerDAO," J. Inf. Technol. Teach. Cases, vol. 14, no. 2, pp. 265–272, Nov. 2024, doi: 10.1177/20438869231181151.
[45] H. Altaleb and R. Zoltan, "Decentralized autonomous organizations review, importance, and applications," in 2022 IEEE 26th Interna-tional Conference on Intelligent Engineering Systems (INES), Georgioupolis Chania, Greece: IEEE, Aug. 2022, pp. 000121–000126. doi: 10.1109/INES56734.2022.9922656.
[46] I. Melnikov, I. Lebedeva, A. Petrov, and Y. Yanovich, "DeFi risk assessment: MakerDAO loan portfolio case," Blockchain Res. Appl., vol. 6, no. 2, p. 100259, Jun. 2025, doi: 10.1016/j.bcra.2024.100259.
[47] J. A. Berg, R. Fritsch, L. Heimbach, and R. Wattenhofer, "An Empirical Study of Market Inefficiencies in Uniswap and SushiSwap," in Financial Cryptography and Data Security. FC 2022 International Workshops, vol. 13412, S. Matsuo, L. Gudgeon, A. Klages-Mundt, D. Perez Hernandez, S. Werner, T. Haines, A. Essex, A. Bracciali, and M. Sala, Eds., in Lecture Notes in Computer Science, vol. 13412. , Cham: Springer International Publishing, 2023, pp. 238–249. doi: 10.1007/978-3-031-32415-4_16.