Exploring the Landscape of Decentralized Autonomous Organizations: A Comprehensive Review of Blockchain Initiatives

Abstract

The present study aims to investigate the DAO initiative and scrutinize the diverse methodologies researchers employ for data collection in this area, highlighting any unresolved problems or limitations and suggesting approaches to enhance blockchain technology for future investigations. A remarkable blockchain initiative is the decentralized autonomous organization (DAO), a decentralized blockchain technology system that lets people self-govern through self-executing rules. The methodology is a qualitative analysis that uses contractual and business aspects to create a legally binding smart contract for DAO collaborations; thus, SPESC and Symboleo are smart-contract languages (SCL) that can involve IT and non-IT individuals in contract development. Blockchain technology has created Decentralized Autonomous Organizations (DAOs) that perform autonomously through smart contracts within their ecosystem without the necessity for centralized control or third-party intervention.

Keywords: blockchain technology, smart-contract languages, decentralized autonomous organization, global economy

Introduction

Blockchain technology is causing significant changes in different areas of the economy and is receiving widespread attention worldwide. (Shetty et al., 2019), Moreover, the impact of Blockchain technology on globalization and various industries is substantial, and one of its unique benefits is the ability to distribute, encrypt, tokenize, and decentralize information, which sets it apart from the traditional Internet (Febiri & Hub, 2021). Presently, many nations and businesses are exploring the capabilities of this technology and its impact on various industries (Febiri & Hub, 2021). Blockchain technology, popularized by Bitcoin, has significantly impacted the finance sector of the global economy, and its growth possibility extends to other industries (Hooper & Holtbrugge, 2019). Blockchain technology can revolutionize the global business ecosystem and remarkably transform businesses through many initiatives (Febiri & Hub, 2021). This paper aims to perform a literature review on Decentralized Autonomous Organizations (DAOs), which are blockchain-based initiatives, and analyze the identified issues and gaps in the existing body of literature. Additionally, it aims to investigate the DAO initiative and scrutinize the diverse methodologies researchers employ for data collection in this area, highlighting any unresolved problems or limitations and suggesting approaches to enhance blockchain technology for future investigations.

Decentralized Autonomous Organization

A remarkable blockchain initiative is the decentralized autonomous organization (DAO), a decentralized blockchain technology system that lets people self-govern through self-executing rules (Hassan & De Filippi, 2021). A DAO functions as a collective entity owned by a community to achieve a common goal through blockchain technology (Ethereum, 2023). DAOs foster collaboration with similarly inclined people worldwide, eliminating reliance on a single

trusted leader to manage operations and finances (Ethereum, 2023). DAO has removed the conventional roles of the Chief Executive Officer (CEO) with discretionary spending powers or a Chief Financial Officer (CFO) who can manipulate financial records (Ethereum, 2023). The rules embedded in the blockchain's code govern business operations and fund allocation (Ethereum, 2023). It involves voting and financial management through the blockchain system (Hassan & De Filippi, 2021). DAOs include intrinsic treasuries that remain inaccessible without the collective group's consent and permission, and their decision-making processes involve proposing and voting to ensure inclusivity and transparency for all members (Hassan & De Filippi, 2021). All activities occur on-chain, ensuring complete visibility (Ethereum, 2023).

Literature Review

The literature review analyzes Decentralized Autonomous Organizations (DAO), which are blockchain-based initiatives. It evaluates the recognized problems and gaps using understandings from 9 peer-reviewed scholarly articles. This study intends to examine the DAO initiative and analyze the various research methods used for data collection in this field. Likewise, it will highlight any issues or limitations that still need to be resolved and suggest ways to improve blockchain technology for future research through scholarly investigation.

Developing a Language Enabling Decentralized Autonomous Organizations

According to Dwivedi et al. (2021), using blockchain and smart-contract technology can significantly enhance the efficiency and automation of different organization procedures. The increasing interest in decentralized autonomous organizations (DAO) shows blockchain technology's enormous potential to transform the global business ecosystem and communities (Dwivedi et al., 2021). The problem is creating a formal specification language for legally binding DAOs (Dwivedi et al., 2021). The research question examines the potential of

developing a language enabling DAOs to form legally binding partnerships (Dwivedi et al., 2021). Also, it addresses the legal aspects of DAOs, language translation, and the feasibility of using this approach in a real-world scenario (Dwivedi et al., 2021). The methodology is a qualitative analysis that uses contractual and business aspects to create a legally binding smart contract for DAO collaborations; thus, SPESC and Symboleo are smart-contract languages (SCL) that can involve IT and non-IT individuals in contract development (Dwivedi et al., 2021). In the data analysis, the authors designed an SCL ontology for characterizing DAOs and transformed it into SLCML with an XML schema. Hence, the explicit language was tested by constructing a Sale-of-Goods contract and converting the code into Solidity for blockchain implementation (Dwivedi et al., 2021). The research shows that SCL ontology can address all legally enforceable business contracts in one framework structure, making smart-contract technology valid for contemporary organizations (Dwivedi et al., 2021). Every contract class inherits attributes from higher levels, and gains specialized knowledge for its specific domain (Dwivedi et al., 2021).

Leveraging Decentralized Autonomous Organization for Good Governance

Saito and Rose (2023) emphasize how DAO governance benefits non-profits by addressing decentralized governance limitations, proffering tailored frameworks with reputation-based decision-making, peer assessment, and transparent computation and accounting. The authors established the potential of DAO frameworks to empower non-profits and advocate for alternative voting mechanisms (Saito & Rose, 2023). The problem is that the potential of a DAO for non-profits has yet to be explored compared to its application in conventional stock companies (Saito & Rose, 2023). The authors did not state the research questions. However, the methodology is a proof-of-concept execution of a DAO governance structure for non-profits,

accentuating the advantages and functionalities of DAO (Saito & Rose, 2023). The data analysis blends a reputation-based voting mechanism, a membership system with mutual assessment, and a prominent NFT to visualize contributions (Saito & Rose, 2023). The study's outcome revealed that blockchain technology effectively addressed the vulnerabilities of non-profit organizations using DAO and exhibited the proper rationale behind the proposed reputation-based governance mechanisms (Saito & Rose, 2023). The result also showed comparative risks and limitations alongside blockchain-based governance's benefits (Saito & Rose, 2023).

Decentralized Autonomous Organizations Tackle Capital Market Venture Shortcomings

Kaal (2023) explores how decentralized technology can improve venture capital (VC) models, addressing roadblocks like ownership conflicts, illiquidity, and timing problems in traditional fundraising. Also, the author examines alternative funding tools for emerging businesses and accentuates the advent of DAO-operated VC corporations (Kaal, 2023). The problem centers on experimental VC reputation measures and traditional VC fundraising, which experience roadblocks such as ownership conflicts, illiquidity, and timing problems (Kaal, 2023). The author did not state the research questions. The methodology examines alternative funding tools that could proffer new businesses distinctive benefits (Kaal, 2023). The data analysis experimented with DeFi capital alternate techniques, seeking to refine them to evade unanticipated consequences and guarantee good assets flows (Kaal, 2023). The outcome shows that the current VC model is constrained and fails to provide long-term value to tech startups (Kaal, 2023). Conversely, traditional fiat VC investments have drawbacks compared to early-stage digital asset acquisitions; however, by employing DAO, VCs can gain flexibility without being bound by mandatory capital calls (Kaal, 2023). Moreover, they can benefit from reputation-based compensation payouts, even during liquidity crises (Kaal, 2023).

Security, Privacy, and Legal Ambiguity Challenges with Decentralized Autonomous Organization

Wang et al. (2019) explain that decentralized autonomy has been the subject of extensive research in information technology for a considerable time (Wang et al., 2019). DAO finds its early manifestations in various domains, such as the self-organization observed in natural ecosystems, the emergence of Cyber Movement Organizations (CMOs) on the Internet, and the development of Distributed Artificial Intelligence (DAI) systems (Wang et al., 2019). The DAO can transform organization aspirations by reducing organizational expenses in communication, administration, and collaboration; however, the problem is that it faces challenges like security, privacy, and legal ambiguity during smart contract execution. (Wang et al., 2019). The authors did not state the research questions. The methodology systematically presents DAO, from its origin to attributes, research structure, routine undertakings, issues, and future tendencies (Wang et al., 2019). The data analysis employed a novel connection model for DAO, which operates on a five-layer architecture (Wang et al., 2019). The effect shows that DOA's concept, model, and applications contribute to its efficiency (Wang et al., 2019).

Governance Issues with Decentralized Autonomous Organizations

Ding et al. (2023) emphasized that in recent years, DAOs have emerged as a critical component of digital infrastructure, and their distinctive organizational features and operational framework have gained considerable prominence as a powerful solution to address various corporate governance challenges such as contract risks and principal-agent dilemmas (Ding et al., 2023). The capabilities inherent in DAOs empower them to tackle these issues and effectively contribute to improved governance practices (Ding et al., 2023). The problem is that DAOs encounter various governance problems because they are a new economic organization; the

traditional corporate governance theories and methods may only partially suit them; however, the potential for unexpected logic vulnerabilities and code loopholes in the governance mechanism can lead to catastrophic consequences for DAOs. (Ding et al., 2023). The authors did not state the research questions (Ding et al., 2023). The ACP parallel intelligence theory methodology presents a sophisticated research paradigm and a pragmatic solution for addressing these challenges; thus, the authors introduce an innovative parallel governance framework for DAOs, leveraging the doctrines of the parallel intelligence theory (Ding et al., 2023). In the data analysis, the authors created a parallel governance approach for GnosisDAO and conducted computational experiments to validate the significance of its governance mechanism with the ecosystem (Ding et al., 2023). The outcome shows that empirical results establish parallel governance as a practical research approach to solving extant governance situations of DAOs (Ding et al., 2023).

Social Resistance and Terrorism Empowerment Through Decentralized Autonomous Organizations

Krishnan (2020) argues that as a blockchain initiative, DAO will revolutionize antagonism to authority by facilitating decentralized and trustless collaboration. Blockchain fosters decentralized and trustless collaboration by utilizing distributed ledgers to record transactions and execute smart contracts through consensus protocols (Krishnan, 2020). Hence, this innovative approach empowers individuals to engage in an open ecosystem, participating in collaborative efforts without mutual trust with keen governance by computer code (Krishnan, 2020). Therefore, leveraging the possibility of DAOs, the traditional hindrances of trust and centralization can be bypassed, opening opportunities for a new paradigm in resistance and organizational structures (Krishnan, 2020). The problem is the possibility of using

cryptocurrencies for illicit and illegal purposes (Krishnan, 2020). The authors did not state research questions or methodology and did not conduct data analysis. DAOs are decentralized organizations based on blockchain technology, and smart contracts permit unrelated contributors to form leaderless organizations without conventional hierarchies (Krishnan, 2020). The authors conclude that governments and corporations must embrace a foresighted standpoint concerning blockchain technology using appropriate DAO to address likely economic and political stability threats (Krishnan, 2020).

Decentralized Autonomous Organizations in the Ethereum Blockchain

According to Faqir-Rhazoui et al. (2021), Blockchain technology has revolutionized decentralized systems, introducing new possibilities for innovative governance and coordination methods; hence DAOs are notable for their decision-making systems that allow online communities to reach a consensus and make collective agreements. The problem is inadequate research and analysis on DAO platforms, specifically their growth, voting systems, activity, and funds, and lack of support from strong Blockchain ecosystem providers (Faqir-Rhazoui et al., 2021). The authors did not state the research questions; however, the methodology is a quantitative analysis of the three platforms, Aragon, DAOstack, and DAOhaus, currently available to build and manage DAOs and compared them using quantitative metrics (Faqir-Rhazoui et al., 2021). In the data analysis, the authors examined the development, exercise, voting system, and funds of Ethereum's primary network and xvii based on data from 72,320 users and 2,353 DAO districts (Faqir-Rhazoui et al., 2021). The research outcome indicates strong evidence of substantial variations in development, exercise, and voting outcomes among different DAO platforms (Faqir-Rhazoui et al., 2021).

Five-Layer Intelligent Architecture for Decentralized Autonomous Organization

According to Qin et al. (2023), leveraging the power of blockchain and Web3 technologies, DAOs can reshape resources, organizational frameworks, and production relationships groundbreakingly. Thus, the authors seek to reassess DAOs, exploring their organizational and operational aspects and presenting a refined and comprehensive definition of DAOs as decentralized autonomous entities and their corresponding functions (Qin et al., 2023). The problem revolves around employing an infrastructure based on a cyber-physical-social system (CPSS) and parallel intelligence with supporting technologies like digital twins, metaverse, and Web3 (Qin et al., 2023). The methodology is a five-layer intelligent architecture with the closed-loop equation and novel function-oriented intelligent algorithms (Qin et al., 2023). The data analysis exhaustively explores the incentive instruments for diverse entities, including humans, digital humans, and robots, furnishing a thorough breakdown (Qin et al., 2023). The result shows that a five-layer intelligent architecture with supporting technologies like digital twins, metaverse, and Web3 efficiently manages DAO (Qin et al., 2023).

Decentralized Autonomous Organizations Aids Special-Purpose Financing

Bischof et al. (2022) accentuate that DAO has materialized to elevate self-organization to phenomenal peaks. Nevertheless, despite its immense potential in special-purpose financing, compliance conditions necessitate the presence of a central authority within the DAO governance model, which can facilitate the implementation of DAO decisions that involve interactions with traditional legacy systems (Bischof et al., 2022). The problem is that the current state of DAOs needs a standardized decentralized solution for crisis management (Bischof et al., 2022). The authors did not state the research questions. The methodology explores the employment of emerging technologies to establish a basis for special-purpose financing, using longevity as a

prime exemplar of the assignment (Bischof et al., 2022). The authors conducted data analysis using qDAO, a mixed governance approach blending centralized and decentralized procedures, allowing legal compliance while involving participants in decision-making (Bischof et al., 2022). The outcome demonstrates that qDAO has the prospect to enhance the advancement of humanity, nurturing individuals to enjoy a healthy lifespan of over 120 years (Bischof et al., 2022).

Problems and Gaps Identified in the Literature

The literature identifies several problems and gaps in blockchain initiatives focusing on Decentralized Autonomous Organizations (DAOs). Firstly, there is a need to create a formal specification language that can legally bind DAOs (Dwivedi et al., 2021). Additionally, there is a lack of sufficient research and analysis on DAO platforms, particularly regarding their growth, voting systems, activity, and funds (Faqir-Rhazoui et al., 2021). Although DAOs have the potential to transform organizational processes and reduce expenses in communication, administration, and collaboration, they face challenges such as security, privacy, and legal ambiguity during smart contract execution (Wang et al., 2019). Moreover, DAOs encounter various governance problems as they are novel economic organizations, and traditional corporate governance theories and methods may only partially suit them (Ding et al., 2023). The presence of unexpected logic vulnerabilities and code loopholes in the governance mechanism can have catastrophic consequences for DAOs (Ding et al., 2023).

Another problem concerns utilizing a cyber-physical-social system (CPSS) infrastructure, parallel intelligence, and supporting technologies like digital twins, metaverse, and Web3 (Qin et al., 2023). Furthermore, the potential of DAOs for non-profit organizations has not been explored extensively compared to their application in conventional stock companies (Saito & Rose, 2023). The current state of DAOs also lacks a standardized decentralized solution for crisis

management (Bischof et al., 2022). Lastly, there is a concern regarding the possibility of cryptocurrencies serving as a tool for illicit and illegal purposes (Krishnan, 2020).

Areas of Improvement

As a Blockchain initiative, DAO is a rapidly evolving technology with great potential for transforming various aspects of organizations. However, several areas of improvement to ensure the successful implementation and growth of DAOs. There is a need to develop a formal specification language that enables legally binding DAOs and standardized protocols for specifying and enforcing legal agreements within the DAO framework, which hinders the adoption of DAOs in industries that require legal compliance and regulation (Dwivedi et al., 2021). Likewise, the research and analysis on DAO platforms still need to be improved, particularly in growth, voting systems, activity, and funds (Wang et al., 2019). Faqir-Rhazoui et al. (2021) emphasize the importance of conducting comprehensive studies to understand the dynamics and functioning of DAOs better.

Moreover, while DAOs have the potential to revolutionize organizational efficiency by reducing expenses in communication, administration, and collaboration, they face challenges related to security, privacy, and legal ambiguity during smart contract execution to build trust and confidence in DAOs as reliable and secure systems (Wang et al., 2019). Similarly, as a new form of economic organization, DAOs encounter governance problems that differ from traditional corporate governance theories and methods; hence, there is a need to develop suitable governance mechanisms for DAOs to ensure effective decision-making and prevent catastrophic consequences from logical vulnerabilities and code loopholes (Ding et al., 2023). In addition, implementing DAOs requires an infrastructure based on a cyber-physical-social system (CPSS),

and supporting technologies like digital twins, metaverse, and Web3 will enhance their functionality and scalability (Qin et al., 2023).

Similarly, Saito & Rose (2023) suggested exploring the potential of DAOs in non-profit organizations in other areas like conventional stock companies and non-profits where DAO have untapped opportunities because understanding how DAOs can transform the non-profit sector can unlock new possibilities for transparency, accountability, and decentralized decision-making. Also, the current state of DAOs needs a standardized decentralized solution for crisis management (Bischof et al., 2022). Hence, establishing robust crisis management protocols within the DAO framework is crucial to ensure swift and effective responses to unforeseen events or emergencies (Bischof et al., 2022). Finally, there is a concern about the potential misuse of cryptocurrencies associated with DAOs for illicit and illegal purposes (Krishnan, 2020); hence, there is a need for adequate regulatory frameworks and security measures to prevent and detect such activities while fostering innovation and legitimate use cases for cryptocurrencies within DAOs.

Research Questions

The absence of research questions is evident in several scholarly works. The scholarly authors Faqir-Rhazoui et al. (2021), Wang et al. (2019), Saito & Rose (2023), Ding et al. (2023), Qin et al. (2023), Kaal (2023), Bischof et al. (2022), and Krishnan (2020) did not explicitly state any research questions in their respective studies. However, Dwivedi et al. (2021) asked the following research questions:

1. Which formal semantics govern the legal components of a business procedure?
2. What does the machine-readable language transformation entail concerning ontology?

3. What does the language's feasibility evaluation approach involve when applied to a specific use case?

Methodology

The authors use different methods to explore DAO as a Blockchain Initiative. In their study, Dwivedi et al. (2021) utilized a methodology that incorporates contractual and business aspects to create legally binding smart contracts for DAO collaborations, employing smart-contract languages (SCL) such as SPESC and Symboleo to involve both IT and non-IT individuals in contract development. Faqir-Rhazoui et al. (2021) employed a quantitative analysis methodology to compare and evaluate three existing platforms, namely Aragon, DAOstack, and DAOhaus, in terms of their capabilities for building and managing DAOs, using quantitative metrics as a basis for comparison. Likewise, Wang et al. (2019) presented a comprehensive methodology that systematically explores various aspects of DAOs, including their origin, attributes, research structure, routine undertakings, challenges, and future trends.

In addition, Ding et al. (2023) introduced the ACP parallel intelligence theory methodology, which proposes a research paradigm and governance framework for DAOs; this methodology leverages the doctrines of parallel intelligence theory to address challenges in the field. Qin et al. (2023) developed a methodology based on a five-layer intelligent architecture, incorporating a closed-loop equation and novel function-oriented intelligent algorithms. Also, Kaal (2023) employed a methodology to examine alternative funding tools that offer unique benefits to new businesses. Also, Bischof et al. (2022) used a methodology that explores the utilization of emerging technologies for establishing special-purpose financing, using the example of longevity as a primary case study for their investigation.

Data Analysis

The data analysis in the study employed various approaches. In the data analysis conducted by Dwivedi et al. (2021), an SCL ontology was designed to characterize DAOs and transformed into SLCML using an XML schema. The explicit language was tested by constructing a Sale-of-Goods contract and converting the code into Solidity for blockchain implementation. Faqir-Rhazoui et al. (2021) examined Ethereum's primary network and xvii, focusing on the development, exercise, voting system, and funds of 72,320 users and 2,353 DAO districts. A novel connection model for DAO, operating on a five-layer architecture, was employed in the data analysis by Wang et al. (2019). Ding et al. (2023) created a parallel governance approach for GnosisDAO and conducted computational experiments to validate the significance of its governance mechanism within the ecosystem.

Further, Qin et al. (2023) extensively explored incentive instruments for various entities, including humans, digital humans, and robots, providing a comprehensive breakdown. Saito & Rose (2023) executed a proof-of-concept for a DAO governance structure for non-profits, highlighting the advantages and functionalities of DAO. Kaal (2023) experimented with DeFi capital alternate techniques in the data analysis, aiming to refine them to avoid unforeseen consequences and ensure smooth asset flows. Bischof et al. (2022) conducted data analysis using qDAO, which combines centralized and decentralized procedures in its governance approach to ensure legal compliance while involving participants in decision-making.

Conclusion

The results of different scholarly papers reviewed shed light on several factors that need consideration regarding DAO blockchain initiatives. Dwivedi et al. (2021) reveal that the SCL ontology can encompass all legally enforceable business contracts within a single framework, establishing the validity of smart-contract technology for contemporary organizations. In this framework, each contract class inherits attributes from higher levels and acquires specialized knowledge for its specific domain Dwivedi et al. (2021). Faqir-Rhazoui et al. (2021) present substantial evidence of significant variations in development, exercise, and voting outcomes across different DAO platforms. Wang et al. (2019) indicate that DAO's concept, model, and applications contribute to its efficiency based on the research outcome. Likewise, Ding et al. (2023) highlight that empirical results establish parallel governance as a practical research approach for addressing existing governance situations of DAOs. Qin et al. (2023) demonstrate that a five-layer intelligent architecture, supported by digital twins, metaverse, and Web3 technologies, effectively manages DAO.

Further, Saito & Rose's (2023) data analysis incorporates a reputation-based voting mechanism, a membership system with mutual assessment, and a prominent NFT to visualize contributions. Their study's outcome reveals that blockchain technology effectively addresses non-profit organizations' vulnerabilities using DAO while presenting risks and limitations alongside the benefits of blockchain-based governance. Kaal (2023) finds that the current VC model is limited in providing long-term value to tech startups. However, by employing DAO, VCs can overcome these limitations and gain flexibility without being bound by mandatory capital calls. Additionally, reputation-based compensation payouts can be obtained, even during liquidity crises. Bischof et al. (2022) demonstrate that qDAO has the potential to enhance

humanity's progress, enabling individuals to enjoy a healthy lifespan of over 120 years. Krishnan (2020) concludes that governments and corporations should adopt a forward-thinking perspective on blockchain technology and leverage appropriate DAO to mitigate potential economic and political stability threats.

Blockchain technology has created Decentralized Autonomous Organizations (DAOs) that perform autonomously through smart contracts within their ecosystem without the necessity for centralized control or third-party intervention (Wang et al., 2019). Addressing the areas of improvement summarized above is essential for the successful development, adoption, and long-term sustainability of DAO, a Blockchain initiative. Also, by focusing on these challenges, researchers, developers, and policymakers can ensure the realization of the full potential of DAOs in transforming organizational structures and processes.

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