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A BIBLIOMETRIC EXAMINATION OF ARTICLES ON DAOS GOVERNANCE USING THE VOS VIEWER

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Abstract With the introduction of DAOs, a new phase of corporate governance challenges has emerged, and this study tries to understand the future course of direction for research in this area by bibliomretric analysis.

The scopus collection database was searched for global literature on DAO governance published between 2015 and 2023 (September). The keywords "DAO," "governance," "blockchain," and "smart contracts" were used to find relevant papers. The bibliometric analysis of these articles was carried out using VOSviewer.

The SCOPUS database has 93 papers on the subject of DAOs and governance between 2015 and 2023 (September 28, 2023). Case studies, original research, and reviews were included in these publications. 2.25 percent of these papers were published in 2015; 3.37 percent in 2016, 3.37 percent in 2017, 2.25 percent in 2018, 5.62% in 2019, 10.11% in 2020, 19.10 percent in 2021, 17.98 percent in 2022, and 35.96 percent in 2023.The United States and China produce the most papers, with Macao coming in second. There is also evidence of a collaboration between China and Macao, as well as the United States and Spain.

Research in these areas will help to address issues, strengthen the technology, and discover novel ways to use decentralised governance for the benefit of society as DAOs continue to develop as an essential component of numerous sectors, including finance and governance.

***Index Terms*- DAO, VOS Viewer,blockchain, bibliometric analysis**

I. INTRODUCTION

A new era of corporate governance has dawned with the emergence of Decentralized Autonomous Organizations ("DAOs"). Several firms claim to be able to provide entirely open corporate structures in which hundreds to millions of users can vote as a board of directors, and in which all investors can participate in company decisions anonymously and without judgment (Allen and Berg,2020).

A decentralized autonomous organization, or DAO, can be thought of as a separate corporate governance structure. DAO's are similar to other types of company or corporation in the sense that they have their own rules and habits that govern how they decide to run their organization, similar to that of a limited liability company, a publicly traded corporation, or a partnership (Ilyushina and Macdonald,2022). A DAO requires some basic attributes that link the stakeholders together. There are four things that are essential for a DAO to exist: a blockchain, a smart contract, a token and governance in order for it to operate (Mondoh et al.,2022). This paper aims at extracting the keywords most associated with the DAO's with the help of bibliometric analysis.

Organizations are constantly grappling with the challenge of evolving rapidly to meet the ever-changing demands of their customers. Amidst this, centralized hierarchies and outdated management practices often stand as barriers to agility and innovation. There is transformative potential of decentralized governance, facilitated by groundbreaking technologies like blockchain. By examining the inefficiencies inherent in traditional centralized systems and presenting robust case studies from the blockchain realm.

Decentralized governance, underpinned by blockchain technology, has gained significant attention as a potential avenue to address inefficiencies inherent in traditional centralized organizational structures. A plethora of studies have delved into the benefits and challenges of this transition.

Smith et al. (2017) critically evaluated the inadequacies of conventional centralized governance models in today's swiftly evolving digital landscape. Their findings spotlighted the pressing need for more agile structures, with decentralization emerging as a viable solution to empower stakeholders and engender trust. Corroborating this, Johnson (2019) offered compelling quantitative insights that reveal a tangible correlation between centralized decision-making and waning productivity.

Blockchain's potential as a catalyst for revolutionary change in organizational governance is extensively documented. Jensen et al. (2019) provided an in-depth analysis of blockchain's intrinsic attributes, highlighting its potential to drive transparency, ensure data immutability, and facilitate automation through smart contracts. In a similar vein, Wessel et al. (2021) delved into the burgeoning concept of decentralized autonomous organizations (DAOs). Their work elucidates how DAOs, underpinned by smart contracts, can pave the way for innovative coordination and governance structures. Further contributing to this discourse, Mougayar (2022) elucidated comprehensive frameworks tailored to the effective management of decentralized organizations.

A growing body of literature is dedicated to the practical applications of blockchain-driven decentralization in diverse sectors. Seminal works by Saberi et al. (2019) and Novak et al. (2020) have explored its transformative impact on supply chain management and accounting, respectively. Raval (2016) and Risius et al. (2017) have shed light on its potential in intellectual property rights management and regulatory compliance. Supplementing these theoretical insights, real-world case studies, such as those presented by Paul (2021) and Briggs et al. (2019), furnish empirical evidence of tangible benefits accrued through decentralized workflows in areas like payments and contract management.

Despite the burgeoning interest, empirical investigations into decentralized governance remain in nascent stages. Nevertheless, Åhlström et al. (2021) took a pioneering step by developing an analytical model that simulates the financial implications of decentralization, unveiling potential cost benefits.

In summation, the extant literature underscores the promise of decentralized governance in fostering innovation, bolstering productivity, and enhancing trust. Our research seeks to further this discourse by offering actionable insights and strategies tailored to assist traditional organizations in navigating this paradigm shift, ensuring they remain at the forefront of competitive dynamics.

Hence, this paper seeks to offer a blueprint for the research aiming to revolutionize their management and productivity through bibliometric analysis of existing publications on DAO's governance.. It presents a compelling vision for the future of organizational governance, suggesting a shift from the centralized to the decentralized, paving the way for a more responsive and efficient digital era.

II.Methodology

Bibliometrics is a statistical method that quantitatively analyses research publications that are focused on a specific topic using a variety of mathematical methodologies (Donthu et al., 2021). It may also foresee the direction of future research and evaluate the main areas of research as well as the calibre of the studies. The scopus database contains almost all notable research publications and includes integrated analysis tools to

produce representative results. Furthermore, WOS search results could be transferred to an application such as VOSviewer for further analysis..

However, there hasn't yet been a more published bibliometric examination of works on governance of decentralised autonomous organisations. These references should provide more information, therefore bibliometric study of them is necessary. Our study was therefore completed at the right time to offer a thorough grasp of DAO governance and future research areas.

The scopus database was searched for publications about DAO's governance that were published worldwide between 2015 and 2023 till 28 September 2023. The keywords "DAO's" and "governance" and "blockchain" and "smart contracts" were used as search phrases to find the publication that was the closest match.

"The year of publication, language, journal, title, author, affiliation, keywords, document type, abstract, and counts of citations for the articles that complied with the requirements were all saved into CSV format". The retrieval took place on September 28, 2023. The co-authorship, co-occurrence, citation, bibliographic coupling, co-citation, and themes were examined using VOSviewer (version 1.6.10). The terms "Links attribute" and "Total link strength attribute" are used to specify two common weight properties.

III.RESULTS

3.1Bibliometric analysis of publication output

Between 2015 and 2023 (September 28, 2023), a total of 93 publications on the subject of DAOs and governance were found in the SCOPUS database. These publications comprised case studies, original research pieces, and reviews.

Table 1- database distribution

articles	44	47.31183
review paper	2	2.150538
book chapter	9	9.677419
conference paper	38	40.86022
	93	

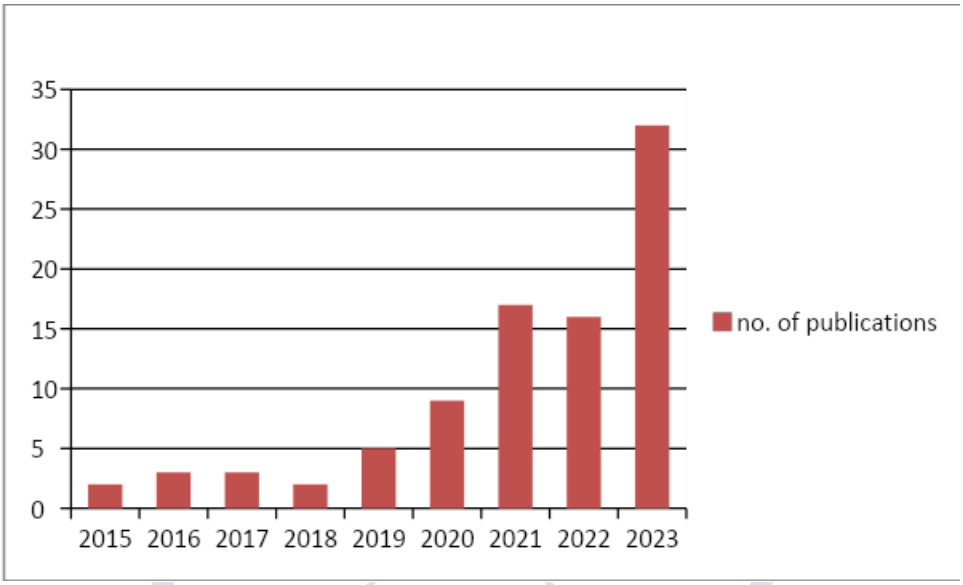
2.25 percent of these papers were published in 2015; 3.37 percent in 2016, 3.37 percent in 2017, 2.25 percent in 2018, 5.62% in 2019, 10.11% in 2020, 19.10 percent in 2021, 17.98 percent in 2022, and 35.96 percent in 2023.

Following is the table of year wise publication-

Table 2- year wise publication-

Years	no. of publications	Percentage
2015	2	2.15%
2016	4	4.30%
2017	5	5.38%
2018	3	3.23%
2019	5	5.38%
2020	9	9.68%

2021	17	18.28%
2022	16	17.20%
2023	32	34.41%
	93	



Graph 1- year-wise publications

3.2 Bibliometric analysis of the keywords

The final analysis included keywords that were supplied by the paper's authors and appeared in the SCOPUS core database more than five times. Eleven of the 595 terms satisfied the requirement. The most often occurring keywords were "governance" (total link strength 79) and "DAOs" (total link strength 192), both of which were strongly associated with "blockchain and decision making." Smart contracts and DAO comparisons were the other two keywords, with a total link strength of 108. To display the frequency of the keywords that appeared more than ten times, a word cloud was also made. DAOs were found to be the most common, followed by blockchain, smart contracts, and governance (see Fig.1).

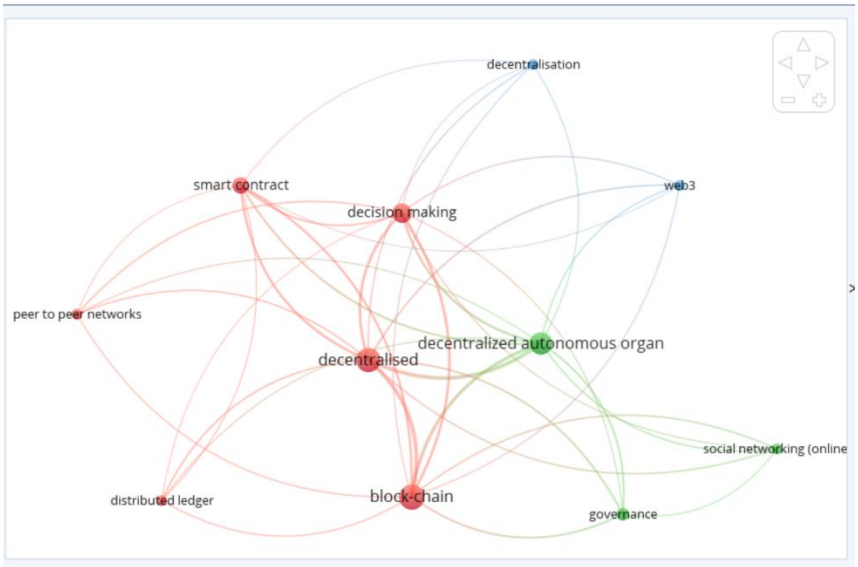


Figure 1- bibliometric analysis of the keywords

3.3 Bibliometric analysis of the citations and publications

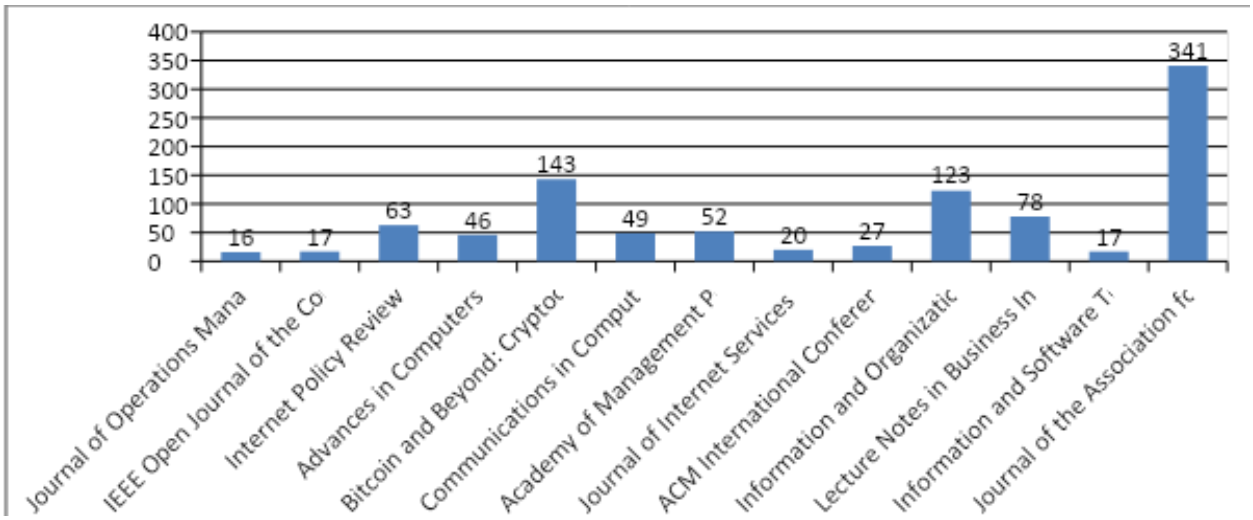
Bibliometric analysis of citations and publications is used to evaluate and analyse academic or scholarly publications quantitatively, with an emphasis on the citations they receive and the features of the articles themselves. Researchers and organisations can better grasp the impact, influence, and trends in a particular field of study with the use of this kind of analysis (Martinez et al.,2018).

The top 14 most cited articles in the field of DAO'S and governance were listed in table 3. Most of them were research articles including descriptive studies, case series and case reports.The mean citation count of the top 14 most cited articles was 24 (range, 16–341).

Table -3 authors, year of publication and citations

Author full names	Title	Year	Source title	Cited by
Liu, Lu (57221410442); Zhou, Sicong (57214777313); Huang, Huawei (56183488900); Zheng, Zibin (58077637300)	Task management in decentralized autonomous organization	2022	Journal of Operations Management	16
Wang, Andre (57986633600)	From Technology to Society: An Overview of Blockchain-Based DAO	2021	IEEE Open Journal of the Computer Society	17
Brache, JosÃ© (57201382032); Zwerg-Villegas, Anne Marie (56454372400)	Decentralized autonomous organization	2021	Internet Policy Review	63
Singh, Madhusudan (57091032000); Kim, Shiho (55949373900)	When is a DAO Decentralized?	2022	Complex Systems Informatics and Modeling Quarterly	3
DuPont, Quinn (55788249400)	Blockchain technology for decentralized autonomous organizations	2019	Advances in Computers	46
Hou, JiaChen (55303729500); Ding, WenWen (57211063967); Liang, Xiaolong (57280518000); Zhu,	Experiments in algorithmic governance: A history and ethnography of "The DAO," a	2017	Bitcoin and Beyond: Cryptocurrencies,	143

FengHua (55112010800); Yuan, Yong (55041229900); Wang, FeiYue (57211758869)	failed decentralized autonomous organization		Blockchains, and Global Governance	
Bokkisam, Hanumantha Rao (57220699140); Savelli, Iacopo (57195943616); Morstyn, Thomas (56396999100); Cuffe, Paul (36650163900)	Designing a smart-contract application layer for transacting decentralized autonomous organizations	2017	Communications in Computer and Information Science	49
Allen, Darcy W. E. (57191611242); Berg, Chris (56661768500); Lane, Aaron M. (57213561586); MacDonald, Trent (57160709800); Potts, Jason (7202337575)	Contracting in the smart era: The implications of blockchain and decentralized autonomous organizations for contracting and corporate governance	2021	Academy of Management Perspectives	52
Ding, Wenwen (57211063967); Li, Juanjuan (54581126500); Qin, Rui (54581514000); Kozma, Robert (7004822939); Wang, Fei-Yue (57211758869)	A comparative analysis of the platforms for decentralized autonomous organizations in the Ethereum blockchain	2021	Journal of Internet Services and Applications	20
Schneider, Bettina (57201112213); Ballesteros, Ruben (58010216700); Moriggl, Pascal (57218212194); Asprion, Petra M. (53866037200)	A New Architecture and Mechanism for Decentralized Science MetaMarkets	2023	IEEE Transactions on Systems, Man, and Cybernetics: Systems	2
Zichichi, Mirko (57211272761); Serena, Luca (57219287822); Ferretti, Stefano (7004899635); D'Angelo, Gabriele (9041628500)	Conflict-resolution lifecycles for governed decentralized autonomous organization collaboration	2015	ACM International Conference Proceeding Series	27
Norta, Alex (23036260500)	Governance and control in distributed ledgers: Understanding the challenges facing blockchain technology in financial services	2019	Information and Organization	123
Nâ€™Da, Aboua Ange Kevin (57217103701); Matalonga, Santiago (55247434200); Dahal, Keshav (57203938484)	Creation of smart-contracting collaborations for decentralized autonomous organizations	2015	Lecture Notes in Business Information Processing	78
Galenovich, Anton (57218506538); Lonshakov, Sergey (57202254074); Shadrin, Alexey (57218506569)	Evolving process views	2016	Information and Software Technology	17
De Filippi, Primavera (55533530700); Mannan, Morshed (57191906045); Reijers, Wessel (56872884900)	Governance in the blockchain economy: A framework and research agenda	2018	Journal of the Association for Information Systems	341



Graph -2 journals wise citations

About DAOs and governance, papers have been published in 77 journals; 4 of them have more than three articles.

3.4 Bibliometric Analysis of Co-authorship-

Bibliometric analysis of co-authorship is used to evaluate and examine author collaborations in the context of scientific or academic publications quantitatively. It focuses on the co-authorship trends within a certain discipline, field of study, or dataset (Moral-Munoz et al.,2020).

There is no proof of co-authorship among the four authors that wrote two papers on the same topic out of the 85 authors who have produced articles on DAOs and governance. There is no connection strength and four clusters, each with four pieces (see Fig.2).

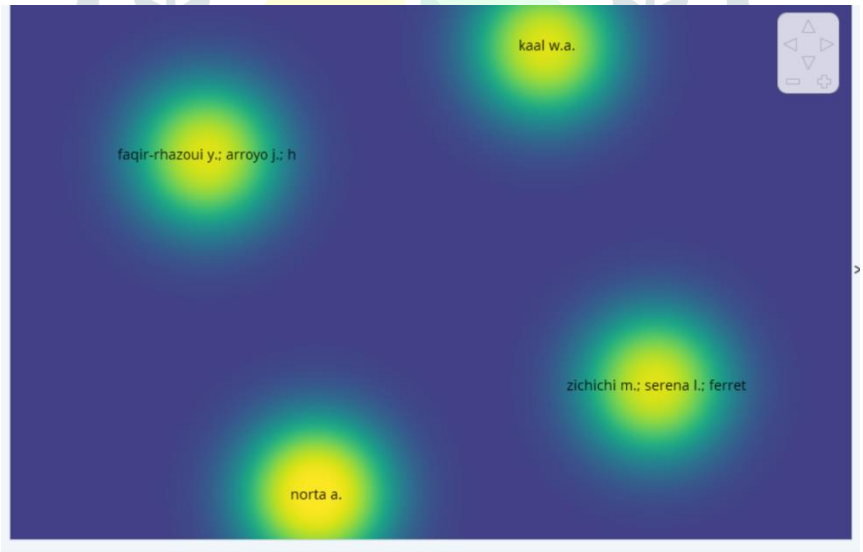


Figure 2- bibliometric analysis of co-authorship-

3.5 Bibliometric analysis of co authorship of countries

A study technique used to assess and examine cooperative relationships in academic or scholarly publications amongst academics and institutions from different nations is called bibliometric analysis of co-authorship between countries. Finding patterns in international collaboration and comprehending the influence and trends in international research endeavours are the main objectives of this kind of analysis (Wang et al.,2020)**.**

Forty countries demonstrated co-authorship, but only ten of them met the requirement of publishing five or more publications. Ten elements spread over four clusters resulted in a total connection strength of 27. The large, dark yellow rings indicate the density of papers published in the corresponding nation (see Fig 3).

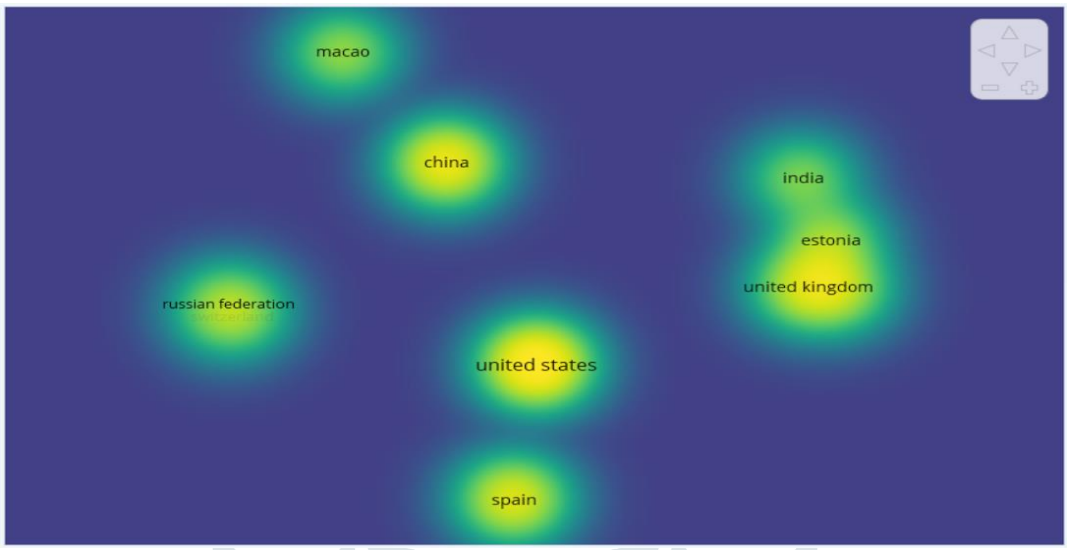


Figure 3a- bibliometric analysis of co authorship of countries

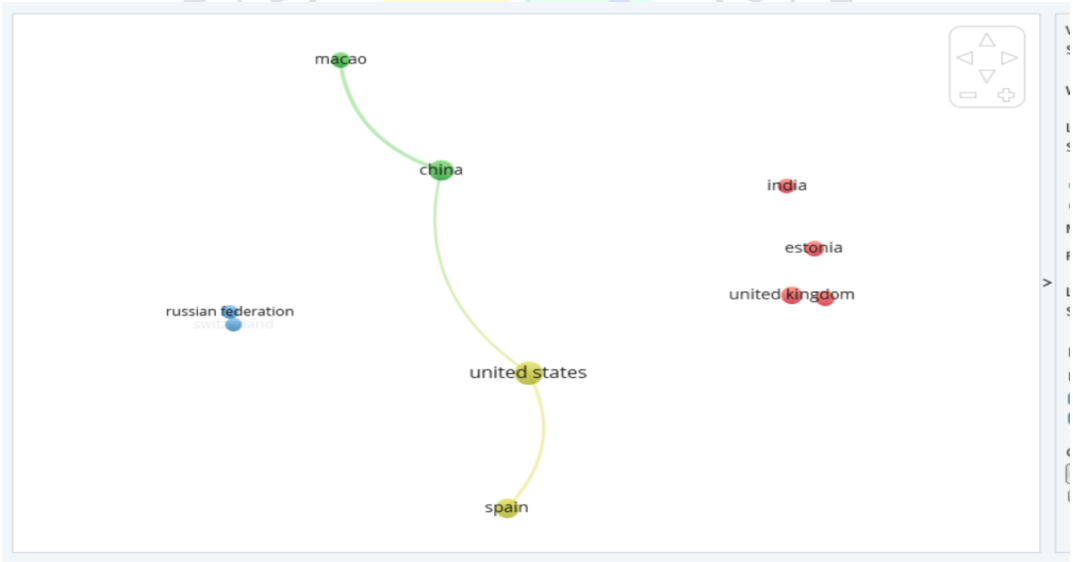


Figure 3b- bibliometric analysis of co authorship of countries

There is proof of a connection between China and Macao, as well as the USA and Spain, regarding co-authorship. Maximum number of papers are written in USA and China followed by Macao

3.6 Bibliometric Analysis on co-authorship of organizations

Bibliometric analysis of co-authorship involving organisations is used to look at and comprehend partnerships and collaborations between various organisations (such universities, research centres, businesses, etc.) in the context of academic or scholarly publications(Sanchez et al.,2017). The co-authorship ties between organisations and the final research output are the main topics of this kind of investigation (see Fig 4) .

Out of 198 organizations 3 organizations met the threshold to publishing at least three papers and there is no linkage between them. There were three clusters and three items in each cluster.

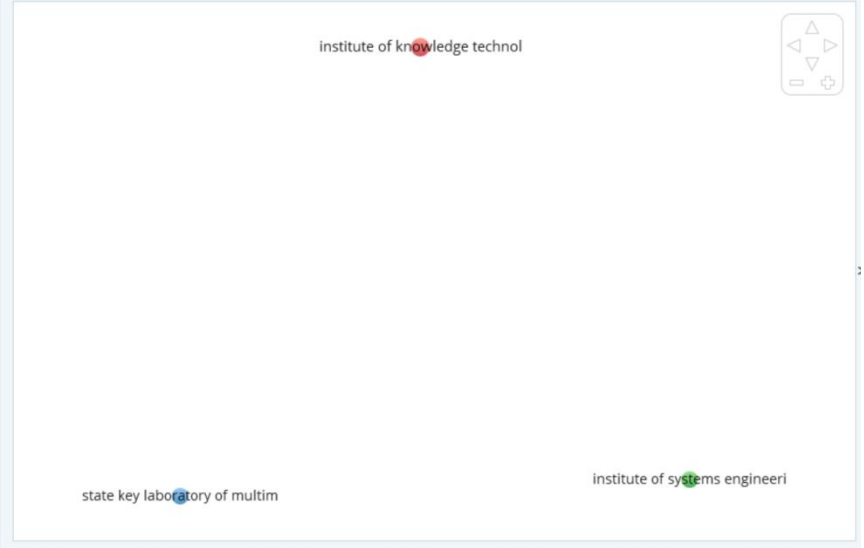


Figure 4- bibliometric analysis on co-authorship of organizations

3.7 Bibliometric analysis of Bibliographic coupling -documents

Bibliographic coupling basically means that two linked papers have cited common references in their research papers. There were 76 items, 12 clusters and 518 link strength. Cluster 1 includes 10 items . the clusters are coloured in blue and green, the area of research by Dupont and Muller is DAO's and corporate governance. The papers were published in 2017 and 2018 respectively (see Fig.5).

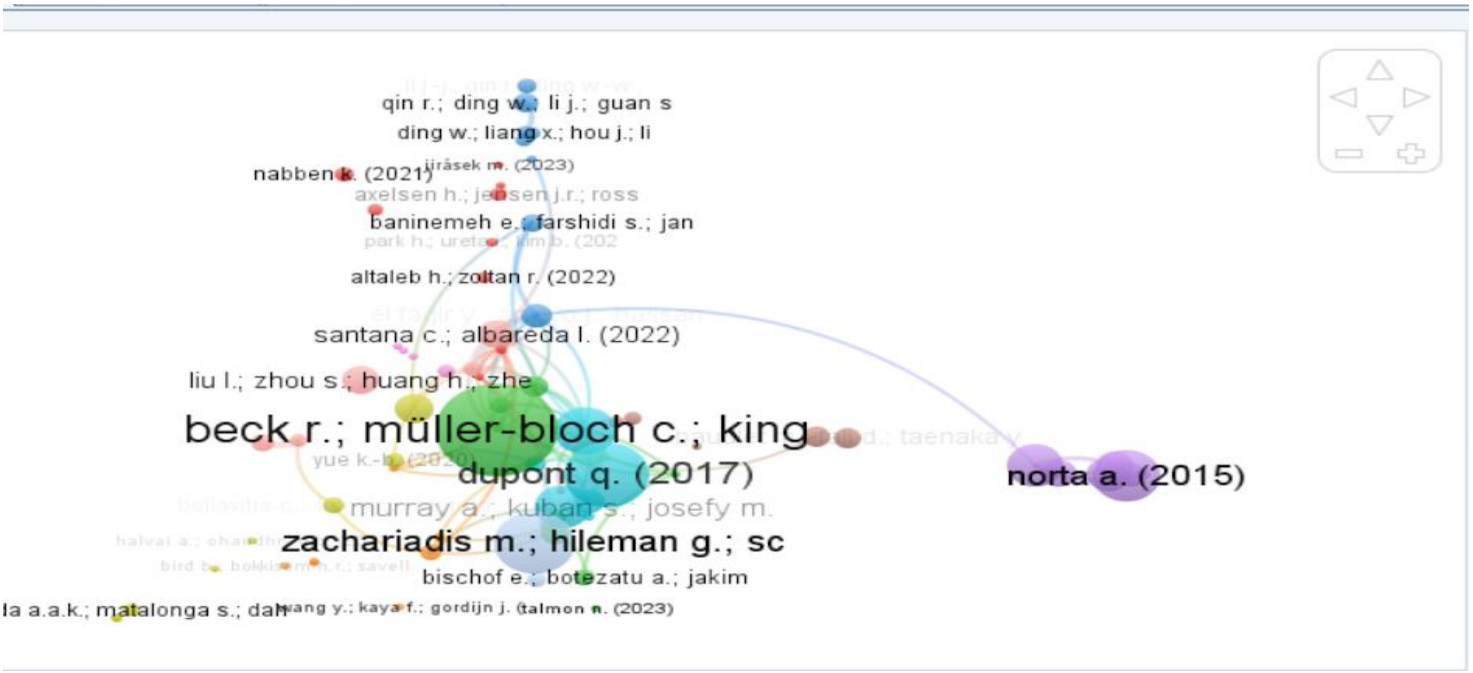


Figure 5- bibliometric analysis of bibliographic coupling -documents

3.8 Bibliometric analysis of bibliographic coupling- sources

A study technique in bibliometrics called "bibliometric analysis of bibliographic coupling" examines the connections between academic or scholarly works by looking at their citation and reference lists (Cavalcante et al.,2021). In order to evaluate the intellectual links between articles, bibliographic coupling entails finding common references or citations between them. There are 4 items and in 1 cluster with total link strength of 11 (see Fig.6).

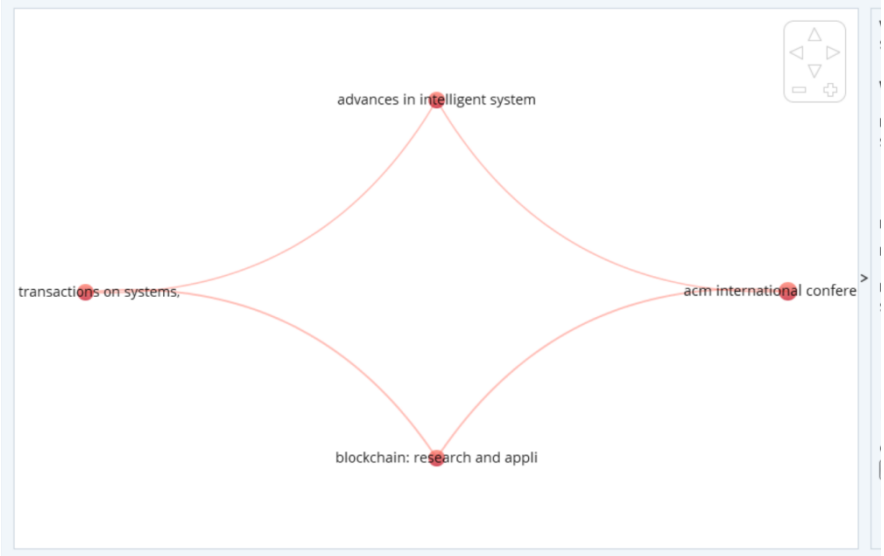


Figure 6- bibliometric analysis of bibliographic coupling- sources

IV.Findings and Discussion

As DAOs continue to evolve as an integral part of various sectors, such as finance, governance, and beyond, research in these areas are increasing exponentially in addressing challenges, improving the robustness of the technology, and exploring innovative ways to leverage decentralised governance for the betterment of society.

This study has identified well-known writers, subjects, and the most significant journals in DAO governance , the study supplements the available literature base on the subject. The findings show that the researches were directed by a small number of writers, including Filippi, De., Norta, A., Hou. The trend from the analysis on papers show that scholarly interest in the area has increased since 2015, indicating that DAO's governance gained impetus from that point on. Findings about pertinent writers, publications, citations, and affiliations in the field show that the Journal of the Association for Information Systems, Bitcoin and Beyond: Cryptocurrencies, Blockchains, and Global Governance, Information and Organization are few prominent journals.

Analysing the research activities countries wise indicates that the U.S .is in the forefront of DAO research followed by China. . Blockchain technology's decentralised nature means that discoveries and ideas reach a global audience, which helps DAOs be understood and used more widely around the world. The findings of the study pertain to the laws governing blockchain technology and DAOs are emerging and constantly changing. Stakeholders can benefit from research that clarifies the legal ramifications and compliance standards related to DAO. For businesses functioning in this field, this expertise is essential. There is a great need of research in this area to have a sound governance model for the DAO's.

The topic of Decentralised Autonomous Organisations (DAOs) and governance is quickly expanding, and there are numerous major areas where study might contribute significantly. Here are some study implications for DAOs and governance, this study can help researchers to investigate and build novel governance systems that can improve DAO decision-making. It includes experimenting with various voting techniques, consensus algorithms, and creative ways to dispute resolution. One can examine the practical applications of DAOs outside of blockchain, such as traditional organizations. Researchers can explore the special governance issues that arise in decentralised finance (DeFi) networks, where numerous DAOs play an important role. Examine how decentralised governance can be used to successfully regulate financial systems.
As DAOs continue to evolve as an integral part of various sectors, such as finance, governance, and beyond, research in these areas will assist in addressing challenges, improving the robustness of the technology, and exploring innovative ways to leverage decentralised governance for the betterment of society.

However, Bibliometric analysis based research primarily has data quality issues. Data sources, such as citation databases, may contain errors, inconsistencies, and missing information, which might impair the analysis's accuracy. It frequently relies on previously published articles, which may induce publication bias. Unpublished or difficult-to-access research may be excluded, thus biasing the analysis. Also, many bibliometric databases predominantly index English-language articles, which can cause linguistic bias. Other languages' research could be underrepresented.

V.Conclusion and future research implications

Decentralised organisations' functioning, security, legality, and inclusivity can all be improved with the help of studies in DAO governance. Such study aids in the effective evolution and wider adoption of DAOs as they continue to acquire importance across a number of industries. As we witness the benefits and rise in adaptability of DAOs, we also understand the importance of DAO's legal recognition. Without legal recognition, DAOs have no official legal status, hence cannot enter into contracts, own assets, or take other actions that registered entities can. This legal uncertainty makes it difficult for DAOs to operate and leaves their members vulnerable. Providing a regulatory framework and legal recognition for DAOs would allow them to fully function and innovate while protecting participants. It will allow DAOs to enter into agreements and own assets under the DAO's name rather than relying on individuals. This provides more continuity and reduces liability for members. Enabling DAOs to fully access services like banking and payments that require legal identity. It also Provides standards and oversight to ensure transparency and security for participants. It further allows DAOs to interface with the traditional business world more easily by giving them official legal standing.

In future the researchers can focus more on clear regulations for DAO governance and operations to prevent fraud or abuse, can be framed.Overall, recognizing DAOs legally is critical to unleash the potential of these blockchain-

based entities. Thoughtful regulation and legal frameworks have the opportunity to support DAO innovation and empowerment of individuals while preventing risks. Providing DAOs an official legal status aligns with and enables new modes of decentralized collaboration and economic participation.
Further, Bundling governance layer over traditional organization structure provides several major benefits over traditional top-down governance models-

- Transparency - All rules and governance processes are codified in the open for anyone to inspect. This prevents closed-door decision making.
- Democracy - Governance is distributed across all token holders, enabling broad participation versus centralization with boards and executives. Proposals can be made and voted on by the community.
- Meritocracy - Token holders who contribute more to the DAO often gain more voting power, enabling a merit-based system versus politics and hierarchy deciding influence.
- Flexibility - Governance rules like voting thresholds and quorums can be adjusted through proposals and votes, allowing the DAO to evolve. Traditional org structures tend to be static.
- Speed - Software automation allows governance operations like voting and fund distribution to execute quickly and seamlessly. No bureaucratic delays.
- Reduced corruption - Immutable code and transparency make it much harder for bad actors to hijack the governance process or divert funds.

While DAO governance takes some adjustment, its participatory nature and flexibility can allow more decentralized and equitable community management at scale. The automation enabled by smart contracts reduces administrative drag. Overall, DAO governance establishes a more transparent, democratic system for collective decision making and resource allocation And to empower these advantages of DAO structure, it demands additional research, discussions and legal reforms to the existing Corporate law.

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