Blockchain Technology in Open Government: A Bibliometric Network Analysis in Scopus

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Abstract

The present study aimed to analyze the bibliometric network in Scopus on blockchain technology in open government between the years 2015 and 2023. It was a bibliometric analysis that defined the metrics of scientific production. The indicators were obtained from 132 papers chosen from the Scopus database using keywords in English (Blockchain, open government). The results show that the year with the highest scientific production was 2022 (n=34; 25.8%). In addition, India (23.3%; n=37) is the country with the most publications, while the journal Lecture Notes in Computer Science published 8 (195 citations) papers, with author Ølnes, S. being the most cited (125 citations; n= 2 papers). From the analyzed studies, it is concluded that blockchain technology in open government has increased as a function of available resources, topics and authors, because blockchain is a quantitative tool that promotes the permanent construction of open, dynamic, transparent and efficient institutions.

Keywords: *Blockchain, Open Government, Scientific Production, Bibliometric.*

INTRODUCTION

Globally, blockchain has become a buzzword associated with cutting-edge technological progress, and often appears connected at the same time with the internet of things and artificial intelligence in public debates about developing and building the digital future (Arrasco, 2021).

In that vein, it is important to note that public administration has not been exempt to the growing interest in blockchain outside the financial sector due to the obvious security and efficiency benefits of the technology (Vega, 2019; Movanu, 2023). In this regard, blockchain is gaining followers as a tool that can help reduce bureaucracy, streamline administrative procedures and make government agencies more reliable in the latter situation (Toro-Garcia et al., 2020; Ortega et al., 2023).

On the other hand, the term digital government is used to describe administrations that rely heavily on technological infrastructures in a framework of digitally delivered services and interactions between citizens and government (Vargas, 2021). Thus, the public sector can certainly benefit from decentralized information platforms based on blockchain, in particular, this can be achieved by streamlining the administration's internal and external information exchanges with society, which will save money, time and effort on both sides (Ospina & Zambrano, 2022; Delgado, 2022).

In any case, the blockchain is a step forward on the road to an open government that uses social innovation to promote equality (Benítez, 2020). Moreover, it is a tool that government can employ to increase trust and

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performance, making a variety of digital transactions more open and efficient (Salgado, 2023; Romero et al., 2023).

Therefore, open governments can greatly benefit from Blockchain technology by the way it improves the efficiency and transparency of the public sector in the provision of services that benefit citizens and the economy as a whole, driving citizens to develop an innovative culture on new technologies (Rojkín, 2023; Silva & Angelo, 2022). In this sense, the Blockchain is a cutting-edge innovation that should be taken into account in the iteration of public policies and service delivery (Aliti et al., 2022).

In addition, the importance of blockchain technology in open government has also been widely studied in recent years, driving the creation of metrics and models that aim to explain behaviors and identify causal relationships between components (Nutón et al., 2023). Consequently, bibliometrics, the study of quantifying information about documents and other types of literature, helps researchers to track the growth of scientific publications and draw conclusions about the importance of the evaluated works (Caló, 2022; Leyva et al., 2022).

In this regard, databases that track scientific background can take advantage of this function to reliably detail the resources used and the results of research (Sanz, 2022). For this function, bibliometric indicators are developed, which are numerical representations of the results of metric evaluations of scientific production in this or related domains (Bermeo-Giraldo et al., 2021; Báez, 2022).

Therefore, to better explain and analyze the academic community's understanding of blockchain technology, it is necessary to classify and capture data according to various bibliometric characteristics, such as year of publication, country, subject area, document type, source and authorship. Based on this premise, the study aims to analyze the bibliometric network in Scopus on blockchain technology in open government between the years 2015 and 2023.

METHODOLOGY

In this study, bibliometric techniques were used to examine the available literature on the topic of blockchain technology in open government. The use of bibliometrics was also crucial, as it provided the researchers with the information they needed to conduct the study (Salinas and Garcia, 2022). Since Scopus is widely used and indexes scientific publications from all over the world, it was used for this particular search, which included the years 2015 to 2023.

The following Boolean search terms were chosen and applied to the keywords, title and abstract: *blockchain* AND *technology*, *open* AND *government, to* broaden the scope of the search (Araujo-Inastrilla & Vitón-Castillo, 2023). With this strategy, 154 documents were collected. However, the data were filtered before generating a final sample. A total of 132 information documents were used to create a statistically significant sample. In addition, the following data exclusion criteria were established: 1) research outside the study period (2015-2023), 2) duplicate publications, and 3) studies not directly related to the topic under study.

Accordingly, a set of bibliometric indicators was used to evaluate the contribution of the 132 papers to the academic discourse, including production by year of publication, authorship trends, source or journal, country of origin, type of paper and subject area (Florez-Fernández & Aguilera-Eguía, 2020).

Finally, the data were analyzed using descriptive statistics and count data. Excel was used to collect and evaluate descriptive data on the documentary volume of the sample. VOSviewer V_1.6.19 was also used to generate source density maps and keyword co-occurrence maps.

RESULTS

The bibliometric study, conducted between 2015 and 2023, comprised a total of 132 academic papers, all of which focused on the application of blockchain technology to open government. Figure 1 shows the total number, as well as the distribution of recent international publications indexed by Scopus that are related to this topic. The years 2019-2022, which account for 76% of all global publications with 100 scholarly papers, show signs of an exponential growth trend in annual publication rates.
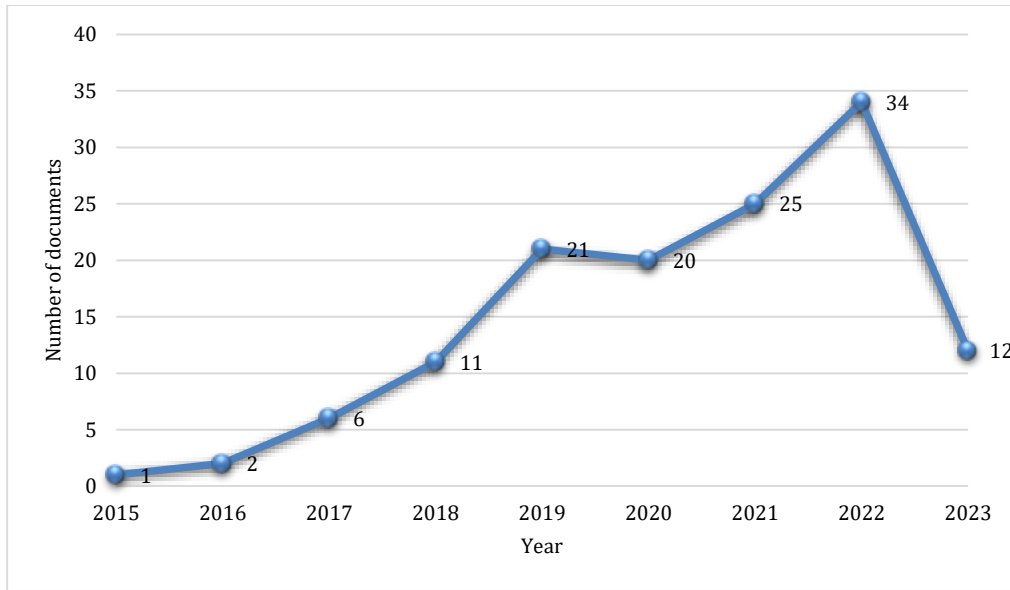
Figure 1. Documents published by year.

Source: Scopus data (2023).

Table 2 shows the worldwide distribution of these papers. The large number of countries registered (n=43) makes it possible to highlight those with the most research published in this field. India (23.2%; n=37), the United States (8.8%; n=14) and China (8.2%; n=13) are the three countries with the highest scientific output. Most of the accepted papers (86%) were written in English, followed by Spanish (11%) and Portuguese (4%).

Table 1. Publication of documents by country.

N°	Country	Number of documents	%	N°	Country	Number of documents	%
1	India	37	23.3%	21	Estonia	2	1.3%
2	United States	14	8.8%	22	Italy	2	1.3%
3	China	13	8.2%	23	Morocco	2	1.3%
4	United Kingdom	9	5.7%	24	Oman	2	1.3%
5	Saudi Arabia	5	3.1%	25	Portugal	2	1.3%
6	South Korea	5	3.1%	26	Thailand	2	1.3%
7	Greece	4	2.5%	27	United Arab Emirates	2	1.3%
8	Pakistan	4	2.5%	28	Vietnam	2	1.3%
9	Spain	4	2.5%	29	Afghanistan	1	0.6%
10	Sweden	4	2.5%	30	Colombia	1	0.6%
11	Taiwan	4	2.5%	31	Egypt	1	0.6%
12	Tunisia	4	2.5%	32	France	1	0.6%
13	Australia	3	1.9%	33	Hong Kong	1	0.6%
14	Denmark	3	1.9%	34	Ireland	1	0.6%
15	Germany	3	1.9%	35	Jordan	1	0.6%
16	Indonesia	3	1.9%	36	Kuwait	1	0.6%
17	Norway	3	1.9%	37	Namibia	1	0.6%
18	Bangladesh	2	1.3%	38	Nigeria	1	0.6%
19	Brazil	2	1.3%	39	Indefinite	5	3.1%
20	Canada	2	1.3%	Total countries		43	

Source: Scopus data (2023).

Fifty-four academic sources were used to compile the information for this analysis. The periodicals that met the criteria for this analysis are listed in Table 2. The majority of the articles (n=8) were published in Lecture Notes in Computer Science, followed by ACM International Conference Proceeding Series (n=7). Due to their impact factors, these journals are considered among the best in their respective categories.

Table 2. Publication of documents by source or journal.

Source or Magazine	Number of documents	Source or Magazine	Number of documents	Source or Magazine	Number of documents
Lecture Notes in Computer Science Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics	8	Amme Idaresi Dergisi	1	Indiana Law Journal	1
ACM International Conference Proceeding Series	7	Applied Sciences Switzerland	1	Industrial Management And Data Systems	1
Lecture Notes in Networks and Systems	4	Asia And The Pacific Policy Studies	1	Information Processing And Management	1
Communications in Computer and Information Science	3	Australian Journal of Telecommunications and The Digital Economy	1	Engineering and Research	1
Smart Innovation Systems and Technologies	3	BMJ Global Health	1	International Journal of Control and Automation	1
Advances in Intelligent Systems and Computing	2	Ceur Workshop Proceedings	1	International Journal of Public Administration in The Digital Age	1
Eai Springer Innovations in Communication and Computing	2	Cities	1	International Journal of Safety and Security Engineering	1
IEEE Network	2	Cogent Business and Management	1	International Journal on Technical and Physical Problems of Engineering	1
Lecture Notes in Electrical Engineering	2	Computer Law and Security Review	1	Journal of Enterprise Information Management	1
Proceedings of the International Astronautical Congress Iac	2	Computing	1	Journal of Financial Reporting and Accounting	1
Public Administration and Information Technology	2	Eurasip Journal on Wireless Communications and Networking	1	Journal of ICT Standardization	1
Acta Medical Informatics	1	Frontiers in Psychology	1	Undefined	17
Advances in Computers	1	IEEE Transactions on Services Computing	1	Total magazines	54

From the data collected from the chosen sources, a bibliographic cluster analysis was performed to classify the various forms of published literature. Figure 2 shows that there are three main clusters: the first corresponds to Lecture Notes in Computer Science (195 citations), the second to Public Administration and Information Technology (59 citations) and the third to ACM International Conference Proceeding Series (24 citations). The data from the bibliographic studies show that papers with a large number of citations tend to appear in the same journals or original sources.
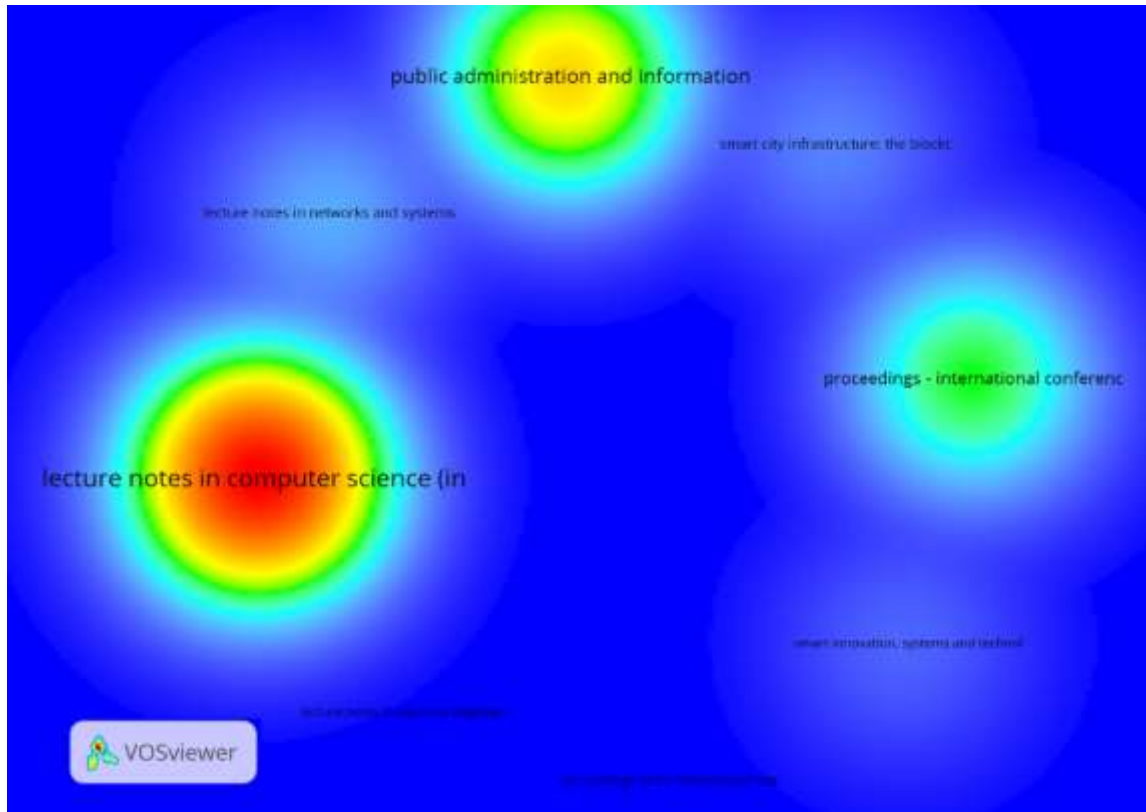
Figure 2. Map of source or journal clustering density.

Source: Results in VOSviewer (2023).

The selected scholarly works included the work of 109 authors from different institutions. Table 3 reveals more information, noting that Ølnes, S. was the author who received the most citations in his published works (125 citations; 2 papers). While in second place are Akram, R.N., Hardwick, F.S. and Markantonakis, K. with 112 citations in their papers.

Table 3. Published papers by author.

By author	Quantity	Total citations	By author	Quantity	Total citations
Akram, R.N.	2	112	Muth, R.	2	0
Beris, T.	2	14	Norta, A.	2	39
Charalabidis, Y.	2	12	Rabe, J.	2	0
Hardwick, F.S.	2	112	Ølnes, S.	2	125
Ietto, B.	2	0	Aarti, E.	1	1
Koubarakis, M.	2	14	Abd El-Aziz, A.A.	1	5
Loutsaris, M.A.	2	12	Abdulla, W.S.	1	0
Markantonakis, K.	2	112	Abdullah, T.	1	11

Source: Scopus data (2023).

Table 4 shows a breakdown of all papers published during the study period (2015-2023) dealing with blockchain technology in open government, classified by both subject area and publication type. According to the results for 19 scientific fields, computer science is responsible for 32% of the global scientific output, engineering for 16% and decision sciences for 11%. Likewise, when the production is analyzed according to the different types of publications, it is observed that conferences account for 56.1% of the production, followed by articles (27.3%), book chapters (13.6%) and books (3%).

Table 4. Publication of documents by subject area and type.

By area	Quantity	%
Computing	100	32%
Engineering	51	16%
Decision Sciences	35	11%
Social Sciences	25	8%
Business, Management and Accounting	24	8%
Mathematics	24	8%
Economics, Econometrics and Finance	11	4%
Medicine	11	4%
Physics and Astronomy	11	4%
Energy	6	2%
Other areas	12	4%
Total	310	100%
By type	Quantity	%
Conference	74	56.1%
Article	36	27.3%
Book chapter	18	13.6%
Book	4	3.0%
Total	132	100.0%

Source: Scopus data (2023).

By filtering the terms that appeared (more than three times) in the titles, keywords and abstracts of the analyzed publications, the information shown in Figure 3 was obtained. Each color represents a different group of keywords, and these groups can be differentiated from each other according to the degree to which VOSviewer considers that there is a link between the terms in question.

Green cluster. "blockchain" (n=101 occurrences), clusters the following words: blockchain technology, healthcare, network security, decentralized, smart contract, distributed ledger, hyperledger fabric.

Blue cluster. "e-government" (n=68 occurrences), clusters the following words: government data processing, electronic money, cryptocurrency, bitcoin, distributed ledger technology.

Red cluster. "open government" (n=49 occurrences), groups the following words: big data, artificial intelligence, open data, internet of things, machine learning, data privacy, digital storage.

Yellow cluster. "transparency" (n=31 occurrences), clusters the following words: security, ethereum, electronic voting, cryptography, peer to peer networks.

The most frequently used terms were grouped together, showing that there is a direct connection between these terms and the research topic.
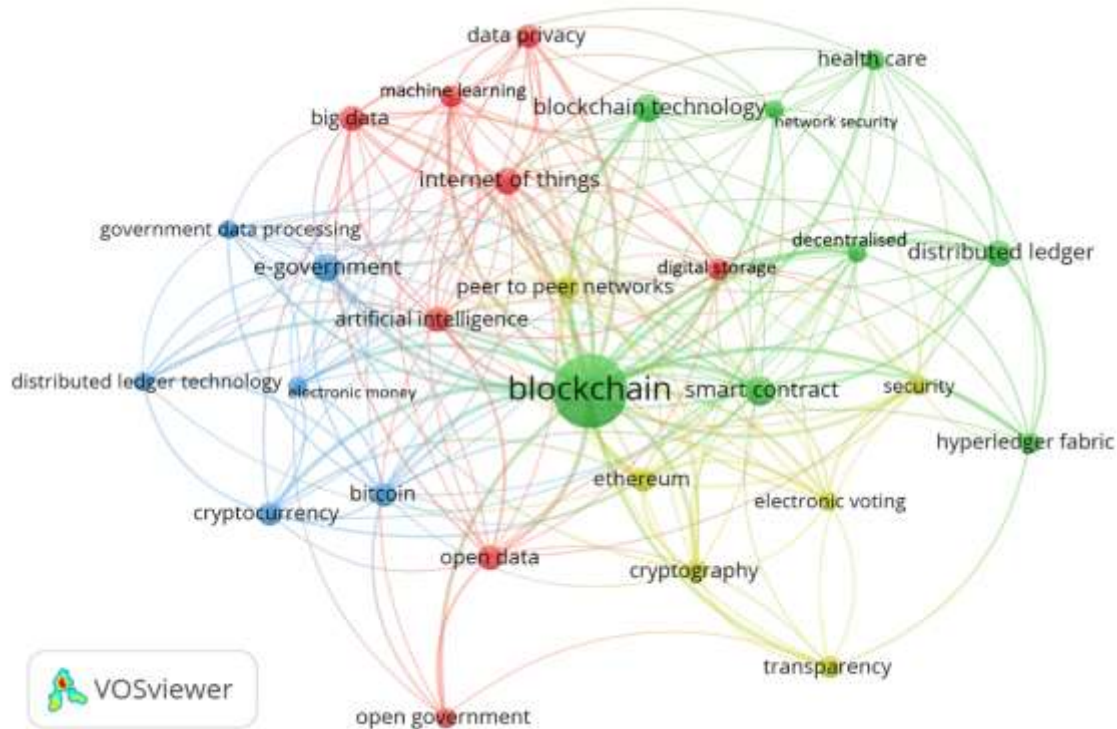
Figure 3. Map of keyword co-occurrence.

Source: Results in VOSviewer (2023).

DISCUSSION

The results of this analysis suggest that, between 2015 and 2023, there was an exponential increase in the number of academic papers discussing the use of blockchain technology in open governments around the world. According to Garcia et al. (2021) point out that the configuration and design qualities of blockchain allow the construction of a theoretical model of open democratic environment, which represents a further step, within the proposals of emerging technopolitical inclusion (Navas et al., 2020). Therefore, the technological governance it offers not only concretizes a disintermediation and self-managed use, typical of democratic types of platforms, but also guarantees political advances in the areas of transparency, openness and accountability, fostering social trust due to its immutability and the elimination of intermediaries (Costas, 2022; Tisocco et al., 2022).

On the other hand, according to Kassen (2022), he states that blockchain represents a step forward in the movement towards Open Government, where public policy is founded on principles of accountability, openness, transparency and citizen participation. Consequently, public agencies can use this mechanism to protect and manage sensitive records, taking advantage of tamper-proof safeguards (Meirobie et al., 2022; Falwadiya & Dhingra, 2022). In that sense, it is crucial to educate institutions on the prerequisites needed to adopt the technologies of the so-called Fourth Industrial Revolution (Rozo-Garcia, 2020).

Therefore, according to Khan et al. (2022), modern state administrations cannot afford to ignore blockchain technology in open government if they want to grow or modernize. In general, Phadke et al. (2022) agrees that blockchain technologies allow in multiple circumstances to eliminate the need for mediators in public administration as it develops a transparent, distributed and secure system, reducing the importance of states in their primary position as legitimate authorities of administration and control, which in turn undermines the idea of the state as an arena for the cultivation of political action, an essential component in the formulation of public policies. In this regard, Sanjeev & Ashutosh (2022) argue that blockchain technologies are a tool that

can help shape the direction of public sector organizations, enabling the development and testing of new empowering and transformative policy practices that can create social value.

CONCLUSION

In line with the study objective, bibliometric analysis of all papers indexed in Scopus from 2015 to 2023 found an exponential increase in research on blockchain technology in open government, with the largest increase between 2019 and 2022 (76%; n=100). Also, about 86% of the papers published on this topic are written in English, with India contributing 23.3% (n=37) of the total output of the 43 countries studied. Among all the authors studied, Ølnes was the most cited (n=125 times) and the most relevant publication source was the journal Lecture Notes in Computer Science (n=8; 195 citations).

Moreover, 56.1% of the papers were conferences classified in the areas of computer science (32%), engineering (16%) and decision sciences (11%). According to VOSviewer's keyword analysis, "blockchain" is the most used term, with 101 appearances. However, "e-government" and "open government" are prominent terms that appear frequently in the study and are directly related to the research conducted.

The analysis of the study of a sample of 132 documents shows that blockchain technology in open government is envisioned as a means to increase the openness of information and a device to combat corruption in public administration. Finally, it is concluded that blockchain technology in open government has led to an increase in the total amount of resources, as well as the diversity of topics and authors, because blockchain has the potential to become a quantitative tool, to strengthen the processes that lead to the permanent construction of open, dynamic, adaptable, transparent and effective institutions.

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