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Research Article

Research Productivity in Blockchain: A Scientometric Analysis

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Abstract

This study provides a scientometric analysis of global blockchain research from 2020 to 2024, using data retrieved from the Web of Science database. A total of 14,449 records were identified, with significant variations in publication trends over the years. The year 2020 recorded the highest number of publications, with 3,045 articles and 9 H-index publications, while 2021 saw a decline to 2,610 records. A notable portion of the research focuses on block copolymers, accounting for 1,097 records, or 40.21% of the total publications. This reflects the growing academic interest in blockchain and its interdisciplinary applications. The study identifies a steady increase in blockchain-related publications over the study period, highlighting a surge in contributions from prolific authors, institutions, and countries. Blockchain research has diversified to include emerging areas such as polymers, nanoparticles, and self-assembly, demonstrating its broad range of applications beyond traditional domains. English is the primary language of publication, and research articles constitute most of the scholarly output. China emerges as the global leader in blockchain research, with substantial collaboration among institutions and researchers driving advancements in the field. This analysis provides valuable insights into trends and developments in blockchain technology, offering a comprehensive overview for researchers, policymakers, and institutions. It also identifies key research areas and suggests strategic directions for future blockchain studies, emphasizing emerging technologies and interdisciplinary applications.

I. INTRODUCTION

Blockchain is a decentralized digital ledger technology that securely records transactions across a network of computers. It organizes data into “blocks,” each containing a timestamp, transaction details, and a cryptographic hash of the previous block. This chain of blocks forms an immutable record, ensuring that once data is added, it cannot be easily altered without modifying all subsequent blocks and gaining consensus from the network. This feature makes blockchain resistant to fraud, counterfeiting, and tampering. Originally developed for Bitcoin by an entity under the pseudonym Satoshi Nakamoto in 2008, blockchain technology addressed the issue of double-spending without relying on a trusted intermediary. Since then, blockchain has expanded beyond cryptocurrencies, with potential applications in areas such as supply chain management, voting systems, and digital contracts. Its distributed nature and high level of security have made it a promising tool for various industries seeking to improve transparency, accountability, and efficiency. Scientometrics, a field of study pioneered by Vassily V. Nalimov and Z. M. Mulchenko in 1969, has become a vital tool for understanding the dynamics of scientific research and its impact. This interdisciplinary field uses quantitative methods to analyze the production and dissemination of scientific knowledge, offering insights into the structure and growth of science over time. By examining factors such as publication volume, citation patterns, and the influence of specific works, scientometrics provides a means to measure scientific progress and assess the effectiveness of research efforts. This approach not only aids in understanding the inner workings of the scientific community but also plays a crucial role in science policymaking and resource allocation. In this article, we explore the key concepts, methodologies, and applications of scientometrics, as well as its growing importance in today’s data-driven research landscape.

II. LITERATURE REVIEW

Zhou *et al.,* (2021) explore the rapid growth of blockchain technology, particularly in cryptocurrency and e-commerce, which has attracted attention from governments, businesses, and researchers. To understand blockchain research trends, they analyzed literature from 2013 to 2018 using science mapping and Latent Dirichlet Allocation models. Their findings highlight four key research areas: blockchain technology, privacy and security, financial applications, and smart applications. They identify three stages in blockchain research evolution: foundational technology, business applications, and integration with advanced technologies like AI and IoT. The study also notes the interconnectedness of cryptocurrency's real-world applications and blockchain advancements. Overall, the study provides a comprehensive overview of blockchain research and discusses future directions. Saah and Choi (2023) examine the use of blockchain technology in the architectural, engineering, and construction (AEC) industry to address challenges like late payments, poor information sharing, and supply chain issues. While previous reviews have focused on specific sectors or used limited methods, this study combines three scientometric tools to analyze over 12,500 bibliographic records from the Web of Science. The findings show that blockchain can optimize AEC processes and solve management issues such as supply chain, risk, cost, and security. The study also highlights the integration of Industry 4.0 technologies with blockchain and identifies underexplored research areas. It provides a comprehensive view of blockchain's role in the AEC industry and suggests future research directions.

Adel, Elhakeem, and Marzouk (2023) analyze the integration of AI and Blockchain Technology (Blockchain 4.0) through a scientometric study of 2,615 journal articles (2017–2023) from the Web of Science database. Using VOS viewer and Biblioshiny, they examined publication trends, key researchers, collaboration networks, top journals, and research hotspots. The study highlights emerging themes and aims to guide researchers, practitioners, and policymakers in advancing Blockchain 4.0 research. Firdaus *et al.,* (2019) analyzed over 1,000 blockchain articles (2013–2018) from Scopus, highlighting trends and applications. Key findings include blockchain's role in IoT security, growing use in healthcare, and the U.S. leading publications, followed by China and Germany. Switzerland and Singapore receive high citations despite fewer publications. International collaborations boost outputs, except in Canada, India, and Brazil. Blockchain is widely used for data privacy, security, and distributed databases.

III. METHODOLOGY

The research conducted focused on blockchain publications between 2020 and 2024. Data were retrieved from the Web of Science database, containing the Science Citation Index Expanded (SCI-EXPANDED), Social Sciences Citation Index (SSCI), and Arts & Humanities Citation Index (A&HCI). The primary search query utilized the term "Blockchain" and was limited to the Title, Abstract, and Keywords of the publications. A total of 14,449 publications related to blockchain were retrieved. The acquired data underwent analysis using BibExcel and VOS viewer, and the findings were organized in MS Excel spreadsheets to extract vital insights.

IV. OBJECTIVES OF THE STUDY

1. To find out the year-wise distribution
2. To study the most productive authors
3. To calculate the top co-occurrences of keywords
4. To find out the most productive institution
5. To identify the language-wise distribution of record
6. To determine the document type-wise distribution of the records
7. To identify the country-wise distribution of publications

A. Bibexcel

Bibexcel is designed to assist in the analysis of bibliographic data. This toolbox can generate data files to be imported into any program that takes tabbed data records for further processing. Bibexcel is freeware for academic, non-profit use. Bibexcel is an excellent tool for bibliometric analysis, often utilized by leading experts such as Olle Persson**.**

B. VOS Viewer

VOS viewer is software that creates and visualizes bibliometric networks. These networks may, for example, contain journals, researchers, or unique publications, and they can be created based on co-citation, bibliographic coupling, or co-authorship considerations. VOS viewer has been developed by Nees Jan van Eck and Ludo Waltman at Leiden University Centre for Science and Technology Studies (CWTS).

TABLE I YEAR-OF DISTRIBUTION OF BLOCKCHAIN RESEARCH

Sl. No.	Year	Records	Percentage
1	2020	3,045	21.07%
2	2021	2,994	20.72%
3	2022	2,985	20.66%
4	2023	2,815	19.48%
5	2024	2,610	18.06%
Total		14449	100%

C. Data Analysis and Interpretation

Provided in Table I is a comprehensive summary of the global research publications on Blockchain spanning a decade, from 2020 to 2024. The data reveals that a total of 14,449 research papers were published during this period, with the highest number of articles 3045 (21.07%) appearing in 2021, while 2024 to shows the lowest productivity with only 2610 (18.06%) articles published. Overall, the table demonstrates

a steady growth in the development and research trends associated with Block chain over the ten years.

TABLE II THE MOST PROLIFIC AUTHORS

Sl. No.	Authors	Records	Percentage
1	Wang Y	144	1.00%
2	Zhang Y	130	0.90%
3	Wang J	123	0.85%
4	Zhang L	123	0.85%
5	Zhang J	118	0.82%
6	Liu Y	114	0.79%
7	Li Y	111	0.77%
8	Li J	98	0.68%
9	Chen Y	90	0.62%
10	Wang H	89	0.62%
11	Wang L	86	0.60%
12	Li X	82	0.57%
13	Zhang H	74	0.51%
14	Wang X	72	0.50%
15	Armes SP	65	0.45%
16	Zhang X	65	0.45%
17	Li L	61	0.42%
18	Liu J	59	0.41%
19	Li H	57	0.39%
20	Chen L	54	0.37%
21	Chen X	53	0.37%
22	Zhang W	53	0.37%
23	Wang C	52	0.36%
24	Chen J	51	0.35%
25	Li B	50	0.35%

Table III shows the document type distribution at the global level and its contribution to blockchain research. It lists 13 document types, such as: Article, Review Article, Editorial Material, Letter, Meeting Abstract, Early Access, Proceeding Paper, Book Review, and so on.

Among them, the highest number of publications were published in the form of articles, with 13,478 (93.28%), followed by Early Access with 340 (2.35%). The lowest number of publications (1; 0.01%) were found for Article; letter, Correction, Biographical-Item, and Data Paper. For the analysis of language-wise literature, it is worth noting that the articles of study have been published in 11 languages around the world. It is known that the vast majority 14340 (99.25%) of the total research output is written in English.

TABLE III DOCUMENT TYPES

Sl. No.	Document Types	Records	Percentage
1	Article	13,478	93.28%
2	Early Access	340	2.35%
3	Retracted Publication	38	0.26%
4	Proceeding Paper	30	0.21%
5	Letter	22	0.15%
6	Editorial Material	21	0.15%
7	Book Chapters	15	0.10%
8	Meeting Abstract	11	0.08%
9	Retraction	6	0.04%
10	Correction	4	0.03%
11	Biographical-Item	1	0.01%
12	Data Paper	1	0.01%
13	Publication With Expression of Concern	1	0.01%

TABLE IV LANGUAGE-WISE DISTRIBUTIONS

Sl. No.	Language	Records	Percentage
1	English	14,340	99.25%
2	Chinese	84	0.58%
3	German	7	0.05%
4	Japanese	7	0.05%
5	French	3	0.02%
6	Russian	3	0.02%
7	Portuguese	2	0.01%
8	Eskimo	1	0.01%
9	Polish	1	0.01%
10	Turkish	1	0.01%
11	Welsh	1	0.01%

TABLE V WEB OF SCIENCE INDEX

Sl. No.	Web of Science Index	Records	Percentage
1	Science Citation Index Expanded (SCI-EXPANDED)	14,294	98.93%
2	Social Sciences Citation Index (SSCI)	358	2.48%
3	Index Chemicus (IC)	278	1.92%
4	Current Chemical Reactions (CCR-EXPANDED)	42	0.29%
5	Conference Proceedings Citation Index – Science (CPCI-S)	33	0.23%
6	Book Citation Index – Science (BKCI-S)	15	0.10%
7	Arts & Humanities Citation Index (A&HCI)	14	0.10%

TABLE VI INTERNATIONAL COLLABORATION ON BLOCKCHAIN

Sl. No.	Countries	Records	Percentage
1	Peoples R China	5,802	40.16%
2	USA	2,538	17.57%
3	Germany	982	6.80%
4	Japan	814	5.63%
5	India	802	5.55%
6	France	657	4.55%
7	England	634	4.39%
8	South Korea	609	4.22%
9	Canada	469	3.25%
10	Italy	458	3.17%
11	Australia	406	2.81%
12	Russia	354	2.45%
13	Spain	345	2.39%
14	Netherlands	312	2.16%
15	Brazil	280	1.94%
16	Taiwan	278	1.92%
17	Iran	249	1.72%
18	Poland	239	1.65%
19	Switzerland	201	1.39%
20	Saudi Arabia	193	1.34%
21	Sweden	151	1.05%
22	Belgium	150	1.04%
23	Greece	135	0.93%
24	Pakistan	129	0.89%
25	Austria	117	0.81%

It is also counted that besides the English language, the Chinese language has been seen as the second position with 84 (0.58%) followed by the German language with 7 (0.05%) and the followed by Japanese French Russian Portuguese etc. research articles published on Block chain.

Table VI indicates the international collaborative research on Blockchain at the Global level. Out of 65 scientific publications, the maximum number of outputs (5802, 40.16%) in Peoples R China research outputs.

The other countries such as the USA (2538, 17.57%), and Germany (982, 6.80%) got the third position and then India got fifth place (802,5.55%) South Korea, England, Germany, Italy, and Switzerland, etc. respectively. The results indicate that very few papers were published by some big countries and it shows that the collaborative countries.

Table VII indicates that the literature outputs from Institutions and Universities in the field of Block chain during the study period. Out of 3304 institutions, we have chosen to analyze only the top most productive research papers which are published by the eminent scholars and faculty members of the Block chain Department.

TABLE VII INSTITUTION AND UNIVERSITY BASED DISTRIBUTION

Sl. No.	Organization	Records	Percentage
1	Chinese Academy of Sciences	656	4.54%
2	Centre National De La Recherche ScientifiqueCnrs	487	3.37%
3	University of California System	255	1.77%
4	Russian Academy of Sciences	230	1.59%
5	University of Chinese Academy of Sciences Cas	227	1.57%
6	Fudan University	202	1.40%
7	United States Department of Energy Doe	199	1.38%
8	Cnrs Institute of Chemistry Inc	193	1.34%
9	Zhejiang University	175	1.21%
10	Indian Institute of Technology System Iit System	156	1.08%
11	University of Science Technology of China Cas	154	1.07%
12	Helmholtz Association	152	1.05%
13	Sun Yat Sen University	148	1.02%
14	Sichuan University	146	1.01%
15	Soochow University China	142	0.98%
16	Shanghai Jiao Tong University	137	0.95%
17	Jilin University	124	0.86%
18	South China University of Technology	121	0.84%
19	Peking University	117	0.81%
20	Max Planck Society	114	0.79%
21	Tianjin University	114	0.79%
22	Zhengzhou University	114	0.79%
23	University of Texas System	112	0.78%
24	Changchun Institute of Applied Chemistry CAS	107	0.74%
25	Tsinghua University	106	0.73%

The Table VII illustrates the results with the highest number of articles (656, 4.54%) published by the 'Chinese Academy of Sciences' and the same articles with (487, 3.37%) published by 'Centre National De La Recherche ScientifiqueCnrs' they have placed in the first and second positions. The other institutions and universities listed in the table above have placed in the next level positions based on the research papers of Block chain. Table VIII showed us the Web of Science Categories of Block chain and the records counts of each research area. This 'Polymer Science' research area holds 3361 (23.26%) records. Followed by 'Chemistry Multidisciplinary' holds 2012 (13.93%) records Followed by 'Materials Science Multidisciplinary' this holds 1657 (11.47%) records.

TABLE VIII WEB OF SCIENCE CATEGORIES

Sl. No.	Web of Science Categories	Records	Percentage
1	Polymer Science	3,361	23.26%
2	Chemistry Multidisciplinary	2,012	13.93%
3	Materials Science Multidisciplinary	1,657	11.47%
4	Chemistry Physical	1,271	8.80%
5	Biochemistry Molecular Biology	1,104	7.64%
6	Engineering Electrical Electronic	641	4.44%
7	Nano science Nanotechnology	632	4.37%
8	Physics Applied	567	3.92%
9	Computer Science Information Systems	529	3.66%
10	Engineering Chemical	481	3.33%
11	Pharmacology Pharmacy	478	3.31%
12	Telecommunications	430	2.98%
13	Cell Biology	412	2.85%
14	Multidisciplinary Sciences	376	2.60%
15	Chemistry Organic	343	2.37%
16	Medicine Research Experimental	323	2.24%
17	Chemistry Applied	311	2.15%
18	Oncology	302	2.09%
19	Physics Condensed Matter	296	2.05%
20	Energy Fuels	255	1.77%
21	Immunology	248	1.72%
22	Chemistry Inorganic Nuclear	242	1.68%
23	Environmental Sciences	230	1.59%
24	Food Science Technology	228	1.58%
25	Physics Multidisciplinary	226	1.56%

TABLE IX KEYWORD DISTRIBUTION

Sl. No.	Keywords	Records
1	Block copolymers	1097
2	Polymers	940
3	Nanoparticles	730
4	Expression	668
5	Behavior	643
6	Design	576
7	Micelles	433
8	Morphology	431
9	Polymerization	424
10	Self-assembly	364

The presented table provides an exhaustive keyword-wise distribution of twenty terms employed in the Blockchain field during the study period spanning 2020 to 2024. The data analysis reveals that the term Block copolymers was the most frequently cited keyword, appeared in 97 of the 1097 records analyzed. The second most utilized term was which appeared in 48 of the records during the study period. It is imperative to note that these findings could have significant implications for Health care professionals and researchers in the field, as they provide insight into the most used terminology related to Blockchain.

IV. FINDINGS OF THE STUDY

1. *Year-wise Distribution:* Blockchain research saw the highest number of publications in 2020 (3,045, 21.07%) and the lowest in 2024 (2,610, 18.06%), with a total of 14,449 publications between 2020 and 2024.
2. *Prolific Authors*: Wang Y emerged as the most prolific author with 144 publications, followed by Zhang Y with 130, and Wang J with 123.
3. *Document Types*: Articles accounted for 93.28% of all publications, making it the most common document type.
4. *Language-wise Distribution:* English dominated the publications (99.25%), followed by Chinese (0.58%). Other languages contributed minimally.
5. *Web of Science Categories:* "Polymer Science" led the research areas with 3,361 records (23.26%), followed by "Chemistry Multidisciplinary" (13.93%) and "Materials Science Multidisciplinary" (11.47%).
6. *Keyword Analysis:* "Block copolymers" was the most frequently used keyword, appearing in 1,097 records, followed by "Polymers" and "Nanoparticles."
7. *Country Contributions:* China was the top contributor to blockchain research, accounting for 40.16% of publications, followed by the USA (17.57%) and Germany (6.80%).
8. *Institutional Contributions:* The Chinese Academy of Sciences ranked highest in institutional contributions (656 publications), followed by the Centre National de la Recherche Scientifique (487).
9. *Collaboration Patterns:* Collaborative research was prominent, especially involving China, the USA, and Germany, with significant contributions from smaller countries like Switzerland and Singapore.

V. CONCLUSION

The study highlights significant growth and diversification in blockchain research from 2020 to 2024, driven by contributions from prolific authors, institutions, and countries. English dominates as the primary language, and many publications are research articles. Emerging research areas such as polymers, nanoparticles, and self-assembly demonstrate blockchain's interdisciplinary applications. China leads global research, with substantial collaboration fostering advancements. This analysis provides a comprehensive overview for researchers, policymakers, and

institutions, enabling strategic focus on key areas and trends in blockchain research.

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