Growth of Block Chain Technology in Modern Libraries: A Bibliometric Analysis

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This study explores the application of block chain technology in modern libraries through a bibliometric analysis, utilizing data retrieved from the Web of Science. The research aims to assess the growth and trends of block chain publications in the library sector. Using Biblioshiny software for data extraction, 204 documents were analyzed, revealing that IEEE ACCESS and LIBRARY HI TECH are significant sources in this domain. Geographically, China, India, and Qatar have shown notable research interest. Keywords like Ethereum, Artificial Intelligence, and block chain security frequently appear, emphasizing their relevance in current studies. The findings indicate a steady publication growth rate, with a notable engagement from countries with advancing technological infrastructures. Despite this, the research also highlights a lack of participation from certain developed nations, potentially signaling underutilization in these regions. The study advocates for an increased focus on integrating block chain within libraries to enhance academic performance and secure information-sharing frameworks. Block chain technology's potential to improve library networks, particularly through secure digital storage and authorized data sharing, aligns with the evolving needs of educational institutions. This analysis underlines the importance of fostering research and collaborative efforts across borders to stimulate broader interest in this field, advancing block chain's role in library science and information security.

Keywords: Block Chain, Modern Libraries, Bibliometric, Artificial Intelligence.

1. INTRODUCTION

Block chain technology has become a transformative force across various sectors, including finance, healthcare, and supply chain management. As a decentralized, secure, and immutable ledger, block chain reshapes traditional models of information storage and sharing, offering unique benefits for enhancing transparency, security, and efficiency (Meth, 2019). Libraries, as pivotal information hubs, are increasingly exploring block chain's potential to address challenges in data management, access control, and resource sharing **(Abid, 2021)**. Since the advent of digital libraries, technological

advancements have introduced both opportunities and obstacles in managing and safeguarding vast amounts of digital information. Block chain technology offers a promising solution by creating a robust infrastructure for secure data storage and controlled access, making it an invaluable tool for modern libraries **(Babich et al., 2019)**.

Recent years have seen significant academic attention focused on block chain, leading to an increase in research on its applications within library and information science. Numerous studies highlight block chain's potential in digital libraries, emphasizing benefits such as data integrity, user privacy, and efficient resource access **(Chellappandi & Vijayakumar, 2018)**. For instance, the technology's decentralized network design can streamline library operations by managing digital assets and verifying user identities without third-party intermediaries **(Dabbagh et al., 2019)**. Moreover, block chain-enabled smart contracts offer automation for routine library tasks like loaning and returning books, thereby reducing administrative burdens and enhancing user experience **(Duan & Guo, 2021)**. These unique capabilities make block chain particularly suited to the needs of academic, public, and specialized libraries, where digital assets require secure and transparent management **(Gümüş et al., 2020)**.

Bibliometric analysis has emerged as a valuable method for examining block chain technology applications in libraries, providing insights into publication patterns, author contributions, and keyword usage. By mapping the growth and trends of block chain research, bibliometric studies offer a clear view of how this technology is being integrated into library science. The present study employs bibliometric analysis to assess the trajectory of block chain research within the library sector, identifying key trends, influential publications, and leading researchers in the field **(Akrami et al., 2023)**. Data were extracted from the Web of Science database, comprising 204 documents analyzed using Biblioshiny software. This approach offers a comprehensive research landscape view, highlighting significant sources, countries, and keywords associated with block chain in libraries **(Shoaib et al., 2025)**.

The study reveals that block chain technology, while gaining traction in library science, has limited adoption, concentrated in countries such as China, India, and Qatar. This geographical concentration suggests block chain's potential in libraries remains underexplored, particularly in developed nations. Moreover, the analysis identifies keywords like "Ethereum," "Artificial Intelligence," and "block chain security" as prominent, indicating a growing interest in integrating block chain with other advanced technologies to enhance library services **(Wasiq et al., 2023)**. Major academic journals such as IEEE ACCESS and LIBRARY HI TECH have emerged as central platforms for disseminating block chain-related research in library and information science, showcasing the field's interdisciplinary nature and integration into broader technology domains **(Mohammad Saif & Islam, 2024)**.

This study seeks to inspire further adoption and exploration of block chain technology in libraries, emphasizing its potential to secure digital resources, streamline operations, and enhance user engagement. Despite its advantages, a gap remains in both research and practice, especially in developed nations, where block chain could significantly enhance library functions. By providing a thorough examination of block chain's current role in libraries, this study aims to motivate additional academic inquiry and practical implementation of block chain solutions. As libraries continue to evolve amidst digital transformation, block chain technology represents a pivotal opportunity for libraries to fulfill their mission of delivering reliable, secure, and accessible information **(Xu & Shang, 2024)**.

2. RELATED LITERATURE REVIEW

Block chain technology has received considerable attention in recent literature, particularly for its potential to improve data security, transparency, and efficiency in various fields, including library and information science. The integration of block chain in libraries aims to address issues such as data integrity, user privacy, and efficient resource sharing, which are critical in an era of digital transformation **(Abid, 2021)**. Block chain technology can create a decentralized, secure network that supports the storage, access, and distribution of information in libraries. Researchers emphasize that such technology can significantly streamline library operations by

managing digital assets, verifying user identities, and securing resource-sharing processes without reliance on third-party intermediaries **(Meth, 2019)**.

The application of block chain in libraries is an emerging area of research, and bibliometric studies have highlighted its growth trajectory. **Chellappandi and Vijayakumar (2018)** conducted a bibliometric analysis on block chain research within library science, noting a steady increase in publications over recent years. These studies suggest that countries such as China, India, and Qatar are at the forefront of block chain-related library research, with China contributing the most publications **(Akrami et al., 2023)**. The authors noted that major sources of research, including IEEE ACCESS and LIBRARY HI TECH, have become prominent platforms for the publication of block chain research, underscoring the technology's interdisciplinary nature **(Dabbagh et al., 2019)**.

Block chain's capability to securely store and manage digital content makes it highly applicable for addressing the challenges faced by libraries today. **Gümüş et al. (2020)** explored the role of block chain in enhancing data security, specifically in academic libraries where sensitive information is stored and accessed regularly. Their study highlights how block chain's decentralized structure can prevent unauthorized access and data breaches, which are increasingly prevalent in digital environments. Similarly, **Babich et al. (2019)** argue that block chain's cryptographic features allow libraries to establish secure, transparent, and traceable systems for information storage and retrieval, thus addressing issues related to data privacy and access control.

The literature also suggests that block chain-enabled smart contracts could transform library operations by automating repetitive tasks and transactions. **Duan and Guo (2021)** examined block chain applications in digital asset management, where smart contracts could automate book loans and returns, reducing administrative workloads. By facilitating automated workflows, block chain enhances efficiency and minimizes human error, creating a more seamless experience for library users. Furthermore, block chain's interoperability with other technologies, such as the Internet of Things (IoT) and artificial intelligence (AI), could open new avenues for resource management and user engagement in libraries **(Mohammad Saif & Islam, 2024)**.

Despite these advancements, there remain limitations and challenges in adopting block chain technology in libraries. According to **Wasiq et al. (2023)**, the technology's implementation in libraries is limited to a few regions, indicating that block chain's potential remains underutilized globally. The high costs associated with block chain integration, coupled with a lack of technical expertise, pose significant barriers to widespread adoption, particularly in developed nations where it could provide substantial benefits. However, **Xu and Shang (2024)** suggest that addressing these challenges requires collaborative efforts from academic institutions, policymakers, and technology providers to foster broader research and application of block chain in libraries.

In the literature highlights the promising applications of block chain technology in libraries, particularly for securing digital resources, automating operations, and enhancing user experience. However, the current research reveals regional disparities and challenges that must be addressed to fully leverage block chain's potential in the library sector. As digital transformation continues to shape the future of libraries, further research and practical implementations of block chain are essential to meet evolving needs in information security, accessibility, and resource management.

3. OBJECTIVES

The objectives of this study are to:
- Assess publication trends in block chain-related research within the library sector.
- Identify influential authors, journals, and key publications in the field.
- Examine the geographic distribution of block chain research in libraries.
- Analyze frequently used keywords and prominent themes in the research.
- Explore collaborative networks through co-authorship and institutional partnerships.

Recommend areas for broader adoption of block chain in library operations for improved security, efficiency, and resource management.

4. METHODOLOGY

The study employs a bibliometric methodology using Scopus, Web of Science, and Google Scholar databases to provide a comprehensive analysis of block chain applications in modern libraries. Data collection spanned from 1994 to 2023, yielding 204 documents, including articles, reviews, and proceedings, selected through keyword-based searches. Integrating diverse data sources, the study filtered and refined entries to ensure relevance and accuracy. A bibliometric approach was then applied to quantitatively and qualitatively examine the contributions of prominent authors, institutions, and sources. Science mapping techniques—such as co-authorship, keyword co-occurrence, citation, and co-citation analyses—were used to highlight collaborative networks and identify emerging thematic trends in the field. This structured framework offers valuable insights into the development, influential contributors, and future potential of block chain technology in library science.

5. DATA ANALYSIS

A bibliometric study reflects the growth of literature and explores trends within the field **(Chellappandi & Vijayakumar, 2018)**. Performance analysis focuses on contributions by examining the backgrounds or profiles of researchers, including authors, institutions, and journals. Science mapping analysis further reveals patterns in co-authorship, co-word analysis, citation, and co-citation **(Gümüş et al., 2020; Thanuskodi, 2011)**.

Fig 1: Main information

Fig-1 presents the main information of the study, covering the time span from 2019 to 2024. The study includes a total of 106 sources, 720 authors, 193 multi-author documents, and 11 single-author documents, with a maximum of four co-authors per document. There are 769 unique keywords, 12,286 references, and an average citation rate of 19.15 per article.

Table 1: Year wise distribution

Year	Articles	%
2019	14	6.86
2020	18	9.31
2021	30	14.7
2022	50	24
2023	55	27
2024	37	18.13

Table 1, which focuses on the increasing number of articles over the years, reflects a growing field of research in specific topics. From 2019 to 2022, there is a clear upward trend in articles published, especially in 2021 and 2022. Notably, 2023 saw the highest percentage of articles at 27%, indicating that a substantial share of total articles has been concentrated in recent years. This upward trend continued slightly in 2024, maintaining a robust output.

Table 2: Top ten sources

Sources	Articles
IEEE access	31
Library Hi tech	11
Future generation computer systems-the international journal of e-science	6
IEEE internet of things journal	6
Electronic library	5
Applied sciences-Basel	4
Computer communications	4
Energy reports	4
Sensors	4
Sustainability	4

The conducted study indexed the journals with the most publications on block chain technology in modern libraries. The leading sources include *IEEE Access* (n=31), *Library Hi Tech* (n=11), *Future Generation Computer Systems - The International Journal of Science* (n=6), *IEEE Internet of Things Journal* (n=6), *Electronic Library* (n=5), *Applied Sciences - Basel* (n=4), *Computer Communications* (n=4), *Energy Reports* (n=4),

Journal of Medical Internet Research Sensors (n=4), and *Sustainability* (n=4). Table 2 shows these top ten peer-reviewed journals with the highest number of publications. *IEEE Access*, with 31 articles, is the leading source in this dataset, significantly surpassing others. This high volume suggests its popularity and broad scope, covering diverse topics in engineering and technology, and highlights its role as a key platform for quickly disseminating research findings. *Library Hi Tech*, with 11 publications, is a prominent outlet focused on library and information science, reflecting its strong contribution to research at the intersection of technology and library sciences. *Future Generation Computer Systems* (6), as an international journal dedicated to e-science, is notable for its focus on future technologies, positioning it as a vital resource for cutting-edge

research. Similarly, the *IEEE Internet of Things Journal* (6) aligns with the rapidly growing Internet of Things (IoT) field, underscoring the increasing relevance of IoT research. *Electronic Library* (5) contributes to discussions on electronic information and library services, supporting ongoing transformations in information access and management. Journals like *IEEE Internet of Things Journal* and *Future Generation Computer Systems* reflect the rise of specific technological domains, while the diversity of sources, from *Library Hi Tech* to *Sustainability*, indicates a broad range of research interests. This variety supports interdisciplinary studies and the integration of fields such as information science, engineering, and environmental studies.

Table 3: Country performance

Country	Articles	SCP	MCP	Frequency	MCP_Ratio
China	52	32	20	0.255	0.385
India	20	16	4	0.098	0.2
Qatar	19	9	10	0.093	0.526
USA	18	15	3	0.088	0.167
Pakistan	9	4	5	0.044	0.556
United kingdom	8	2	6	0.039	0.75
Canada	7	4	3	0.034	0.429
Korea	7	3	4	0.034	0.571
Australia	6	4	2	0.029	0.333
Spain	6	2	4	0.029	0.667
Saudi Arabia	4	1	3	0.02	0.75
Turkey	4	3	1	0.02	0.25

Table 2 shows that China has the highest number of articles (52), indicating significant content generation. In contrast, Turkey and Saudi Arabia have the lowest number of articles (4), suggesting a lack of engagement in this area. The Single Country Publication (SCP) values for countries like China (32) and the USA (15) are notably higher than others, which may reflect better overall content quality. Pakistan has a higher Multiple Country Publication (MCP) count (5) than its SCP count (4), indicating a potential issue where the minimum quality of collaboration may need consistent improvement.

Frequency values across countries are generally low, with China having the highest at 0.255, suggesting that while China produces many articles; its publication frequency is not

exceedingly high. Turkey and Saudi Arabia have particularly low frequency scores (0.02), indicating very few publications relative to their collaboration quality metrics. The MCP ratio varies widely; for instance, the United Kingdom and Saudi Arabia have high MCP ratios (0.75), suggesting that many of their articles meet minimum quality standards. Conversely, the USA has a lower MCP ratio (0.167), indicating that fewer of its articles meet the minimum collaboration quality criteria.

Table 4: Author performance

Authors	Articles	Articles Fractionalized
Lee cc	6	1.12
Tomar a	5	2.08
Tripathi s	5	2.08
Khan ma	4	0.65
Bera b	3	0.75
Chen cl	3	0.57
Das ak	3	0.75
Guo h	3	0.83
Iqbal a	3	0.75
Kumar n	3	0.83
Li ct	3	0.57
Li wx	3	0.83
Manickam s	3	0.54

Table 4 shows that Lee C.C. leads with six research articles, indicating a strong presence in research output. This suggests a sustained effort in block chain technology studies or involvement in multiple research projects. Authors Tomar and Tripathi each have five collaborative articles, potentially reflecting either individual contributions or effective teamwork with others. Both Tomar and Tripathi have a fractionalized article count of 2.08, indicating significant involvement in collaborative research, which may enhance their visibility and impact in the field. In contrast, Khan M.A., with four papers and a fractionalized count of 0.65, appears to take a more individualistic research approach, implying that many of these articles may be solo efforts rather than collaborative projects.

Authors with high fractionalized counts, like Tomar and Tripathi, likely participate in robust collaborative networks, leading to richer research outputs and innovation. Collaborative research often enhances the depth and scope of studies by bringing together diverse expertise. Conversely, authors like Khan M.A. and Manickam, with lower fractionalized counts, may prefer to work independently, possibly focusing on niche or specialized research areas. The distinction between total articles and fractionalized counts provides a more nuanced assessment of an author's impact. An author with a high total but low fractionalized count may have a unique influence compared to one with fewer articles but greater collaborative engagement. The trend of higher fractionalized counts suggests an academic shift towards collaboration, where interdisciplinary projects are increasingly prioritized. Authors with a balance of high total and fractionalized counts may represent a synergy between individual expertise and collaborative strength, potentially fostering innovative research outcomes.
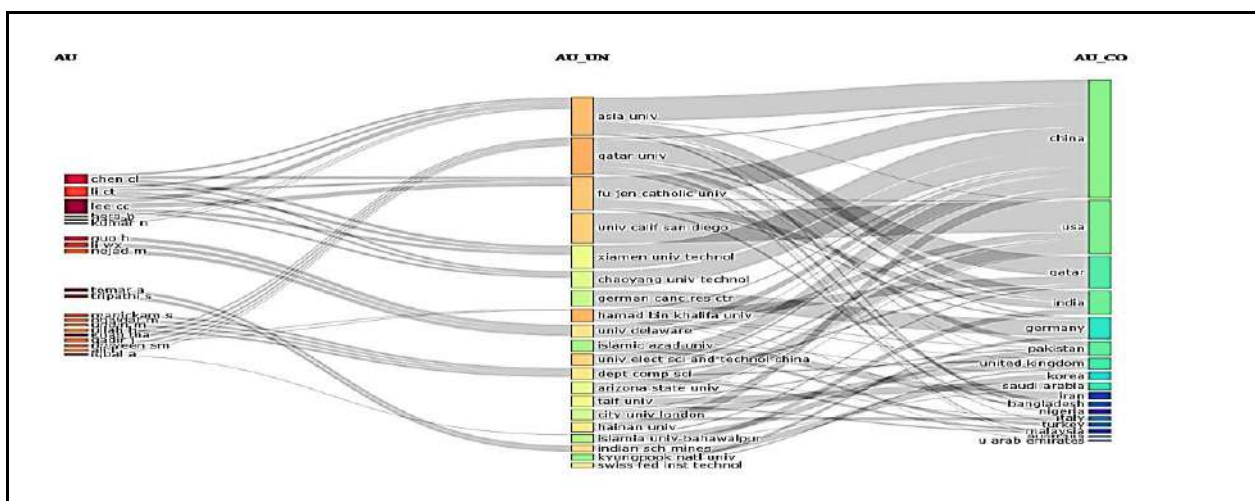

Fig-2: Three field category (AU, AU_UN, AU_CO)

Fig-2 displays the three-field category, highlighting the most prominent authors. Chen D., from Asia University in China, stands out among these, with many other prominent authors also affiliated with Asia University and Qatar University. In India, Tripathi S. and Manickam S. are identified as key contributors.

Fig-3: Most frequently used keywords by the authors

In Fig-3, we analyzed the most frequently used keywords by the authors. The words appearing most often are positioned farther from the center. The top keywords include "block chain" (112 occurrences), "security" (30), "smart contract" (19), "internet of things" (18), "privacy" (17), "block chain technology" (14), "machine learning" (12), "Ethereum" (11), and "artificial intelligence" (9).

6. CONCLUSION

The study concludes that block chain technology holds significant promise for advancing modern libraries, particularly in areas of data security, transparency, and operational efficiency. Through a bibliometric analysis of 204 documents, the study identifies key trends and influential contributors in block chain research within the library sector. Countries such as China, India, and Qatar lead in contributions, while journals like IEEE ACCESS and LIBRARY HI TECH serve as prominent publication sources, underscoring the interdisciplinary interest in this area. The analysis reveals frequent keywords, such as Ethereum, artificial intelligence, and block chain security, highlighting block chain's integration with other advanced technologies.

Despite block chain's potential, the study notes a limited adoption in certain regions, especially developed nations where the technology's benefits could be impactful. This underutilization suggests a need for broader academic and institutional collaboration to overcome barriers like high costs and technical challenges. The study advocates for further exploration and application of block chain in libraries to foster secure information sharing, efficient resource management, and enhanced user experiences. As libraries continue to adapt to digital advancements, block chain represents a transformative opportunity to meet the evolving needs of information management and academic performance.

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