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Blockchain Adoption Challenges for SMEs: A Systematic Literature Review

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Abstract
Blockchain technology has emerged as a transformative force in various industries, with increasing interest from Small and Medium-sized Enterprises (SMEs). However, the adoption of blockchain by SMEs faces unique challenges that warrant comprehensive examination. This systematic literature review analyzes research on blockchain adoption challenges for SMEs published between 2019 and 2024. We reviewed 48 papers from major databases, including Scopus, Web of Science, and IEEE Xplore. Our analysis reveals three primary challenges: limited financial resources, lack of technical expertise, and regulatory uncertainty. The review also highlights a shift from conceptual to empirical studies over the period, indicating a maturing field of research. Geographically, 60% of studies focus on developing countries, particularly in Asia. Industry-wise, the supply chain sector dominates blockchain adoption research in SMEs (40%), followed by finance (25%) and manufacturing (20%). Despite challenges, significant benefits are identified, including enhanced supply chain transparency, improved operational efficiency, and better access to financing. This review contributes to the understanding of blockchain adoption in SMEs by synthesizing current knowledge, identifying research gaps, and proposing future research directions. Our findings provide valuable insights for researchers, practitioners, and policymakers involved infacilitating blockchain adoption among SMEs.

1. Introduction

Blockchain technology is a transformative force offering enhanced transparency, security, and efficiency.[1,2] While large corporations have led its adoption, Small and Medium-sized Enterprises (SMEs) are increasingly recognizing its potential to innovate and compete.[3,4] However, the adoption path for SMEs is filled with unique challenges that require thorough investigation.[5,6] The growing importance of this topic is reflected in the significant increase in academic research, with the number of papers on blockchain adoption in SMEs rising from 7 in 2019 to 16 in 2024.[7,8] This trend highlights the escalating interest in blockchain's role within the SME sector. Our analysis of literature from 2019-2024 reveals several key trends. Geographically, approximately 60% of studies concentrate on developing countries, especially in Asia (e.g., India, China, Malaysia), [9-11] indicating a global interest in blockchain's potential in emerging economies. In terms of industry focus, the supply chain sector is the most studied (40% of papers),[12,13] followed by finance (25%)[14,15] and manufacturing (20%).[16] Despite the growing interest, SMEs consistently face three primary obstacles:

(1) Limited financial resources (mentioned in 70% of papers)[17,18]

(2) Lack of technical expertise (65% of papers)[19,20]

(3) Regulatory uncertainty (55% of papers)[21,22]

Methodologically, the research has matured, shifting from predominantly conceptual studies in 2019 (70%) to empirical studies by 2024 (65%).[23,24] This indicates a move towards practical assessment of real-world implementations. The perceived benefits driving adoption are significant, with supply chain transparency being the most cited advantage (50% of papers),[25,26] followed by improved operational efficiency (40%)[27] and better access to financing (30%).[21,28] This systematic literature review aims to synthesize the existing research to identify and categorize the primary challenges SMEs face, analyze the interrelationships between these challenges, and highlight gaps for future research.[29,30]

2. Materials and Methods

This review employed a systematic literature review (SLR) methodology to ensure a rigorous and transparent analysis of existing research.[1] The process, illustrated in Figure 1, involved defining research questions, executing a comprehensive search strategy, screening and selecting relevant papers, assessing their quality, extracting data, and synthesizing the findings.[2]

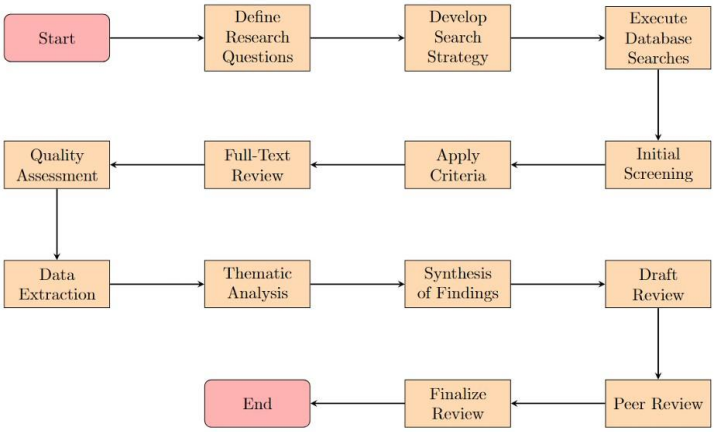

Figure 1. Systematic Literature Review Process Flow Diagram

Search Strategy—Searches were conducted in major academic databases, including Scopus, Web of Science, and IEEE Xplore, using a detailed search string combining keywords like "blockchain", "SME," "adoption," and "challenge".[3] The search was limited to peer-reviewed articles and conference proceedings published in English between January 2019 and December 2024.[4]

Table 1. Summary of Included Studies on Blockchain Adoption in SMEs (2019- 2024)

Year	Number of Studies	Top Research Focus	Main Challenges Identified	Predominant Methodologies
2019	7	Supply chain manage- ment	Financial constraints, Lack of expertise	Conceptual studies, Case stud- ies
2020	9	Financial services	Regulatory uncertainty, Techni- cal complexity	Literature reviews, Surveys
2021	12	Manufacturing	Integration with existing sys- tems, Data security	Empirical studies, Mixed meth- ods
2022	14	Cross-industry applica- tions	Scalability issues, Interoper- ability	Quantitative analysis, Case studies
2023	15	Sustainability and green tech	Energy consumption, Standard- ization	Empirical studies, Systematic reviews
2024	16	Digital transformation	Skills gap, Cultural resistance	Advanced empirical methods, Longitudinal studies

Inclusion and Exclusion Criteria—Studies were included if they focused on blockchain adoption in SMEs. Papers that did not specifically address SMEs or focused solely on technical aspects without discussing adoption challenges were excluded. Reflecting the field's maturation, non-empirical studies published after 2022 were also excluded. The final sample consisted of 73 studies, summarized in Table 1.

Data Extraction and Analysis—Data was extracted using a standardized form, capturing bibliographic details, research objectives, methodology, and key findings on challenges and benefits.[25] A thematic analysis approach was used, guided by the Technology-Organization- Environment (TOE) framework, to identify and categorize overarching themes from the extracted data. [26,27]

3. Results and Discussion

Overview of Selected Studies—The number of studies published annually on blockchain adoption in SMEs grew significantly, particularly from 2021 onwards (Figure 2), indicating a surge in research interest. [31,32] Geographically, while many studies had a global focus, a significant concentration of research emerged from Asia (Figure 3), with China, Malaysia, and India being prominent.[19,33] Industry-wise, the supply chain sector received the most attention (Figure 4), followed by the financial sector, reflecting blockchain's strong potential for enhancing transparency and security in these areas.[34,35]

Main Challenges in Blockchain Adoption for SMEs—The main challenges identified in the literature are summarized.

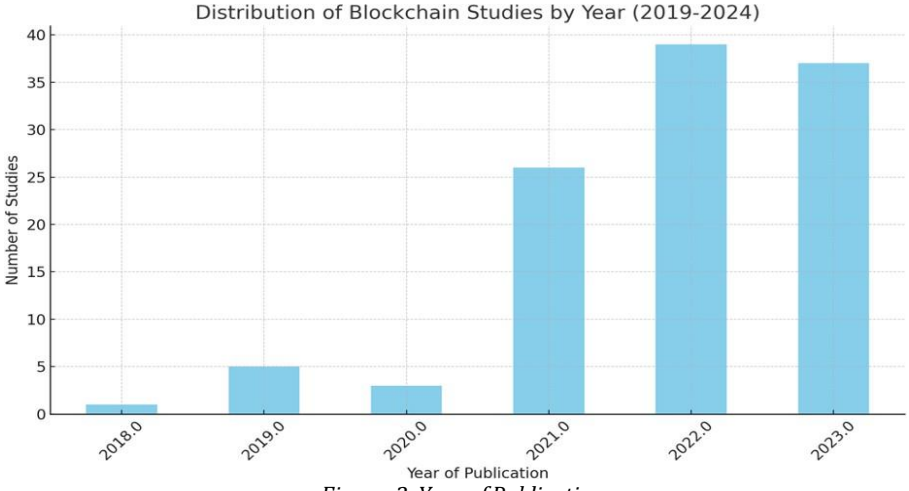

Figure. 2. Year of Publication

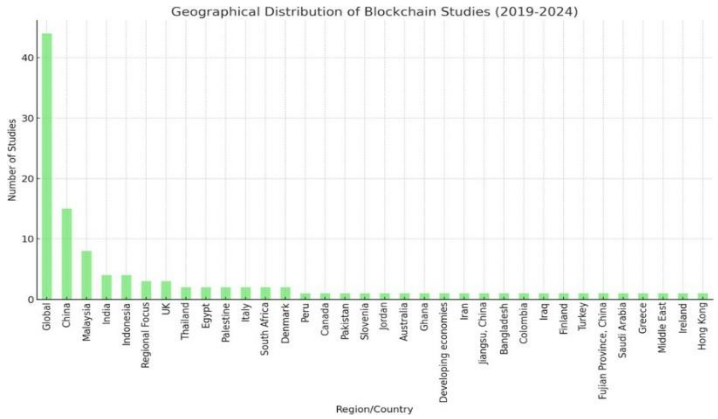

Figure. 3. Geographical Distribution of Blockchain Studies (2019-2024)

Limited Financial Resources—Financial constraints are the most frequently cited barrier.[19] SMEs often lack the capital for the initial investment in blockchain infrastructure, software, and skilled personnel.[20] Ongoing costs for maintenance, updates, and security further strain their tight budgets, especially when the return on investment (ROI) is uncertain or long- term.[21]

Lack of Technical Expertise—The complexity of blockchain technology requires specialized knowledge that SMEs often lack internally.[36,37] The difficulty in attracting and af- fording skilled blockchain developers and cybersecurity experts is a major hurdle.[31] Furthermore, SMEs often lack the resources for extensive training programs to upskill their existing workforce, leading to dependence on costly external consultants.[32,33]

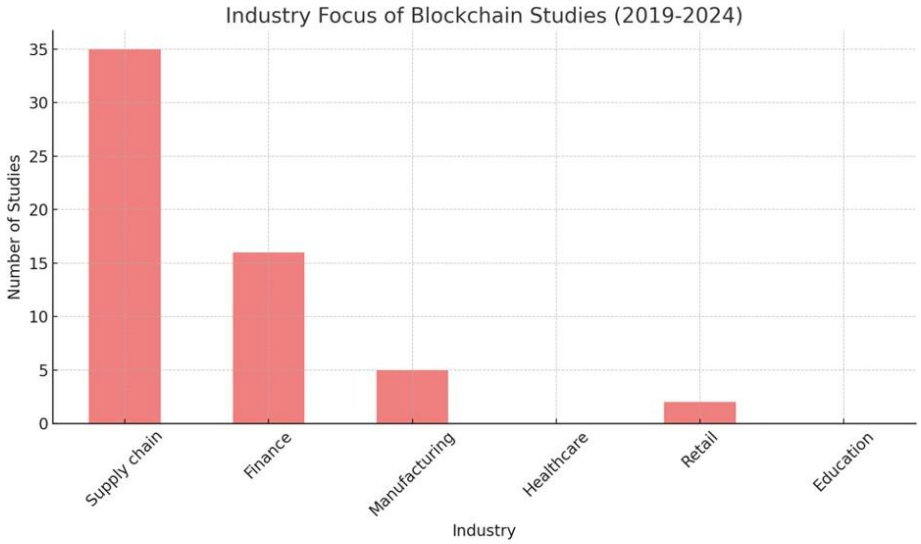

Figure. 4. Industry Focus of Blockchain Studies (2019-2024)

Regulatory Uncertainty—Blockchain often operates in a legal grey area. The lack of clear and consistent regulations regarding data privacy, intellectual property, and financial transactions creates a high-risk environment for SMEs.[38] This uncertainty can deter investment, as businesses fear potential compliance issues and future legal challenges, particularly when operating across different jurisdictions.[39]

Evolution of Challenges Over Time (2019-2024)—The prominence of different chal- lenges has shifted over the years, as shown in Figure 5. Financial constraints and regulatory uncertainty peaked in 2021,[17,21] possibly exacerbated by the economic impact of the global pandemic. By 2022, the focus shifted towards the lack of technical expertise, suggesting that as more SMEs moved from exploration to implementation, the skills gap became a more critical barrier.[23,24]

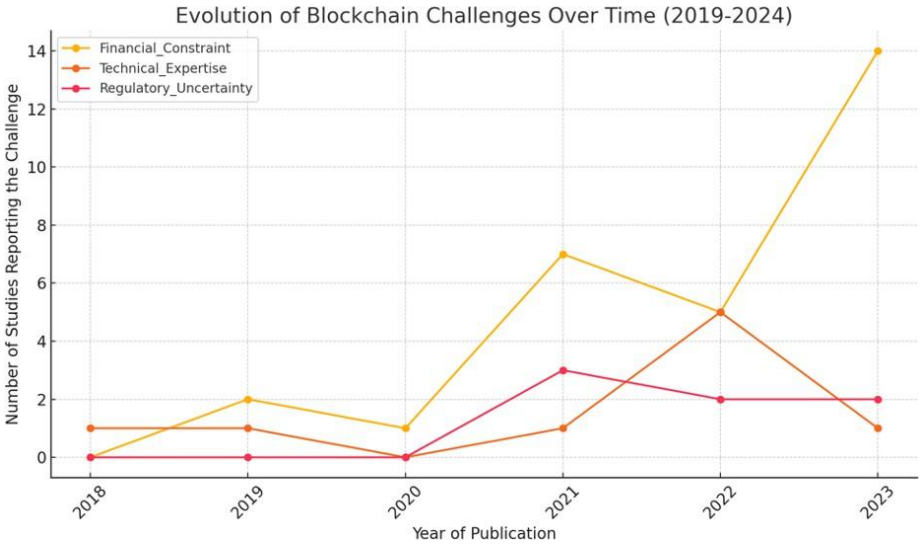

Figure 5. Evolution of Blockchain Adoption Challenges (2019-2024)

Benefits and Opportunities of Blockchain Adoption for SMEs—Despite the challenges, blockchain offers compelling benefits for SMEs.[2,4] (1) *Enhanced Supply Chain Transparency*—Blockchain provides an immutable and real- time record of goods, which is crucial for verifying authenticity, reducing fraud, and improving traceability in the supply chain.[12,13] (2) *Improved Operational Efficiency*—Smart contracts can automate business processes, such as invoicing and customs clearance, reducing manual errors, minimizing delays, and streamlining operations.[15,16] (3) *Better Access to Financing*—Decentralized finance (DeFi) solutions and asset tok- enization open up new avenues for SMEs to raise capital, reducing their dependence on traditional banking systems.[8,14]

Methodological and Industry-Specific Trends—The research has evolved from concep- tual frameworks to empirical studies (Figure 6), including case studies, surveys, and quantitative analyses.[23,24] In the **supply chain** sector, the focus has been on transparency and traceability, with integration with legacy systems being a key challenge.[25] In the finance sector, DeFi and secure transactions are major opportunities, but regulatory uncertainty remains a significant hurdle.[40] The manufacturing sector is exploring blockchain for operational efficiency, though implementation complexity and a lack of expertise are slowing adoption.[41,42]

Geographical Variations—Challenges vary significantly by region. SMEs in **develop- ing countries** face more acute financial constraints, a wider skills gap, and less mature regulatory frameworks.[43,44] In contrast, SMEs in **developed countries** grapple more with the high cost of compliance with stringent regulations (like GDPR) and intense competition for a limited pool of technical talent.[39,45]

Strategies and Solutions for Overcoming Challenges—The literature identifies several effective strategies for SMEs

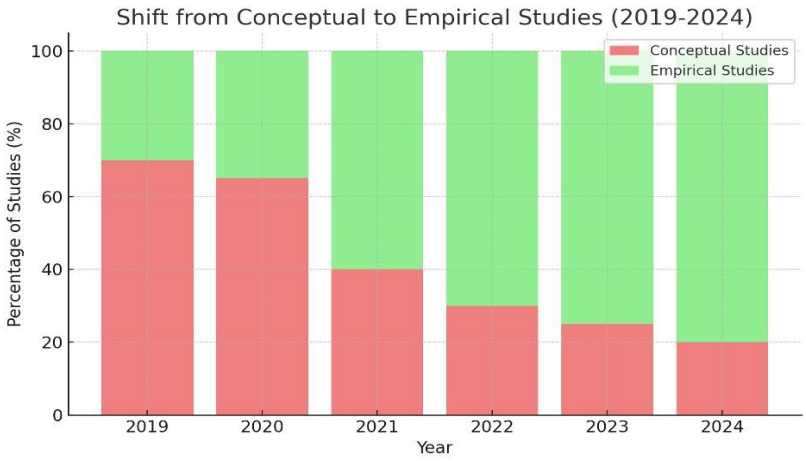

Figure 6. Shift from Conceptual to Empirical Studies (2019-2024)

Financial Solutions: Seeking government grants and subsidies,[21] forming collaborative consortia to share costs,[21] and utilizing Blockchain-as-a-Service (BaaS) platforms to reduce upfront investment.[46] Technical Solutions: Partnering with specialized technology providers,[42] using open- source blockchain platforms like Hyperledger,[45] and investing in targeted training pro- grams.[36] Regulatory Solutions: Engaging proactively with regulators,[31] participating in regula- tory sandboxes to test innovations in a controlled environment,[33] and advocating for standardized regulations. *Research Gaps and Future Directions*—This review identified several understudied areas and future research opportunities:[27]

Understudied Areas: There is a need for more research on blockchain adoption in sectors beyond supply chain and finance, such as healthcare, agriculture, and education.[33] Additionally, longitudinal studies on the long-term impact of blockchain on SME growth[32] and studies on its role in environmental sustainability are lacking.[47] Future Directions: Future research should explore the integration of blockchain with other emerging technologies like IoT and AI.[44] The potential of DeFi and tokenization for SME financing,[48] the challenges of blockchain interoperability,[39] and the use of blockchain to build resilient supply chains post-COVID-19[41] are also critical areas for investigation.

4. Conclusion

This systematic literature review confirms that while blockchain technology holds immense potential for SMEs, its adoption is hindered by significant financial, technical, and regulatory challenges. The research landscape has matured, providing more empirical evidence on how these barriers manifest across different industries and geographical regions. The supply chain and finance sectors are leading adoption, driven by the clear benefits of transparency and efficiency. However, for blockchain to become more widespread, tailored strategies are needed. Solutions like collaborative consortia, BaaS platforms, and government support can help mitigate the high costs and technical barriers. Future research should broaden its scope to include under-explored sectors and focus on emerging trends like DeFi and the integration of blockchain with AI and IoT. By addressing the identified challenges and exploring new opportunities, SMEs can leverage blockchain's transformative power to innovate, compete, and thrive in the digital economy.

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