Blockchain Implementation Challenges in Developing Countries: An evidence-based systematic review and bibliometric analysis

Abu Naser Mohammad Saif, K. M. Anwarul Islam, Afruza Haque, Hamida Akhter, S.M. Masudur Rahman, Nusrat Jafrin, Rasheda Akter Rupa, Rehnuma Mostafa

"Blockchain technology could change our world more than people imagine."

Jack Ma
Co-Founder, Alibaba Group

Contemporary research on technology and innovation management has gauged blockchain as a catalyst for the electronic-information era. As developing countries around the globe are facing challenges to adopt and implement blockchain, this evidence-based systematic review aims to identify the implementation challenges of blockchain technology for developing countries. A total of 1,298 published documents during the period 2016-2021 from the Scopus, Web of Science, IEEE Xplore, and ScienceDirect databases were explored to recognize 19 appropriate publications for research analysis using a PRISMA flow diagram. Based on the identified challenges from the thorough reviews of these 19 publications, using the association technique, the authors developed four comprehensive themes as broad challenges: technological, governance, organizational and environmental, and knowledge. Later, they performed bibliometric analyses using VOSviewer 1.6.17, and based on the bibliometric evidence constructed term co-occurrence network plots. The results show that developing countries face challenges vis-à-vis technological, governance, organizational and environmental, and knowledge issues when implementing blockchain technology. Hence, to make blockchain adoption and implementation processes successful in developing countries, these broad categories of challenges must be properly addressed. In addition, practitioners of disruptive technology, policymakers, consultants, IT experts, business people, top company managers, and above all, respective governments need to pay attention to these challenges for accelerating the blockchain adoption and implementation process in developing countries.

1. Introduction

The present age is filled with science and technology. Today's modern civilization is the gift of seamless and robust technological development. Therefore, we are going through an innovative flow of amazing technology that spreads among various sectors, like manufacturing, retail, and financial services (Chang et al., 2019; Hou et al., 2020). Blockchain is a suitable technology for various sectors to maintain a distributed ledger of transactions, properties, etc. Blockchain alters the way of doing business (Wagire et al., 2019) and has the potential of generating new business models (Gökalp et al., 2018). This technology was invented by Satoshi Nakamoto in 2008 as a transaction ledger for the cryptocurrency bitcoin, which could solve the problem of sharing transaction information among involved parties without any central control. Blockchain is a distributed database that records the transactions between parties efficiently and in a provable and enduring way (Iansiti et al., 2017).

Many organizations are enhancing their interest in blockchain technology because of the significant advantages for business. In addition to confirming data integrity, blockchain allows increases in direct transactions between suppliers and customers, along

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with keeping correct records of asset movement (Lacity, 2018). Blockchain also plays a vital role in enhancing the traceability of transactions, increasing cost-effectiveness, and improving the performance of banks and other financial institutions (Hassani et al., 2018; Frizzo-Barker et al., 2019; Palmie et al, 2020). Blockchain is also being adopted in real estate and public registries to take advantage of the immutability possible with distributed ledger systems (Konashevych, 2020). Likewise, educational institutions have begun to adopt blockchain technology (Bhaskar et al., 2020).

Though blockchain has the ability to improve performance in the financial sector, it faces several challenges such as scalability, security, privacy leakage, energy consumption, laws and regulations, cybercrime, and so on (Chang et al., 2020). Firms also face governance, legacy, and coordination issues at the time of adopting blockchain technology (Upadhyay, 2020). Blockchain adoption in the health sector deals with some additional challenges, such as large data sharing in hospitals, data security and management, handling socio-economic data, and so on (Attaran, 2020). Although blockchain solves some issues involved with integrating IoT-based precision agricultural systems, it still poses challenges to security and privacy (Torky & Hassanein, 2020; Ferrag et al., 2020). Blockchain has the potential to decentralize educational documents and materials which encourage lifelong learning. Yet even still, privacy, security, and proper standardising for implementation are significant challenges for educational institutions (Bhaskar et al., 2020).

After considering the potentialities and challenges of blockchain technology, many developing countries have started taking some measures to adopt blockchain technology in their organizations. Disruptive technology like blockchain can facilitate those developing countries that are on a positive path of development to accomplish Sustainable Development Goals (SDGs) (Parmentola et al., 2021). Blockchain is especially advantageous for developing countries in addressing ineffectiveness in operations, establishing legal property rights, and reducing corruption (Kshetri & Voas, 2018).

Several studies have been done on blockchain adoption, benefits, impacting factors, and blockchain in the supply chain or the financial sector (Post et al., 2018; Hye et al., 2020; Janssen et al., 2020; Garg et al., 2021). Still, studies are scarce regarding the challenges of adopting blockchain technology generally, including for developing countries. This has been referred to as a future research gap to explore further (Hoxha & Sadiku, 2019; Janssen et al., 2020; Chang et al., 2020).

By developing countries, we imply countries with a lower GDP and a less developed and sophisticated economy than developed countries. In this study, researchers focus on the previously identified gap, which will address the challenges of blockchain adoption, particularly from the perspective of some similarly developing countries, such as India, Vietnam, Indonesia, Brazil, Pakistan, Philippines, Nigeria, and Kenya. Hence, this study aims at addressing the following research question: ***What are the challenges of adopting blockchain technology in developing countries?***

To fill the research gap on this topic, the authors reviewed the existing literature related to the topic to find out the challenges in a broader context.

2. Materials and Methods

The authors traced four rudimentary levels in this evidence-based systematic review (Bahinipati et al., 2021; Breet et al., 2021). The levels are: search, assessment, synthesis, and analysis (Mengist et al., 2020; Saif et al., 2021).

2.1 Literature search

At first, we performed a systematic exploration of available research papers (Sengers et al., 2019) on blockchain implementation challenges in developing countries. Leading academic research databases were used to search and extract relevant publications (Saif & Islam, 2022). We selected 2016 as the starting year for literature exploration and all of the scientific databases, that is, Scopus, Web of Science, IEEE Xplore, and ScienceDirect exhibited exploration results from 2016.

Table 1 exhibited 1,298 records that were found in those academic research databases.

2.2 Literature assessment

To assess the relevant literature, we used a PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) flow diagram as previously recommended (Munn et al., 2018; Zhang et al., 2019; Page et al., 2021).

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Table 1. Search procedures

Search expressions	Search within	Date range	Query thread	Number of records
Blockchain implementation challenges in developing country	All fields	2016 to 2021	ALL (blockchain AND implementation AND challenges AND in AND developing AND country) AND PUBYEAR > 2015 AND PUBYEAR < 2022	1,298

Figure 1 reveals the step-by-step progressions to trace the final number of publications. We thus finally selected 19 documents, which focus on the challenges of blockchain adoption and implementation in developing countries, to conduct this study.

2.3 Literature synthesis

After identifying 19 relevant and applicable publications, we then synthesized those pieces of literature as suggested by Borrego and colleagues (2014), and by Snyder (2019).

2.4 Analysis and reporting

At this stage, we prepared a table, as proposed by Younas and Ali (2021), for analyzing and reporting the results. Table 2 illustrates a total of 19 papers that were traced by the PRISMA flow diagram. Based on this illustration, the researchers developed relevant themes as broad challenges for implementing blockchain in developing countries.

At this stage, using the association technique, we pinned down various challenges that could be categorized

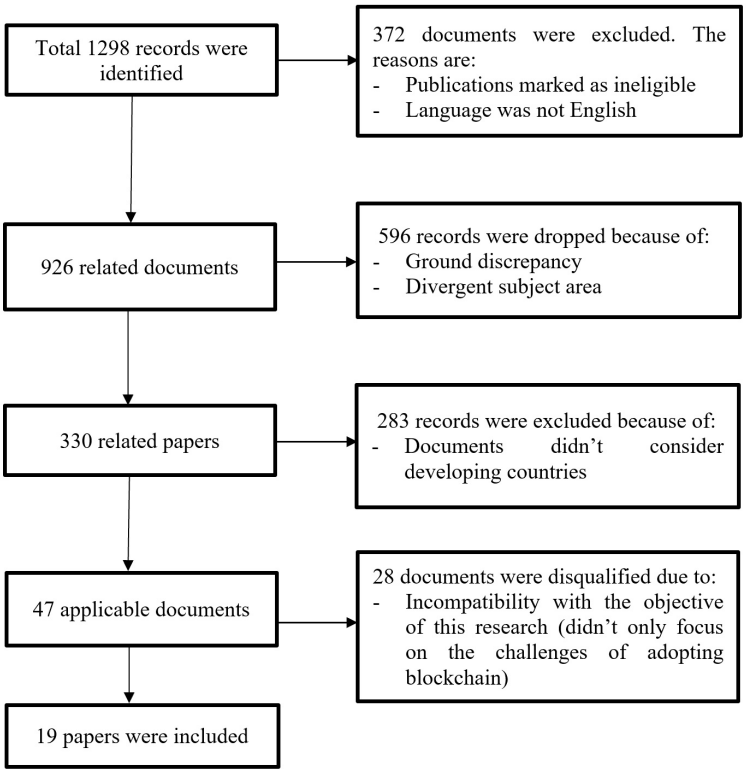

Figure 1. The result of PRISMA flow diagram

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Table 2. Reporting the identified studies

Study Number	Author(s) and Year	Study Purpose/Focus	Methods Used	Challenges Identified
1	Makhdoom et al. (2019)	This study focuses on mapping the benefits and challenges of adopting blockchain technology.	A literature review tactic and a conceptual framework are adopted for this study.	IoT validation rules, IoT-oriented consensus protocol, and security problems.
2	Bore et al. (2017)	This study concentrates on the initial designing, execution, and appraising of the blockchain-enabled School Information Hub (SIH).	For conducting the study, the authors adopt a generic methodology to develop the proposed SIH.	Lack of systematic record-keeping.
3	Kursh & Schnure (2016)	This paper aims to draw the attention of academicians and policymakers to include fintech and blockchain-related topics in the business studies curriculum, especially for university students.	The authors adopt a qualitative approach for conducting this study.	Regulation issues, privacy, security, and trust issues.
4	Toufaily et al. (2021)	This paper focuses on blockchain execution in the private and public sectors by investigating various challenges and implementation problems.	Authors adopt the explanatory research design which is based on qualitative data.	*Technological Challenges:* technological amateur, security, data privacy, cost of the technology, technology regulatory uncertainty, network effects, and ecosystem readiness. *Organizational challenges:* governance and leadership readiness, business model alignment, and organizational readiness.
5	Sanka et al. (2021)	Authors concentrate on blockchain adoption, its current acceleration, and various challenges.	For conducting the study, the authors adopt the quantitative survey and analysis of blockchain.	Scalability issues, privacy issues, quantum computing threats, lack of knowledge of blockchain, and uncertainty in the adoption of the new system.
6	Bamakan et al. (2021)	This study focuses on how blockchain would attain the requirement of pharmaceutical cold chain objectives.	This is a theoretical-based case study.	Security and privacy of data, data storage power, cost, standardization, and social challenges regarding blockchain adoption.
7	McGhin et al. (2019)	This paper addresses the requirement and challenges of blockchain implementation in the healthcare industry.	It is a survey-based study where the authors adopt the PRISMA approach.	Lack of standardization, key management scalability, IoT overhead, and general software vulnerabilities.
8	Yadav et al. (2020)	This paper tries to find out different barriers to implementing blockchain in the Indian agricultural sector.	In this study, the authors attempt to provide a comprehensive literature review with the help of the Delphi method.	Inadequate government regulation and regularity, huge consumption of resources (energy, infrastructure) and initial capital requirement, insufficient knowledge among agro-stakeholders about the ease of use of blockchain, the reluctance of agro-stakeholders to adopt blockchain.

Table 2. Reporting the identified studies

9	Kouhizadeh et al. (2021)	This research describes blockchain technology and its adoption barriers.	To investigate blockchain adoption barriers, the authors use the Technology-Organization-Environment (TOE) framework and force field theories.	In this study, 22 barriers are categorized under four broad dimensions: technological, organizational, environmental (supply-chain context), and environmental (external context).
10	Dutta et al. (2020)	This paper highlights overall blockchain opportunities, their social impacts, major trends, and challenges.	To conduct the study, the authors adopt a systematic literature review approach.	Organizational, technical, and different operational challenges.
11	Upadhyay et al. (2020)	The authors focus on challenges, potential opportunities, and various applications of blockchain.	To construct an integrated framework for the blockchain execution, the authors use the three-stage process of systematic literature review (SLR) approach.	Insufficient clarity, governance, security and privacy, maintenance cost, implementing and executing the smart contract, scalability of transaction.
12	Saheb et al. (2021)	The purpose of this study is to appraise the organizational values and challenges of blockchain technology faced by the banking industry.	The authors adopt a mix-method qualitative analysis and PRISMA approach for this study.	Environmental, technological, organizational, cultural, and political resistance.
13	Chang et al. (2020)	This paper describes the evolution and challenges of FinTech and blockchain technology in the financial industry.	To conduct this qualitative study, the authors employ the interview method.	Scalability, Security, Privacy Leakage, Energy Consumption, Privacy, Regulations and law, Cybercrime.
14	Sharma & Joshi (2021)	The study explores the challenges and significant issues of blockchain technology adoption in the health care industry in India.	Authors adopt a literature review and semi-structured interview to conduct the study.	Legal issues, insufficient support from top management, little understanding of blockchain technology, and lack of IT experts.
15	Reyna et al. (2018)	To investigate the unique features, challenges, and potential benefits of integrating the blockchain and IoT applications.	A survey and descriptive statistics are used to conduct this study.	Storage ability and scalability, inadequate security, insufficient anonymity, smart contracts, and legal issues.
16	Hewa et al. (2020)	This study explores the different benefits and challenges of blockchain-based smart contracts.	In this qualitative study, researchers don't mention any specific framework or method.	Legal acceptance, latency in transaction completion, extensive computational overhead in consensus, blockchain platform operational costs.
17	Lu et al. (2020)	This study investigates the features, potential trends, and challenges of blockchain for the development of this technology.	This is a qualitative study based on the systematic literature review approach.	*Technical challenges:* scalability and capacity, chain structures. *Organizational challenges:* regulation and laws, governance, identity and ownership management, resource sharing, and privacy protection.
18	Zhou et al. (2020)	This paper highlighted the determination of the Critical Success Factors (CSFs) and implementation challenges of blockchain in the maritime industry.	For conducting this study, the authors interview 30 maritime professionals through questionnaires.	Political, economic, technological, environmental, and legal challenges are identified in this study.
19	Queiroz & Wamba (2019)	This paper aims to investigate the drivers of blockchain adoption in the supply chain with its challenges.	The authors adopt the technology acceptance model (TAM) and unified theory of acceptance and use of technology (UTAUT) model.	Scalability, technological shortcomings, and lacking an updated regulatory body.

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mainly into the topics of: technological, governance, organizational and environmental, and knowledge.

Technological Challenges

The technological context surrounds the technical capability, difficulty, complexity, and emergence of innovations for adoption (Rogers, 1995). Many researchers have agreed that technological challenges act as the main barriers to adopting and implementing blockchain (Kouhizadeh et al., 2021). Technological amateurishness, the cost of technology, scalability, interoperability, complexity, and technology-related regulatory uncertainty are all technological challenges. Hacking and system attacks, which have happened in cryptocurrency system, raise questions about the security of blockchain (Yli-Huumo et al., 2016). Security and privacy issues pose major challenges to blockchain adoption and implementation. According to Ateniese and colleagues (2014), the lack of certification can be responsible for increasing privacy issues. They also added that the use of certified bitcoin can accelerate the acceptance of blockchain in e-commerce.

Insufficient accessibility of IT infrastructure among stakeholders hampers effective and stable blockchain implementation (Kouhizadeh et al., 2021). One of the significant technological barriers to blockchain implementation is timestamping dependability, which is directly associated with distributed network dependability (Mense & Flatscher, 2018).

Other technological challenges of stable and successful blockchain adoption and implementation include the quantum computing threat, data storage, IoT overhead, software vulnerabilities, power consumption, cybercrime threat, routing attack, complicated technical barriers, extensive computation, insufficient data storage capacity, and general shortage of IT experts.

Governance Challenges

In an organization, responsibility delegation, communication, and decision-making processes are determined by governance mechanisms (Weill & Ross, 2005). Researchers have identified several governance challenges that create obstacles to blockchain adoption and implementation. According to Rikken et al. (2019), differences among blockchain protocols are a significant hindrance to blockchain implementation.

Many countries are not yet ready to adopt blockchain technology due to a lack of effective regulations (Yadav et al., 2020). Yadav et al. (2020) also added that uncertainty about blockchain regulation issues creates hesitation among stakeholders, which serves as a barrier to properly implementing this technology.

Management scalability, inadequate government regulations, insufficient trust among stakeholders, and the lack of an active regulatory board are some of the governance challenges that directly affect blockchain adoption and implementation. Transparency of code, especially when based on smart contracts, is a vital governance challenge for blockchain implementation. Lack of accountability and responsibility among stakeholders threatens the process of blockchain implementation. Shortage of compelling distributed ledger-based apps, insufficient clarity in governance, compliance difficulties with new rules and laws, and legal issues were also considered significant governance challenges.

Some other challenges, such as conflict resolution, incidences of tax evasion, and integration issues with various laws and regulations (Hans et al., 2017; Hye, Min, & Hong, 2017; Kwok & Koh, 2019) are also categorized under governance challenges for blockchain implementation. In some cases, a government's unwillingness to adopt has thwarted efforts at blockchain implementation. A lack of clear incentives and rewards by the government for successful implementations of blockchain systems serves to demotivate professionals and experts in adopting this technology. In most developing countries, the blockchain adoption process suffers due to a lack of standardization, whereas the state-backed Blockchain Services Network (BSN) in China appears to be a further advanced standardization effort. With this initiative, China is promoting its digital yuan currency and establishing a non-fungible token (NFT) market apart from cryptocurrencies.

Organizational and Environmental Challenges

Several studies (Dutta et al., 2020; Lu et al., 2020; Kouhizadeh et al., 2021; Saheb et al., 2021; Toufaily et al., 2021) have emphasized and addressed organizational and environmental challenges for the successful adoption and implementation of blockchain systems. Organizational readiness, inter-organizational connectedness, management lifecycle, business process, status quo mindset, shortage of compelling apps,

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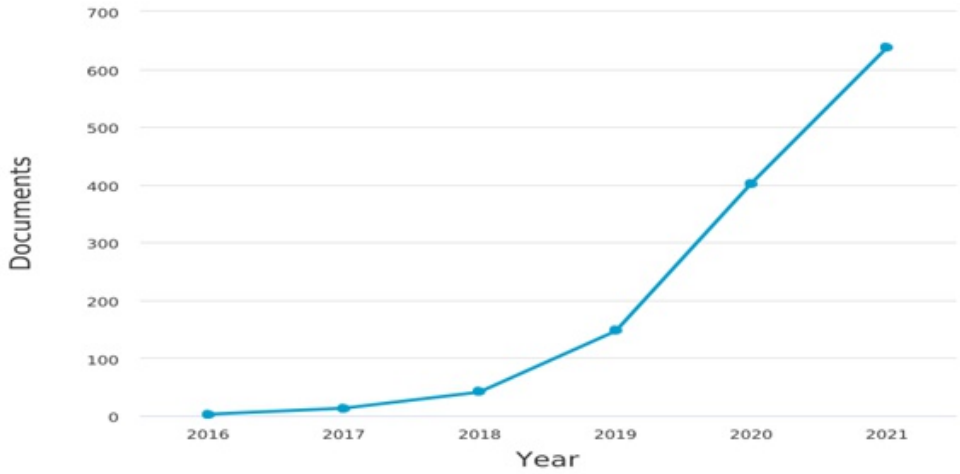

Figure 2. Trend of publications
Source: Authors' articulation based on the data from the research databases

uncertain return on investment (ROI), lack of integration with the existing legacy system, lack of disrupting business model, business model alignment, inadequate infrastructure, lack of data integrity and trust, and a lack of willingness to adopt blockchain were all considered as organizational challenges (Dutta et al., 2020; Saheb et al., 2021; Lu et al., 2020; Kouhizadeh et al., 2021).

Organizational culture in companies guides employees through work discipline and expected behaviors towards other organizations (Kouhizadeh et al., 2021). Kouhizadeh and colleagues (2021) opined in their study that resistance to change in organizational culture acts as an obstacle to blockchain implementation. Organizations typically hesitate to replace or alter legacy systems, which creates a major blockage for blockchain adoption.

Environmental and external characteristics, ecosystem readiness, rules and regulations requirements regarding environmental protection, marketing noise of confusion and mistrust (credibility of blockchain), political resistance, environmental cost, and intellectual property concerns were also considered environmental challenges.

Knowledge Challenges
Technological adoption may not be successful due to the limitation of knowledge (Li et al., 2019). Lack of familiarity regarding blockchain technology, insufficient knowledge of stakeholders about blockchain, and lack of skilled and knowledgeable professionals are considered major knowledge challenges for blockchain implementation in developing countries (Li et al., 2019). All stakeholders require awareness-raising and training to adapt to this new system. But most organizations are unable to ensure proper training and orientation for their staff, which is a significant barrier in the path of blockchain adoption and implementation. Another challenge that falls under this category is little support from top management. Without the full support and cooperation of top management, it is impossible to integrate blockchain with existing legacy systems. Lack of understanding creates a lack of trust among stakeholders, including IT experts, technicians, business people and managers, security experts, policymakers, and professionals. Lack of trust also disrupts the blockchain implementation process (Li et al., 2019).

3. Results of Bibliometric Analysis

For bibliometric analysis, we used several graphs and charts to present the outcome of scientific works recorded in the scientific research databases.

Figure 2 depicts the trend of publications on blockchain adoption challenges, especially in developing countries for the period 2016-2021.

This figure represents an upward trend in publications on this issue. Before 2016, no significant research work on the challenges of blockchain implementation had

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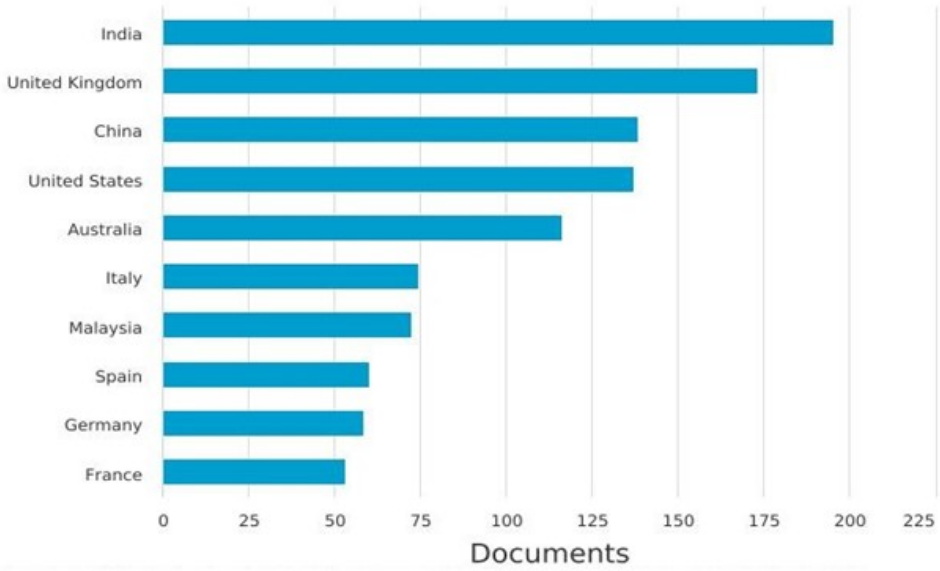

Figure 3. Country-wise publications
Source: Authors' articulation based on the data from the research databases

been performed. One of the reasons is that implementation challenges often do not come up before elementary adoption and execution. The most work done on this issue was between 2016 and 2021. In 2021, publications on blockchain implementation challenges were peaking as blockchain adoption and implementation are still in their infancy in many parts of the world.

Figure 3 represents country-based publications on the topic of blockchain implementation challenges. The most work in this field has been performed in India, which proves that India is emphasizing blockchain implementation. Till 2021, India had around 190

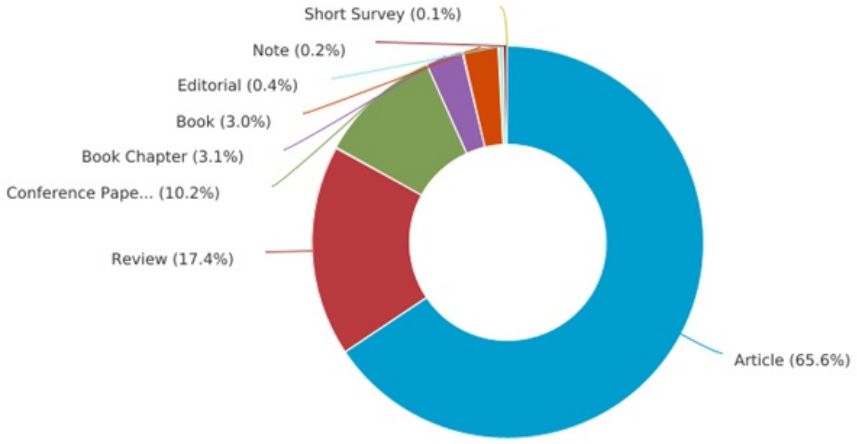

Figure 4. Types of publications
Source: Authors' articulation based on the data from the research databases

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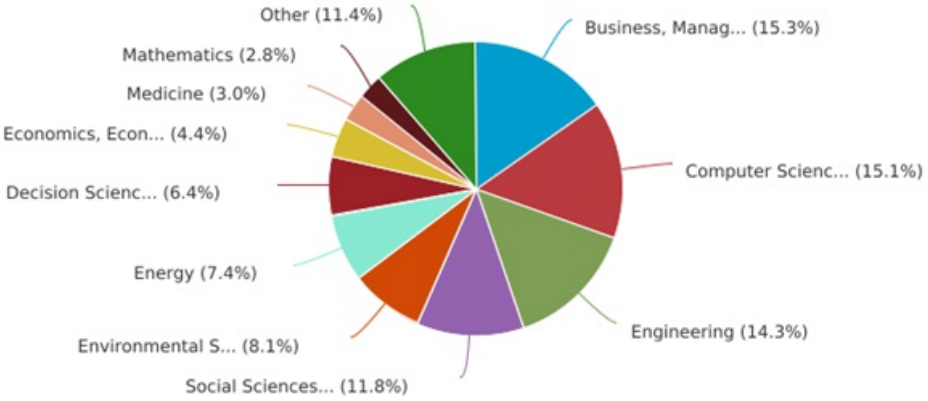

Figure 5. Publications based on subject areas
Source: Authors' articulation based on the data from the research databases

publications in the databases.

While China and the United States of America have contributed to the literature almost equally in the specific domain of blockchain implementation, France among those in the survey has made the lowest literature contribution.

Figure 4 exhibits that research articles (65.6%), reviews (17.4%), and conference papers (10.2%) were the major forms of publications from 2016 to 2021.

Taken in context, it can be argued that researchers and academicians are more interested to present their work in journals and to share their thoughts at conferences so that they can receive specific suggestions, comments, and feedback from reviewers and fellow participants.

Figure 5 represents the publications based on different subject areas about blockchain implementation

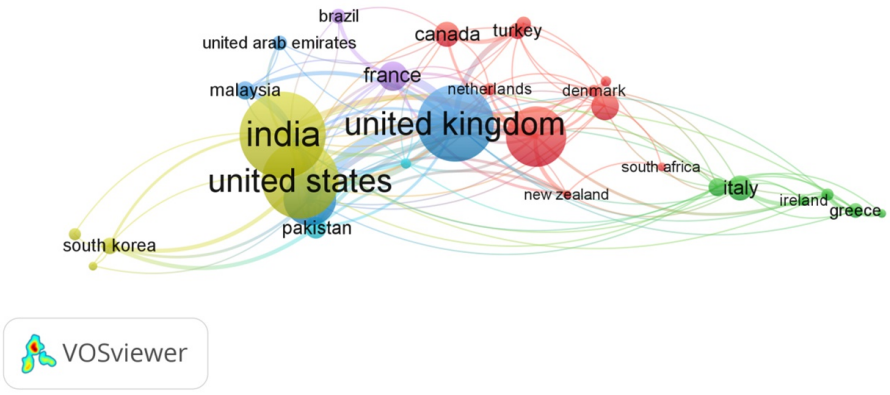

Figure 6. Co-authorship network of countries
Source: Output generated from VOSviewer

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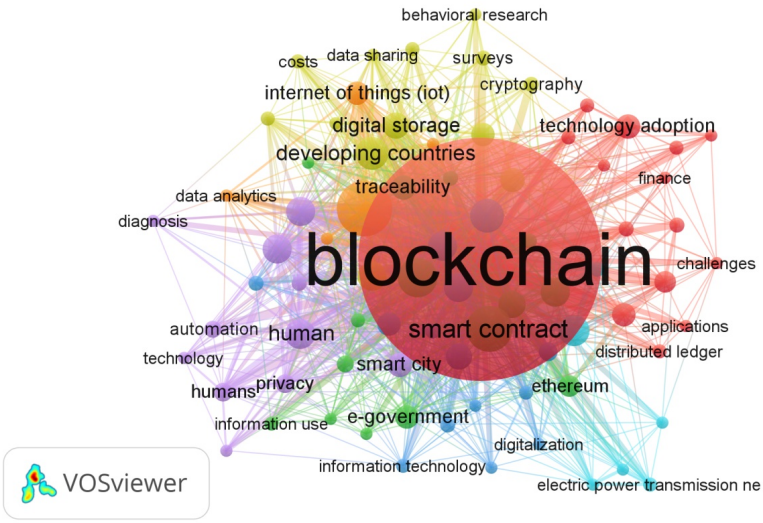

Figure 7. Network map of assembled bibliographic information
Source: Output generated from VOSviewer

challenges for developing countries from 2016 to 2021. From Figure 5, it is clear that researchers in various fields are concerned about the issue of blockchain.

Among the subject areas, business management, computer science, and engineering were the most significant from which more than 44% of the research was published. Publications from some other subject areas, such as decision science, economics, medicine, and mathematics are very scarce. Therefore, this finding calls for more research in these particular subject areas.

Figure 6 depicts the co-authorship network between countries in the field of blockchain implementation challenges. In this network, each node represents a country and the thickness of the connection between two nodes represents the intensity of collaboration between two countries.

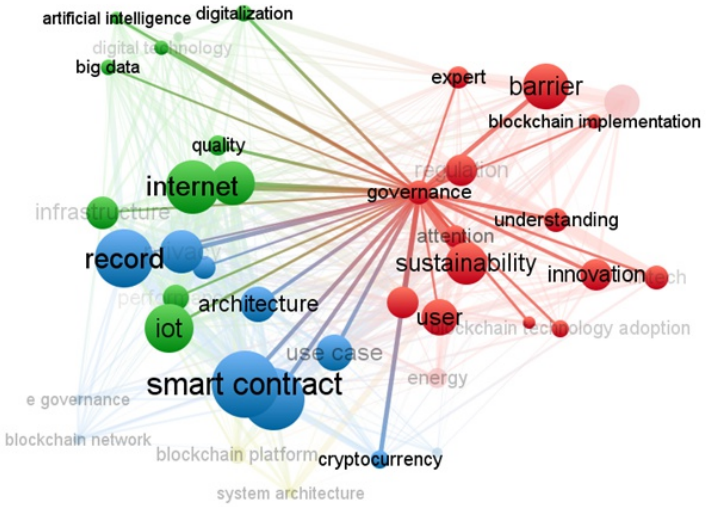

Figure 8. Term co-occurrence map
Source: Output generated from VOSviewer

Figure 6 map reflects that India, the United States, and the United Kingdom are the most central collaboration countries, as they are presented by the larger nodes. On the other hand, Greece and South Africa are the least central countries for co-authorship. The increased thickness of the links between the United Kingdom and Pakistan indicates that these two countries collaborated most.

Figure 7 represents a map based on bibliographic information. This map shows all the keywords of the studied publications (considered as the unit of analysis) based on a co-occurrence analysis (considered as the type of analysis) in the area of blockchain implementation challenges. To grasp the whole picture, the authors adopted the full counting technique.

This map reflects blockchain as a keyword that has the highest co-occurrence. Other keywords, such as smart contract, Internet of Things (IoT), technology adoption, data analytics, human, digital storage, traceability, developing countries, challenges, privacy, and information technology, are depicted in this map as a network of identified terms.

Figure 8 depicts the term co-occurrence map based on the selected publications' titles and abstracts. This map is based on text data and information.

According to Figure 8, smart contract, record keeping, internet, sustainability, IoT, architecture, use case, governance, user, innovation, barrier, quality, energy, and big data were identified as dominant terms associated with blockchain implementation challenges in the network. Although system architecture, blockchain network, blockchain platform, and e-governance are connected in the network, they are not identified as dominant terms.

4. Discussion and Conclusions

This study was conducted to identify the challenges of adopting blockchain technology in developing countries. The result of this research shows that the challenges of adopting blockchain in developing countries fall into four categories, that is, technological, governance, organizational and environmental, and knowledge. To discover this, we reviewed the existing literature related to blockchain adoption and implementation challenges in developing countries.

Despite the identified challenges, we believe that blockchain-based solutions can still benefit a large proportion of people in the developing world. In this age of technological precision, blockchain can play a significant role in achieving sustainable development goals and economic growth in developing countries. Although blockchain can enhance the performance and efficiency of operations, especially in financial sectors, the adoption rate of this technology is still very low in developing countries due to multiple factors. Several challenges slow down the process of blockchain technology adoption and implementation.

From the bibliometric analysis, we found that from 2016 to 2021 numerous studies were conducted on blockchain implementation and challenges. India had more publications compared to other developing countries during this period. Most works regarding blockchain challenges were found in the form of articles. Furthermore, blockchain adoption challenges were studied more in the business and management discipline compared to other disciplines.

Among the four obstacles, the most significant are technological challenges (Kouhizadeh et al., 2021). Technological challenges of blockchain systems involve several issues, such as privacy, cryptocurrency security, data storage, scalability, interoperability, complexity, IoT overhead, timestamp dependability, power consumption, and software vulnerabilities (Yli-Huumo et al., 2016; Mense & Flatscher, 2018). We found that digital storage, privacy, and IoT are found to co-occur with the term "blockchain". Furthermore, IoT and cryptocurrency terms are dominantly associated with blockchain challenges, which is consistent across the technological challenges category.

The lack of governance hinders the successful implementation of blockchain systems. Therefore, to obviate the failure of blockchain implementation, stakeholders need to develop effective governance mechanisms (Yadav et al., 2020). We found that various countries are not diligent in building effective regulations, new rules, and laws for blockchain implementation (Hans et al., 2017; Hye et al., 2017). In addition, smart contracts are a daunting governance challenge. Furthermore, the government has the proclivity not to award and incentivize successful blockchain implementation, the reasons for which could be further explored.

The research showed that stakeholders tend to pay scant attention to the organizational and environmental challenges during blockchain implementation. A lack of organizational readiness, integration, trust, and infrastructure problems accentuate the organizational challenges to implementing blockchain (Toufaily et al., 2021; Kouhizadeh et al., 2021). Employees' resistance to accepting a new technology, such as blockchain, in replacing an old system is another challenge (Kouhizadeh et al., 2021). Likewise, the changing organizational culture at a company is not a trifling matter, which behavioral research has shown as co-occurring with blockchain implementation challenges.

The lack of insight people have about blockchain technology creates barriers to successful implementation (Yadav et al., 2020). Additionally, the lack of skilled IT professionals, training and orientation, along with inadequate top management support in developing countries intensifies the knowledge challenges (Sharma & Joshi, 2021; Sanka et al., 2021). We found that the term "expert" is considered as dominant in association with blockchain implementation challenges, suggesting that more expertise is needed. In many developing countries, blockchain is not yet well established due to the knowledge gap among stakeholders and policymakers, although this may also be true globally. Adequate knowledge workers with translatable expertise will be required in developing countries to ensure stable and successful local implementations of blockchain technology.

Furthermore, the current state of Central Bank Digital Currencies (CBDC) reveals that many developing and rising countries throughout the world are at various stages of blockchain and cryptocurrency adoption. The importance of CBDCs has been emphasized as a result of this, even while at various stages of experimentation and new usage. In addition, cross-border initiatives between developing and developed nations might be undertaken to promote global connections toward solving various obstacles.

5. Limitations and Future Research

The results of this article will assist policymakers in developing countries to better recognize the major challenges of adopting blockchain systems. By addressing those challenges sagaciously, developing countries will be able to maximize the benefits of blockchain innovation. Government, policymakers, and top management should ensure proper training and orientation to develop skilled workers for blockchain technology. Furthermore, a clear and transparent set of regulatory guidelines that fall under the governance category will also be required to initiate and implement blockchain systems on a wider scale for developing economies.

Effective coordination, collaboration, and communication among top management, professionals, business people, and IT experts, together with regulators and policymakers, can improve a nation or region's process of blockchain adoption and successful implementation. Up to this point, however, research on this topic has not focused on any specific developing country. Hence, further research may be conducted on individual developing countries to augment the results. Moreover, future researchers can empirically investigate and explore further by considering the four challenges identified here, that is, technological, governance, organizational and environmental, and knowledge.

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