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Using Blockchain Technology to Improve the Integrity and Transparency of Procurement Processes between SMMEs and Government: A Systematic Literature Review

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Abstract
Fourth industrial revolution (4IR) technologies, such as blockchain, have the potential to improve public and private sector procurement processes. However, governments, including the South African (SA) government, have failed to recognize the significance of blockchain technology for several reasons, including corruption. The PRISMA methodology was used in this study to conduct a systematic literature review of the use of blockchain technology to improve the integrity and transparency of procurement processes between small-, medium- and micro-enterprises (SMMEs) and the SA government. The Scopus database was used to search for literature, and the final analysis included 12 articles that met the eligibility criteria. The 12 articles were analyzed using thematic analysis and the results demonstrated that 10 of the articles applied to this study as they discussed the use of blockchain in relation to integrity and transparency. The remaining two articles did not emphasize the use of blockchain technology in enhancing the integrity and transparency of the procurement processes. The common factors in the 10 articles that were found to impact integrity and transparency were as follows: handling of contracts, risks involved, security of the data, approaches used, management of the procurement process, transaction processing, the chain of events in the procurement process, access to critical data, the application process for securing contracts, quality of products, costs, and types of contracts. We believe that once blockchain technology has been implemented, SMMEs and the public will trust and be confident in the procurement processes as corruption would have been eliminated and tenders would be awarded fairly.

Keywords: *Fourth Industrial Revolution, 4IR, Blockchain Technology, SMMEs, PRISMA, Corruption, Public Procurement*

JEL Classifications: *H57, L14*

1. Introduction

Corruption and a lack of transparency have ravaged some governments and economies [1]. Corruption is considered one of the most significant threats to the economic security of any country or organization [2]. Several anti-corruption measures such as legislating, adopting rules and regulations making certain behavior illegal, and increasing punishments for illegal conduct [3] have been implemented to reduce or combat corruption. While these methods have reduced corruption to a certain extent, perpetrators often find ways to remain corrupt and use various strategies to either escape or postpone detection and punishment indefinitely. Therefore, much effort is needed to eradicate corruption. The impact of corruption on developing economies is devastating because these economies are already struggling [4]–[6]. South Africa (SA) is one such emerging and developing economy. According to Transparency International's 2021 Corruption Perception Index (CPI) report, SA is engulfed in corruption, with a CPI score of 44/100 and is ranked 70 out of 180 [7]. The CPI ranks 180 countries and territories worldwide based on the perceived levels of public sector corruption. The results are given on a scale of 0 (highly corrupt) to 100 (very clean).

Small, medium, and micro enterprises (SMMEs) are considered important to both developed and emerging economies [8]. In SA, SMMEs are important for economic growth and development, contributing approximately 36% to the total gross domestic product (GDP) [9].

They are considered fundamental to addressing issues such as economic growth, job creation, and poverty alleviation [10]. SMMEs have been credited with driving economic growth and development in developed countries around the world [11]. Governments frequently engage SMMEs to provide services through procurement processes. However, because of the high levels of corruption within governments, most SMMEs have failed to benefit from this trade relationship with governments [12], while some have benefited owing to the corruption [12]. Given the critical role that SMMEs and public procurement play in growing a country's economy, there is a need to fully support their transactional activities and procurement

processes. Thus, several attempts and proposals have been made by researchers and governments regarding methods for eliminating corruption during procurement processes between governments and private service providers such as SMMEs [3], [13]. Attempts and proposals include the introduction of compliance measurements, regulatory frameworks, and severe punishments, among others. These attempts and proposals have reduced corruption to some extent, but despite concerted efforts to implement a broad range of anti-corruption measures, the problem of malfeasance persists [3]. Currently, there is no effective evidence-based prevention method to combat and stop corruption [13] when tenders are awarded to SMMEs.

This review article aims to explore the use of blockchain technology to improve the integrity and transparency of procurement processes between SMMEs and governments with a focus on SA. We focus on SA because its government departments continue to rely on a manual paper-based procurement system with few electronic features [14]. This has allowed for a high level of human interference, contributing to corruption, favoritism, and inefficiency, demonstrating the country's readiness to fully implement e-procurement in its public sector [14]. Although the SA government has implemented numerous policy frameworks and systems to ensure fair, equitable, transparent, and cost-effective public procurement processes, the processes remain vulnerable to mismanagement and irregularities [15]. According to [16], poor procurement processes result in the appointment of incompetent contractors, and practitioners engage in unethical behavior, such as bribery, out of desperation for work [16]. Given the challenges that SA's public procurement processes face, the use of blockchain to manage these processes is likely to improve them by eliminating corruption and increasing efficiency.

The article is structured as follows: Section 2 introduces and describes blockchain technology; Section 3 presents the methodology followed, namely, a systematic literature review (SLR) through a literature search on the use of blockchain technology by governments and SMMEs to meet the aim of the study, and the results of the search; Section 4 presents the results of the thematic analysis conducted on the research literature identified; Section 5 comprises the discussion of the findings and their implications for theory and practice; and Section 6 presents the conclusions drawn and future research prospects.

2. Blockchain technology

Blockchain is a technology that uses a decentralized structure, distributed notes and storage mechanisms, a consensus algorithm, smart contracting, and asymmetric encryption to ensure network security, transparency, and visibility [17]. It is considered a collection of distributed databases that contain all public transactions, records, and digital events, which are shared among the participants [18]. Blockchain technology is a distributed ledger network in which nodes communicate with one another for trading data and transactions [19]. A blockchain is a distributed and decentralized technology comprising time-stamped blocks linked by a cryptographic hash. It has gained widespread acceptance as a solution to the underlying trust and security issues in information transparency and the prevention of tampering with data [20]. Blockchain applications are not only one technique but include cryptography, mathematics, algorithms, and economic models. They incorporate peer-to-peer networks and use distributed consensus algorithms to solve conventional distributed database synchronization problems [19].

Blockchain technology ensures security and transparency through the following processes:

1. The use of digitally distributed databases in which blocks are linked to one another in a linear fashion that cannot be changed.
2. A Merkle tree, which is a data structure that is used to encode blockchain data more efficiently and securely, is saved in the block and is used to validate the transaction. This determines whether a transaction is fraudulent or not.
3. Only when all participants in the supply chain agree on the transaction will a new block of information be added to the blockchain. This ensures that only valid transactions are recorded in the blockchain.
4. When a block is added to the blockchain, it can no longer be tampered with, and the transaction data are permanently recorded. This ensures the preservation of historical records.

If a government department adopts blockchain for contract awarding, we anticipate the process to be secure and efficient. For example, a contract will be stored on distributed databases to avoid it being tampered with because once it has been added, it cannot be altered.

Blockchain offers the following advantages: reliability, efficiency, fault tolerance, scalability, transparency, and traceability [18], [19], [21]. Every transaction is verified before being saved and once saved it cannot be reversed [18]. Such characteristics make transactions between SMMEs and governments transparent and secure. The ability of blockchain technology to record transactions on distributed ledgers opens up new avenues for governments to improve transparency, prevent fraud, and foster trust in the public sector [22]. Each transaction is validated using multiple computers. These systems, which are used to validate blockchain transactions, create a peer-to-peer network. They collaborate to ensure that any transaction is legitimate prior to it being added to the blockchain and thus prevent invalid blocks from being added to the chain [18]. Therefore, blockchain technology assists in the development of trust mechanisms for resolving transparency and security issues, as no single party in the supply chain can alter existing information [20].

In summary, blockchain technology offers the following advantages: information security, technological advantages, improvement of supply chain collaboration and trust, reduction of economic loss and product waste, and sustainable and transparent traceability management. With such advantages, top government officials will be less concerned about security and unethical practices within government because technologies such as blockchain prevent such practices. Therefore, governments should consider implementing such a technology to address issues of integrity and lack of transparency in public procurement processes.

This study examined published academic research on blockchain technology used by governments and SMMEs. The subsequent section presents the methodology followed to conduct a SLR through a literature search to better understand what has currently been done to implement blockchain technology in governments.

3. Methodology and results of the literature search

In terms of the methodology followed, the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework [23] was used to explain the overall article selection and rejection process for the literature review on the use of blockchain technology to improve transparency and integrity in procurement processes. The PRISMA framework is illustrated in Figure 1.

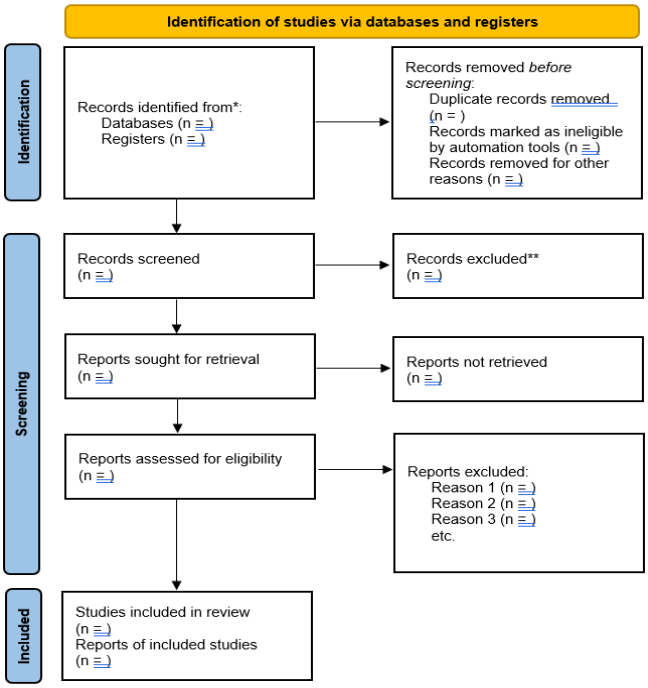

Figure 1. The PRISMA framework [23].

The PRISMA framework consists of three stages: identification, screening, and inclusion. The identification stage identifies the keywords that will be used to conduct the literature search and the source/s where the search will occur. The second stage, screening, details the criteria that will be used to select the best literature from the bulk search. The third stage, referred to as included, reports on the exact final literature that is included in the study after exclusion.

3.1 Identification stage

Following the PRISMA framework, during the identification stage, we decided to use the Scopus database as the source for the literature search. The Scopus database was chosen because the researchers have access to the database via their institution (university). During the identification stage, the following keywords and their various combinations were considered for the search: blockchain, blockchain technology, public procurement, corruption, transparency, procurement processes, SMMEs, SMEs, and governments. An initial search was conducted using the keywords "blockchain" and "block chain" to provide an idea of the overall view of publications that included these terms. A total of 28,581 articles were obtained. The identification stage requires that the output is screened before the actual screening stage. To achieve this, the papers published before 2013 were removed because according to our assessment, there was a sharp rise in the number of studies on blockchain technology from 2016. Furthermore, blockchain technology is a Fourth Industrial Revolution (4IR) technology that came to prominence in 2016 [24]. Finally, in terms of this preliminary screening, articles published in 2022 were removed because we were interested in full-year data only. Figure 2 illustrates the number of papers on blockchain published globally between 2016 and 2021.

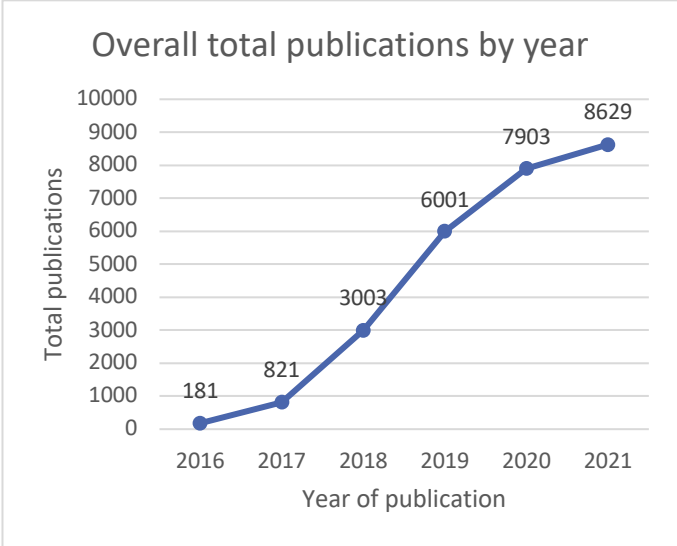

Figure 2. Papers published globally on blockchain.

After performing the preliminary cleaning, we were left with 26,538 papers published between 2016 and 2021. The number of papers published per year in the context of SA only are reflected in Figure 3.

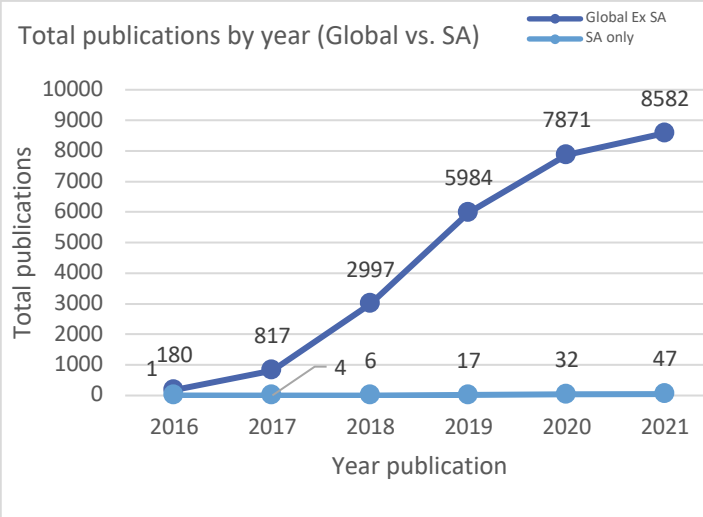

Figure 3. Papers published on blockchain globally vs. SA.

Figure 3 distinctly shows that global research on blockchain technology has risen steadily, whereas in SA the rate of increase has been slow. To date, 26,431 papers have been published globally between 2016 and 2021, while only 107 have been published in the context of SA during the same period. The latter comprises 0.405% of all global publications. This is a low publication rate when compared with the global figure, indicating the need for research on blockchain in the context of SA to be increased significantly.

3.2 Screening stage

According to PRISMA, screening is the second stage and, in this stage, the final query in Table 1 was used. The query is explained as follows: papers on blockchain, conducted in the context of SA, published between 2016 and 2021, open access papers only, and articles written in English only. The output of the query was 12 articles.

Table 1. Search string and results obtained

Query Search String	Total articles included after applying the full search string
TITLE-ABS-KEY ((blockchain OR "block chain") AND (procurement OR government OR corruption OR "supply chain")) AND (LIMIT-TO (OA,"all")) AND (LIMIT-TO (AFFILCOUNTRY,"South Africa")) AND (LIMIT-TO (PUBYEAR,2021) OR LIMIT-TO (PUBYEAR,2020) OR LIMIT-TO (PUBYEAR,2019) OR LIMIT-TO (PUBYEAR,2018) OR LIMIT-TO (PUBYEAR,2017) OR LIMIT-TO (PUBYEAR,2016)) AND (LIMIT-TO (LANGUAGE, "English"))	12

3.3 Included stage

Following the screening stage, the included stage was performed. In this stage, the 12 articles obtained during the screening stage by executing the search query were analyzed. These 12 articles were exported to a CSV file format for further cleaning and analysis in Microsoft Excel. In Excel, we looked for duplicate articles and articles that are in the "In Press" publication stage. None of the papers were deleted as they did not meet the criteria for deletion. Further analysis in Excel was conducted using the total number of citations. Table 2 shows the details of the citation analysis for each of the 12 articles.

Table 2. Citation analysis by article title

Article	Author(s)	Title	Year of publication	Total number of citations
D3	Tandon, A., Kaur, P., Mäntymäki, M. and Dhir, A., 2021.	Blockchain applications in management: A bibliometric analysis and literature review	2021	21
D4	Grover, P., Kar, A.K. and Vigneswara Ilavarasan, P., 2018	Blockchain for businesses: A systematic literature review	2018	16
D2	Daramola, O. and Thebus, D., 2020.	Architecture-centric evaluation of blockchain-based smart contract E-voting for national elections	2022	8
D1	Danielle, N.E.L., 2020.	Allocation of risk in public-private partnerships in information and communications technology	2020	6
D9	Mageto, J. and Luke, R., 2020.	Skills frameworks: A focus on supply chains	2020	5
D6	Dietrich, F., Ge, Y., Turgut, A., Louw, L. and Palm, D., 2021.	Review and analysis of blockchain projects in supply chain management	2021	3
D10	Dietrich, F., Palm, D. and Louw, L.,	Smart contract-based framework to	2020	1

	2020.	increase transparency of manufacturing networks		
D5	Senou, R.B., Dégila, J., Adjobo, E.C. and Djossou, A.P.M., 2019.	Blockchain for child labour decrease in cocoa production in West and Central Africa	2019	1
D7	Gambo, N. and Musonda, I., 2021.	Effect of the Fourth Industrial Revolution on road transport asset management practice in Nigeria	2021	1
D8	Alsaed, Z., Khweiled, R., Hamad, M., Daraghmi, E., Cheikhrouhou, O., Alhakami, W. and Hamam, H., 2021.	Role of blockchain technology in combating COVID-19 crisis	2021	0
D12	Mulaji, S.S. and Roodt, S.S., 2021.	The practicality of adopting blockchain-based distributed identity management in organisations: A meta-synthesis	2021	0
D11	Smidt, H.J. and Jokonya, O., 2021.	The challenge of privacy and security when using technology to track people in times of COVID-19 pandemic	2021	0

It is good practice to eliminate studies that have never been cited. However, because the number of articles that satisfied our search criteria was low, it was decided to not remove articles that had not been cited. The next section provides the results of the thematic analysis of the 12 articles.

4. Thematic analysis results

The 12 articles were analyzed using the thematic analysis method. The thematic analysis process adopted by the study followed the guidelines of [25], which outline the five key steps for qualitative thematic data analysis: text familiarization, coding of the data, revision of the codes, creation of the themes, and revision of the final themes. These steps were followed to report on the key themes derived from the 12 articles in the inclusion criteria for the SLR process.

4.1 Text familiarization

In the text familiarization step, the articles were read and the persistent keywords that emerged when describing the effect of blockchain on the integrity and transparency of the procurement processes in government organizations were identified. Figure 4 shows the word cloud derived using the Atlas.ti analysis software to present the persistent keywords that emerged from the 12 articles.

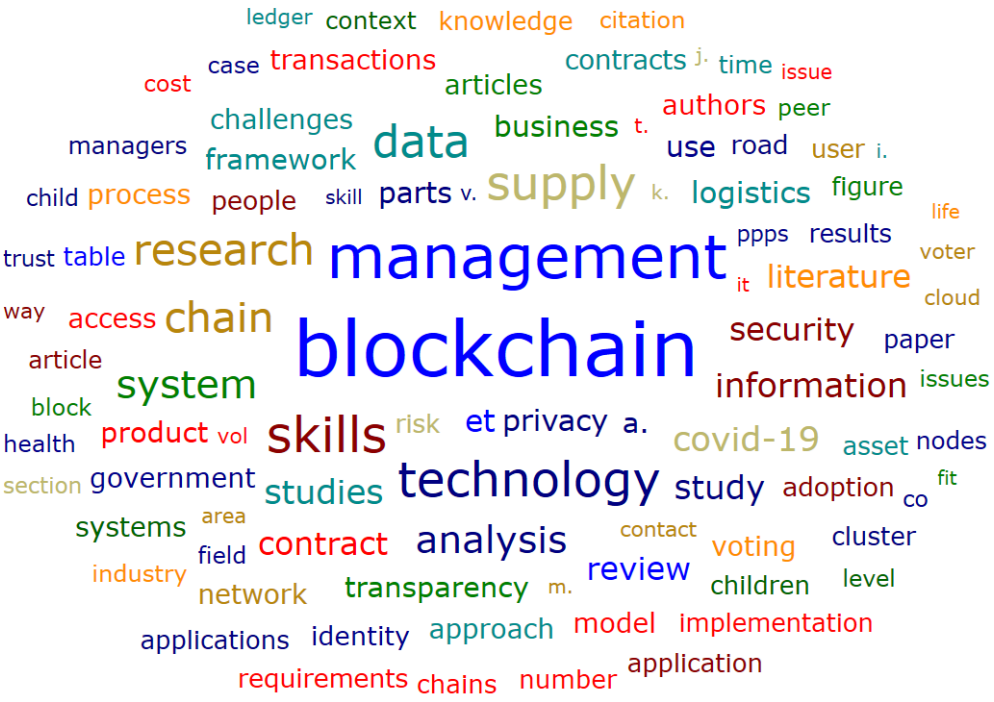

Figure 4. Keywords used to explain the use of blockchain to improve the integrity and transparency of supply chain processes.

4.2. Coding of the data

The keywords identified in the articles described the main objective of the studies. These words were captured and described as the main codes during the coding process of the thematic analysis and are defined in Table 3.

4.3 Revision of the codes

Each of the 12 identified articles highlights some perspectives using the coded keywords to address the aim of this study. Table 4 shows the categories of the articles and their consistency in using the keywords to describe how blockchain enhances the integrity and transparency of government procurement processes.

The analysis of the literature indicates that the codes were not consistently used in all the articles. For example, Election was used in only two articles (D2 and D4), Supply chain was used in three articles (D9, D10, and D12), Voting was used in four articles (D2, D4, D5, and D10), and Skill used in five articles (D1, D7, D8, D9, and D12). We cannot, therefore, conclude that Election, Supply chain, Voting, and Skill are significant in describing the effect of blockchain on the integrity and transparency of government procurement processes.

4.4 Creation of the themes

The codes were analyzed in terms of the two key themes of the study, namely, integrity and transparency. Integrity refers to upholding ethical standards and the moral values of honesty, professionalism, and righteousness. It is a cornerstone for ensuring fairness, non-discrimination, and compliance in the public procurement process. Transparency is a core principle in public procurement. An open and transparent procurement process improves competition, increases efficiency, and reduces the threat of unfairness or corruption. The codes were grouped according to the key themes and are discussed next.

4.4.1 Integrity

The first group of codes dealt with describing how blockchain improves the integrity of the procurement process. Issues such as handling of contracts, risks involved, security of the data, approaches used, and management of the procurement process emerged as the main issues that influence the integrity of the procurement process. Figure 5 shows the codes linked to integrity.

Table 3. Main codes from the 12 articles

Code	Comment
Transaction	An instance of buying and selling a commodity between the government and SMMEs.
Contract	A written agreement enforceable by law, which binds SMMEs and the government.
Supply chain	The network of all the individuals, organizations, resources, activities, and technology involved in the creation and sale of a product. A supply chain encompasses everything from the delivery of source materials from the supplier to the manufacturer through to the end user, which is the government.
Cost	A sum of money for a product before it can be acquired.
Voting	Used to express a wish to follow a particular course of action.
Product	An article or substance that is manufactured or refined for sale.
Management	The process of dealing with or controlling things or people.
Approach	A way of dealing with a situation or problem.
Application	The action of putting something into operation.
Election	A formal and organized choice by a vote of a person for a political office or other position.
Access	The means or opportunity to approach or enter a place.
Chain	A sequence of items of the same type forming a line.
Skill	The ability to do something well; expertise.
Security	The state of being free from danger or threat.
Risk	The term "business risk" refers to the possibility of a commercial business making inadequate profits due to uncertainties, for example, changes in tastes, changing preferences of consumers, strikes, increased competition, changes in government policy, obsolescence etc.

Table 4. Article categories and their consistency in the use of keywords

ARTICLE	Codes														
	Transaction	Contract	Supply chain	Cost	Voting	Product	Management	Approach	Application	Election	Access	Chain	Skill	Security	Risk
D1	X	X		X		X	X	X	X		X	X	X	X	X
D2	X	X		X	X		X	X	X	X	X	X		X	X
D3	X	X		X		X	X	X	X		X	X		X	X
D4	X	X		X	X	X	X		X	X	X	X		X	
D5	X	X			X	X	X	X	X		X	X		X	
D6	X	X				X	X	X	X		X	X		X	X
D7	X			X		X	X	X	X		X		X		
D8	X	X		X			X	X	X		X	X	X	X	X
D9	X	X	X	X		X	X	X	X		X	X	X	X	X
D10	X	X	X		X	X	X	X	X		X	X		X	X
D11						X	X	X	X		X			X	X
D12	X	X	X	X		X	X	X	X		X	X	X	X	X

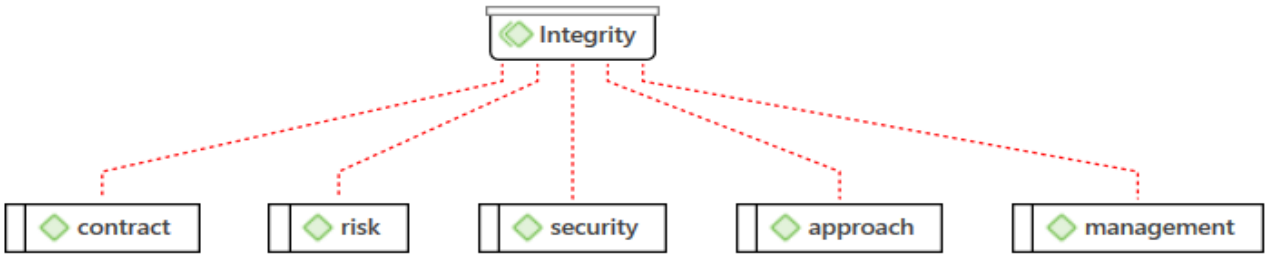

Figure 5. Codes linked to integrity.

The following texts from the identified articles highlight how blockchain technology enhances the concept of integrity of procurement processes in line with the identified codes:

"It provides a number of benefits. First, it reduces economic costs, time, and complexities in executing information exchange and administrative functions. Second, it reduces fraud, bureaucracy, and corruption via smart contracts. Furthermore, it offers increased automation, transparency, efficiency, integrity, security, and auditability. Finally, it contributes to increased public trust owing to effective record keeping and information availability." [D1:2 pp 9-11]

"The system used digital signatures to provide message authentication, cryptographic hashes to create hash chains, and provided resistance to coercion, the integrity of vote cast, voter authentication, voter confidentiality, and other quality attributes." [D2:27 p 5]

"Blockchain-based e-voting architecture can potentially address most of the challenges of traditional voting systems and conventional e-voting. These include issues of voter's authentication, verification of votes, protection of voter's privacy, the security of votes, and integrity of election results." [D2:42 p 1]

"In terms of business- or management-related issues, smart contracts are a critical element of blockchain architecture with significant implications. These contracts are employed to create and execute contractual transactions among inter-organisational parties in a trustless manner and subject to pre-determined rules or criteria." [D3:6 p 2]

"…data integrity enhances data accessibility and provides data compatibility, improves management practice for road transport assets, and components in life-cycle cost analyses enable the removal of outdated systems and unproductive assets. This considers both system and project optimisation report useful information periodically, ideally in real-time, facilitate iterative analysis processes that can be performed regularly." [D7:2 pp 4-5]

"Blockchain gives high efficiency to the e-government systems by decreasing the delays and reducing the service operations costs. In addition, it gives access to the automation feature with blockchain and the shared databases… If any counterfeiting endeavour happens, it will automatically be detected. When it comes to security, blockchain has a lot of ameliorating for data confidentiality and consistency. Data integrity and immutability are some of the benefits that are provided to e-Governments involving blockchain technology." [D8:37 p 11]

"Issues related to data integrity are most acute, as data tampering can have a huge impact on mission-critical services that depend upon reliable data… One of the fundamental steps in enforcing data integrity is safeguarding the digital system (such as a network, a website, a database, and an application) using the data through effective identification and authentication management. In this way, only authorised people can access the system and potentially use the data." [D12:13 p 1]

4.4.2 Transparency

The second group of codes dealt with describing how blockchain improved the transparency of the procurement process. Issues such as transaction processing, the chain of events in the procurement process, access to critical data, the application process for securing contracts, the quality of products, costs, and types of contracts emerged as the main ones that influence the transparency of the procurement process. Figure 6 shows the codes linked to transparency.

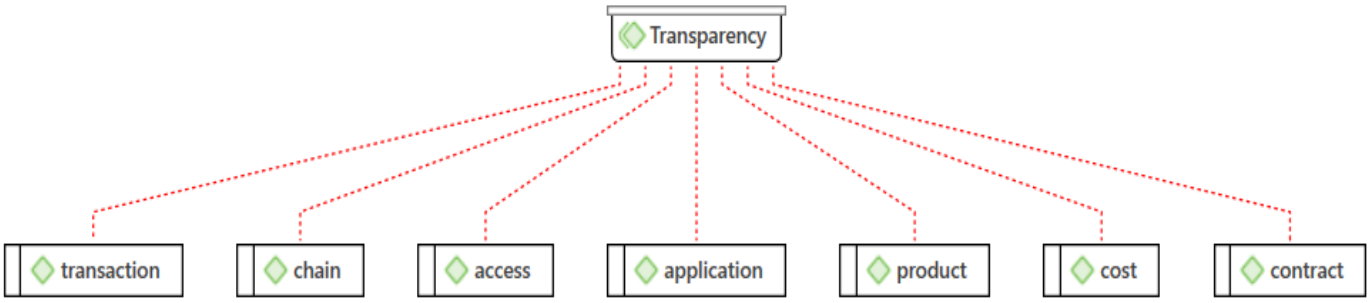

Figure 6. Codes linked to transparency.

The following text highlights the sentiments shared by the identified articles on how blockchain technology enhances the concept of transparency of procurement processes in line with the identified codes.

"Smart contracts can provide the public sector with the ability to ensure certainty and transparency in transactional processes. Over 46 countries across the globe have launched 200 blockchain initiatives. Smart contracts reduce transaction time and costs as the contracts execute themselves by integrating the Internet of Things (IoT) into the blockchain. Contractual fraud is easily detected, thus enhancing the security of contracts." [D1:1 pp 11-12]

"A smart contract is an executable code that enables untrusted parties in a blockchain to directly interact and perform transactions with one another without needing a centralised authority." [D2:2 p 4]

"The decentralised nature of blockchain, and its attributes of anonymity, and transparency make it a suitable approach to handle many of the difficulties associated with conventional e-voting systems." [D2:82 p 1]

"In terms of business- or management-related issues, smart contracts are a critical element of blockchain architecture with significant implications. These contracts are employed to create and execute contractual transactions among inter-organisational parties in a trustless manner and subject to pre-determined rules or criteria." [D3:6 p 2]

"Indeed, blockchain is a technology that allows a decentralised environment to be created for the executions of transactions without any means of data alteration." [D5:1 p 1]

"…the increase of supply chain transparency is identified as the main objective of recent blockchain projects in supply chain management. Therefore, most of the recent publications deal with simple supply chains and products. The few approaches dealing with complex parts only map sub-areas of supply chains." [D6:13 p 1]

"Implementation of smart contracts for converting all paper-based contracts that do not have a reliable system that can handle those contracts was delayed during the lockdown worldwide. The paper-based system is not efficient anymore. As such, governments and financial organisations have to do something to keep the businesses running." [D8:10 p 6]

"One of the best options to consider managing the supply chain is blockchain. It can connect all the stakeholders through one decentralised

universal network, and securely shows the data of the silos." [D8:39 p 11]

"…with the continued need for SC transparency and sustained record keeping the emergence of blockchain technologies is likely to equip SC managers of the future with skills and knowledge that will create high SC visibility... The managers need not be equipped with the technical skills but should understand the applications and capabilities of the blockchain technologies to help design SCs that leverage the best technologies." [D9:92 p 13]

"The code of each smart contract is stored on the blockchain and can be identified by a unique address. Users can interact with a smart contract in present cryptocurrencies by sending transactions to the contract address. When a user causes a valid new transaction with a smart contract address as recipient, all participants on the mining network execute the contract's code with the current state of the blockchain and the transaction's content as inputs. The network then agrees on the output and the next stage of the contract by participating in a consensus protocol." [D10:2 p 2]

"By formulating logical requirements to create the identification numbers in smart contracts, the processes and their relations in the physical world can be mapped virtually on the blockchain. Thus, each asset receives a virtual identity. A complete integration of this approach in the whole manufacturing supply chain ensures the secure traceability, authenticity, and auditability of each assembled product and its components. Therefore, transparency can be increased for all stakeholders and vulnerabilities that allow counterfeit parts to enter the supply chain can be reduced. The implementation of blockchain on a public platform provides full transparency for the customer, while the implementation on a private blockchain network only provides a restricted transparency." [D10:22 p 5]

4.5 Finalization of the themes

The two main themes of the study are integrity and transparency. The study identified 12 articles in the research literature that explain how blockchain technology enhances the integrity and transparency of the procurement processes of government organizations. A document network was created from the identified articles to categorize the articles according to their emphasis on integrity and transparency. This is depicted in Figures 7 and 8.

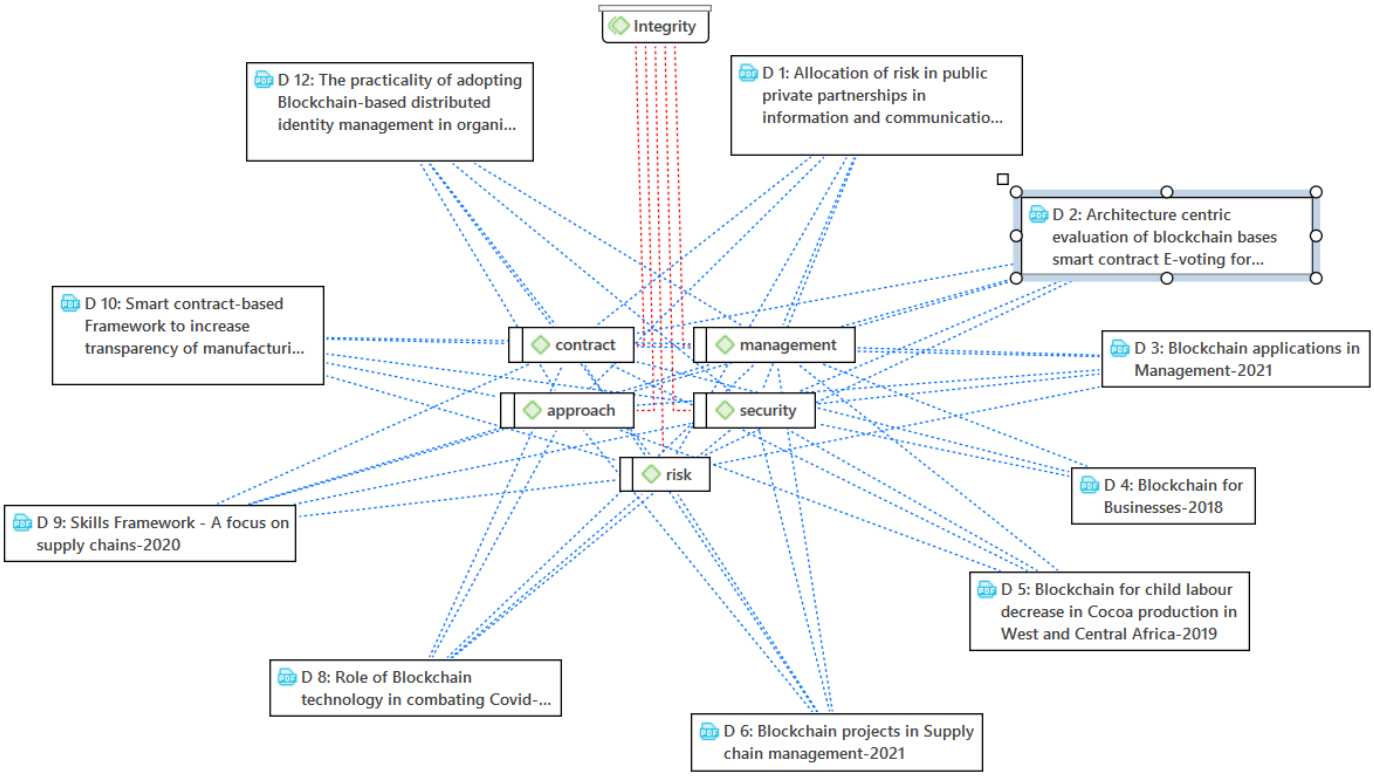

Figure 7. Articles explaining how blockchain enhances the integrity of the procurement processes.

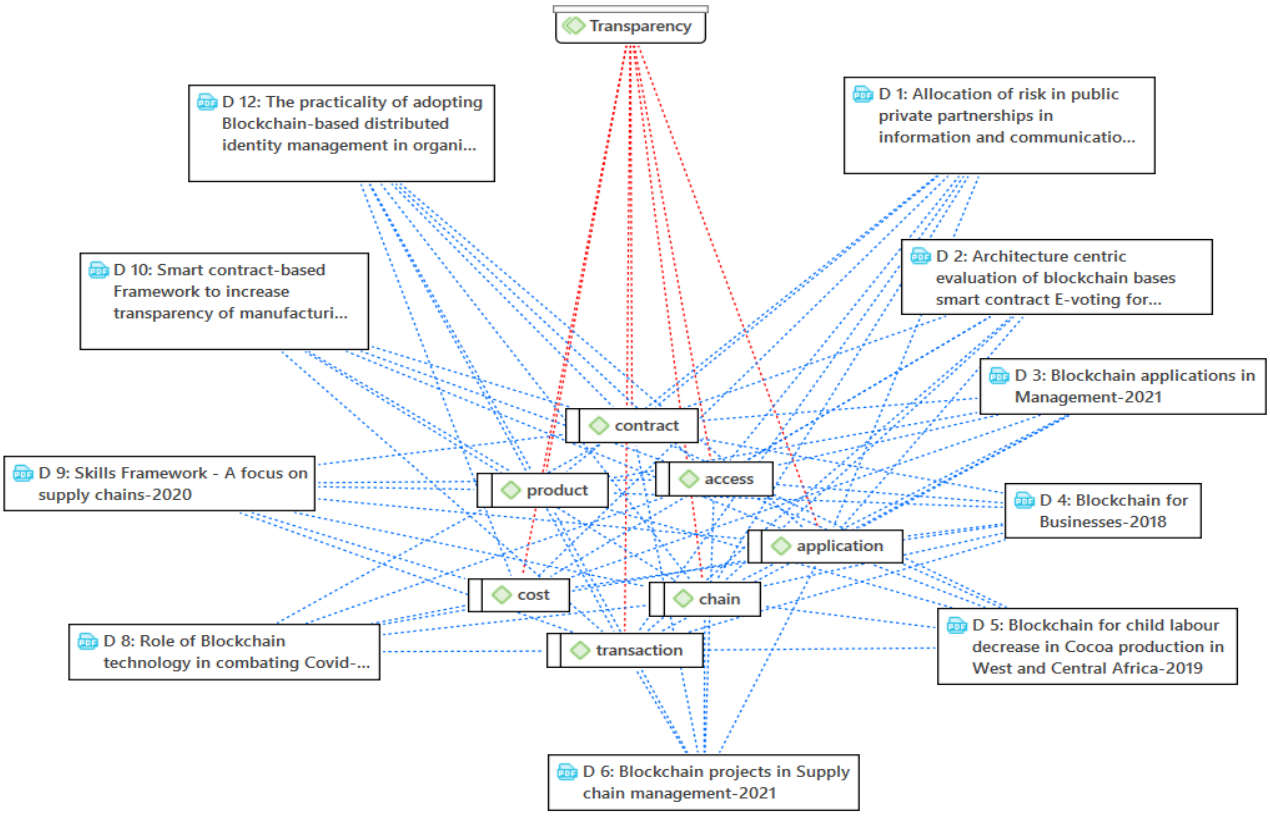

Figure 8. Articles explaining how blockchain enhances the transparency of the procurement processes.

From the analysis of the documents above, it is evident that articles D7 and D11 did not emphasize addressing the use of blockchain technology with respect to enhancing the integrity and transparency of the procurement processes. Although the articles made the inclusion criteria for the SLR, they were not significant in terms of the effect of blockchain technology on government procurement processes.

5. Discussion

The results show that 10 of the 12 articles that satisfied the PRISMA criteria of selection were conclusive in answering the aim of the study. The 10 articles addressed issues of transparency and integrity when using blockchain technology. According to the results, the following are the main factors that drive the integrity of procurement processes when using blockchain: handling of contracts, risks involved, security of the data, approaches used, and management of the procurement process. The following are the main factors that drive transparency: transaction processing, the chain of events in the procurement process, access to critical data, the application process for securing contracts, the quality of products, costs, and the types of contracts. This finding implies that when the SA government intends to implement blockchain technology in their procurement processes, the abovementioned are the factors to consider in order to ensure that the system addresses these concerns and fosters integrity and transparency.

To improve the integrity of the procurement processes or the transactions between the SA government and SMMEs, the former must implement blockchain technology. Blockchain technology will improve integrity through the ways in which it handles contracts (smart contracts), secures data, and manages the procurement processes. According to [25] blockchain technology reduces fraud, bureaucracy, and corruption via smart contracts. Furthermore, it offers increased automation, transparency, efficiency, integrity, security, and auditability. Finally, it contributes to increased public trust owing to effective record keeping and information availability. Once the SA government has implemented blockchain technology, the citizens and SMMEs should be more trustful of the government. This should encourage them to transact with the government as they are guaranteed integrity and the award of tenders that are fair and fraud-free.

Data in traditional systems suffer from various challenges such as the lack of security, integrity, reliability, and convenience because they do not have a consistent structure for data security and reliable policies [26]. Therefore, in their study, the authors [26] propose a blockchain-based integrity and reliable information management system to address these challenges. The results of their study demonstrate the effectiveness and robustness of their proposed blockchain-based integrity and reliable information management system. This is in line with our findings that the integrity of procurement processes will be improved through the implementation of blockchain-based

procurement systems because they will foster security, integrity, reliability, and convenience of the data (such as smart contracts) that are going to be stored in the blockchain system. Blockchain technology has also been applied to cloud computing systems to improve data security and trust (integrity) in computing or processing [27], [28]. While several models and solutions exclusive of blockchain have been proposed such as data integrity tests and secure multi-party calculations [27], they have not been successful in assuring users of data integrity and security. Therefore, the introduction of blockchain-based data integrity mechanisms has seen significant strides being made toward data integrity and security.

The use of blockchain will not allow users to tamper with contracts or the data saved into the blockchain [29]. According to [29], blockchain is a technology that allows a decentralized environment to be created for the execution of transactions without any means of data alteration. Furthermore, transparency will be emphasized using blockchain technology in that the way the technology handles and processes transactions, eliminates altering the already saved records. According to [30], smart contracts can provide the public sector with the ability to ensure certainty and transparency in transactional processes. Therefore, when all contracts between the SA government and the SMMEs are managed and processed via blockchain technology, transparency and integrity will be enforced.

6. Limitations and future work

This study, like any other, has limitations. First, this study is only theoretical, implying that empirical validation of the factors explored in the context of the SA public sector is required. Second, this review demonstrated a low publication rate of blockchain studies relative to global figures, indicating the need for significantly increased blockchain research in the context of SA.

7. Conclusion

Corruption has caused several economies to crumble and struggle owing to the devastating effect it has on the communities. This study conducted a SLR to theoretically investigate the use of blockchain technology to improve the integrity and transparency of procurement processes between SMMEs and the SA government. The Scopus database was used to search for relevant research literature and, following the PRISMA framework, 12 articles that met the eligibility criteria were identified. The 12 articles were analyzed using thematic analysis and the results demonstrated that 10 of the articles applied to this study as they discussed the use of blockchain in relation to integrity and transparency. The remaining two articles did not emphasize the use of blockchain technology in enhancing the integrity and transparency of the procurement processes. The common factors in the 10 articles that were found to impact integrity and transparency were as follows: handling of contracts, risks involved, security of the data, approaches used, management of the procurement process, transaction processing, the chain of events in the procurement process, access to critical data, the application process for securing contracts, quality of products, costs, and types of contracts. This finding implies that when the SA government implements blockchain technology in their procurement processes, these are the factors to consider to ensure transparency and integrity. We believe that once blockchain technology has been implemented in SMMEs, the public will trust and be confident in the procurement processes as corruption would have been eliminated and tenders would be awarded fairly.

Based on these findings, there is a need for further research. Further research should focus on empirically validating the factors identified in this study. Furthermore, the identified factors can be triangulated into a framework that informs the implementation of blockchain technology.

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