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Mitigating bureaucratic inefficiencies through blockchain technology in Africa

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With the Fourth Industrial Revolution (4IR) wave engulfing African governments, the need to do, and use something new has already infiltrated many public sector organizations. While modern technologies are being embraced in the private sector, African governments are emulating new technologies and other Information Communication Technologies (ICTs) to advance their economies while managing the risk that these sophisticated technologies can trigger. Blockchain technology is one of the emerging 4IR technology that is believed to have the capacity to mitigate bureaucratic inefficiencies, although scholars argue implementing such comes at a higher price. To understand how blockchain can help reduce inefficiencies in African bureaucracy, the researchers employed the systematic literature review analysis where documents from various databases such as Scopus, Web of Science, and Google Scholar were systematically sampled depending on how they offer meaningful data concerning blockchain implementation. The analyses of these secondary sources revealed multiple challenges and opportunities associated with blockchain technology in the African government. The challenges include poor project management, weak institutions that do not uphold accountability and transparency in data entry using blockchain, unavailability of blockchain infrastructure, risk-averse attitude, and absence of institutional readiness. By implementing enabling technology policies in government, the study revealed that blockchain could help improve taxation in African bureaucracies and mitigate data altering and errors while maximizing efficiency. Further merits in public healthcare and education can be realized by using blockchain technology. The conclusions drawn from this study have shown that for African bureaucracy to thrive using blockchain technology, there is a need to prepare public sector institutions to embrace blockchain technology. At the same time, investment in soft and technical skills remains fundamental to mitigate inefficiencies in public service provision. Institutional readiness is another deterrent to blockchain technology as public administration regard this technology as demanding since it may require change, and management where institutions and structures are reshuffled to respond to the demands of blockchain technology in the delivery of public goods.

KEYWORDS

bureaucracy, inefficiencies, blockchain technology, African governments, public service delivery

Introduction

Global public administrations are dealing with a fresh set of social, economic, and political issues. Managing risk and uncertainty, ensuring trust and legitimacy in public institutions, boosting the agility and efficiency of institutions, and pursuing diversity, social inclusion, and better service delivery are a few of these problems (Lindgren et al., 2019). Along with all these

difficulties, strict budgets are required to ensure balanced management. Incorporating new technology into the day-to-day operations of public administrations is seen as a strategy to address these issues and save money, prevent corruption, raise tax revenues, and improve economic efficiency (Shava and Hofisi, 2017; Adam and Fazekas, 2021). With the Fourth Industrial Revolution (4IR) wave engulfing African governments, the need to do and use something new has already infiltrated many public sector organizations. While innovative technologies are being embraced in the private sector, African governments are emulating new technologies (internet of things, cloud computing, artificial intelligence, robotic, big data, 3D printing) and other Information Communication Technologies (ICTs) to advance their economies while managing the risk triggered by these sophisticated technologies (Shava, 2022).

Blockchain as noted in the study of Falwadiya and Dhingra (2022) is one of the emerging, cutting-edge, and disruptive technologies of the 4IR which can mitigate bureaucratic inefficiencies, although scholars argue implementing such comes at a higher price. In Africa, Kenya is one of the few countries that has embraced blockchain to properly verify property records and transactions as well as extend access to credit to the informal sector (Gebre 2018). Blockchain and artificial intelligence (AI) are also used by MyBucks the first Fintech business enterprise to provide various virtual banking products across Africa, Australia and Europe.

A study conducted by AlShamsi et al. (2022) has shown that blockchain technology may bring numerous opportunities to different economic sectors. Its flexible use, for instance, in the banking sector indicates that blockchain drives customer transactions using uniform blockchain standards by allowing transparent auditing of transactions. In Brazil, blockchain has been widely embraced and the government implemented the Public Digital Bookkeeping System (SPED) within the country's federal revenue agency (RFB) to advance the accounting sector (Prux et al., 2021). As noted by Sebold et al. (2012) blockchain enables crosschecking, integrates accounting and tax information on taxes levied in various levels of government in Brazil and also enhances the process of tax inspection.

Crosby et al. (2016), compared blockchain to traditional auditing methods and keeping transactions of government spending. His analysis has shown that blockchain can transform public auditing systems by minimizing corruption as all spending is carefully recorded, thereby improving transparency. According to Ismail et al. (2019), blockchain technology can be employed in the African governments to enhance public healthcare as it reduces communication and computational burden in data management argued in this study, which can be attained by a secure transaction involving a group of networks. Also, smart contract systems can be utilized through blockchain technology to manage healthcare data (Khatoon, 2020). The other significant merit of blockchain which the African governments can utilize in terms of healthcare is that blockchain technology can be used to create a web where patients are linked to medical professionals such as doctors and surgeons and can help medical professionals to keep records of their patients on whether they are taking medication or not. The researchers argue that many African countries are struggling to keep their public health intact; utilizing blockchain can be the answer to mitigate bureaucratic inefficiencies and reduce red tape when it comes to solid public health decisions.

The merits of blockchain can also be recognized in the education of many African states. For instance, applications that support blockchain can be used in colleges and universities to verify degree certificates, any certificates, assessments, and credit transfers, including data management. Blockchain can also help minimize student admissions loopholes; hence its role in verifying academic qualifications is essential as it may protect employers from academic fraudsters who can compromise the integrity of institutions. Vidal et al. (2019) observed that blockchain technology is influential in permitting students to access their certification while being protected by their institution. Such a positive technology gesture can help minimize hacking as students are protected from the external force that may want to steal their qualifications for personal use.

Although the preceding discussion has pointed out various advantages of using blockchain technology in African bureaucracies, there are technological, economic, social, cultural, and political factors that may determine how blockchain can be embraced or not. It should be noted that African bureaucracies do not have a universal approach to technology adoption, as many still use the traditional way of governing public institutions. Using modern technology such as blockchain may require African public sector organizations to implement change management which may be resisted if not carefully institutionalized in public sector organizations. The researchers argue that although blockchain may help mitigate financial risks, it may not be favourable in African bureaucracy as it transforms the *status quo* in the process of eradicating grounds for rampant corruption in African bureaucracy.

Although blockchain is expected to shift, the *status quo* arguments arise concerning the technological capacity of African governments as their technical ability does not correspond to the equal feasibility of embracing blockchain. The stringent regulations and absence of policies to embrace and regulate disruptive technology remain a setback to achieving efficiency in public sector organizations. From this background, the paper seeks to answer the following questions:

- Can blockchain mitigate bureaucratic inefficiencies in African governments?
- What are the conditions for blockchain adoption in African bureaucracy?
- What solutions can be offered to African governments to enhance the adoption of blockchain to enhance efficiency?

The remainder of the article focuses on the materials and methods followed by a discussion on the contextualization of blockchain in government. The third section discussed the conditions for blockchain adoption in African bureaucracy followed by a discussion of the results and discussion. The last section concludes while the last section provides recommendations and direction for further research.

Materials and methods

This research answers the following questions: Can blockchain technology help reduce the inefficiencies caused by bureaucracy in African governments? What are the requirements for using blockchain technology in African administrative systems? What kind of a solution may be proposed to the African government to increase the use of blockchain technology and boost efficiency? In this study, a systematic review of the previous research was performed. A preliminary search is recommended by Tawfik et al. (2019) to find relevant articles, confirm the validity of the given idea, eliminate duplication of already

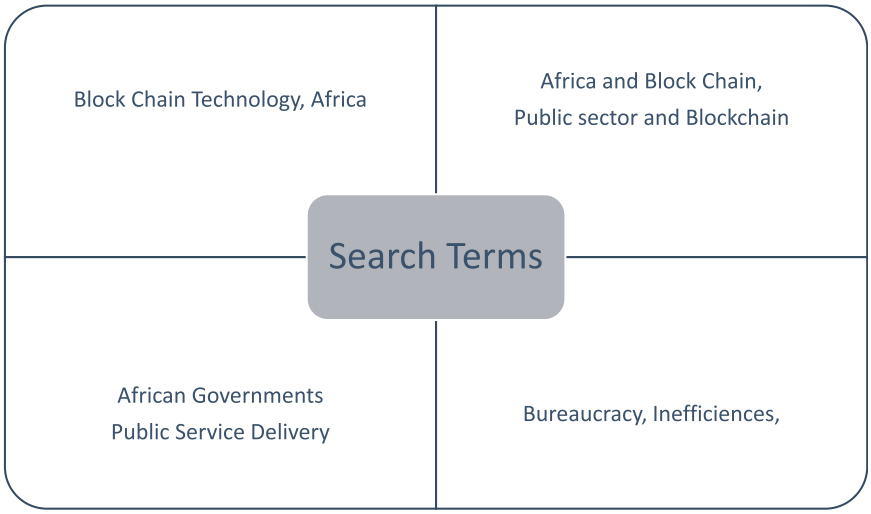

FIGURE 1
Search Terms.

addressed questions, and ensure sufficient articles for conducting its analysis. In addition, the concerns of relevant and important blockchain adoption should be the primary focus of the themes. Further, Tawfik et al. (2019) claimed that developing a familiarity with and a profound grasp of the research subject by watching relevant films and participating in relevant discussions is of the utmost importance for improved retrieval of results. These measures are crucial to ensure that we do not publish the same study that has been published in the past and to ensure that we do not waste our time attempting to address a problem that has been discussed for a considerable amount of time (Tawfik et al., 2019; Dziopa and Ahern 2011; Mhlanga, 2021; Mhlanga, 2022).

As proposed by Vassar et al. (2016), the authors of this study investigated every potential avenue to lessen the impact of bias, including conducting a detailed hand search to retrieve reports that may have been overlooked during the initial search. In this investigation, five different approaches to manual searching were utilized. These included searching for references within included studies and reviews, making direct contact with authors and industry professionals, and looking at related articles and articles that were cited within Google Scholar, Scopus, and Web of Science. The first step in improving and refining the results of manual searching was to search the reference lists of the included articles. Next, the reviewers performed citation tracking, which involves tracking all the articles that cite each. Finally, as part of the manual search, electronic searching of databases was also performed. In the final round of the research, "related to" and "similar" items were analyzed.

Independent reviewing was conducted following the recommendations by Tawfik et al. (2019) by designating a "tag" and a unique method for each team member. This was done to compile all the results at the end for comparison of differences and discussion, as well as to maximize retrieval and minimize bias. The primary factor in determining whether a study was included was whether it was pertinent to our research topics and, secondarily, how recent the study was. Priority was given to papers that were published after the year 2000. Most of the criteria for excluding papers are that they are irrelevant, duplicated, lack full text, or contain only abstracts. These exclusion criteria were laid out to protect the researchers from harbouring any prejudice.

Key search terms considered in the study

The search phrases are the words that we used to look for material that is relevant to the review of literature; these terms indicate the topics and keywords that are most important to the research conducted in this study. The figure below outlines the keywords considered for this paper.

Figure 1 gives the search terms that were considered during the search. The screening and selection process is depicted in the flow diagram shown below in Figure 2.

Figure 2 outlines the screening and selection criteria. As shown in Figure 2, 55 articles were reviewed through the systematic literature review. We offer a data verification stage, in which every incorporated article is checked with its equivalent in an extract sheet by evidence images to find mistakes in the data, as suggested by Tawfik et al. (2019) because of the predicted human error and bias.

Literature review

Contextualizing block chain technology in government

Janowicz et al. (2018) describe blockchain technologies as data structures that rest on distributed ledger technology that focuses on capturing and transferring value. Blockchain is described in the "Program for Development of a Digital Economy" as a distributed register whereas Pestunoz (2020) views blockchain as a distributed journal where records can be added and are not revised but can be appended only. Interestingly, such a restriction is implemented based don't the fact that while strict conditions are in place to amend records some conditions must be met to execute such a procedure. This

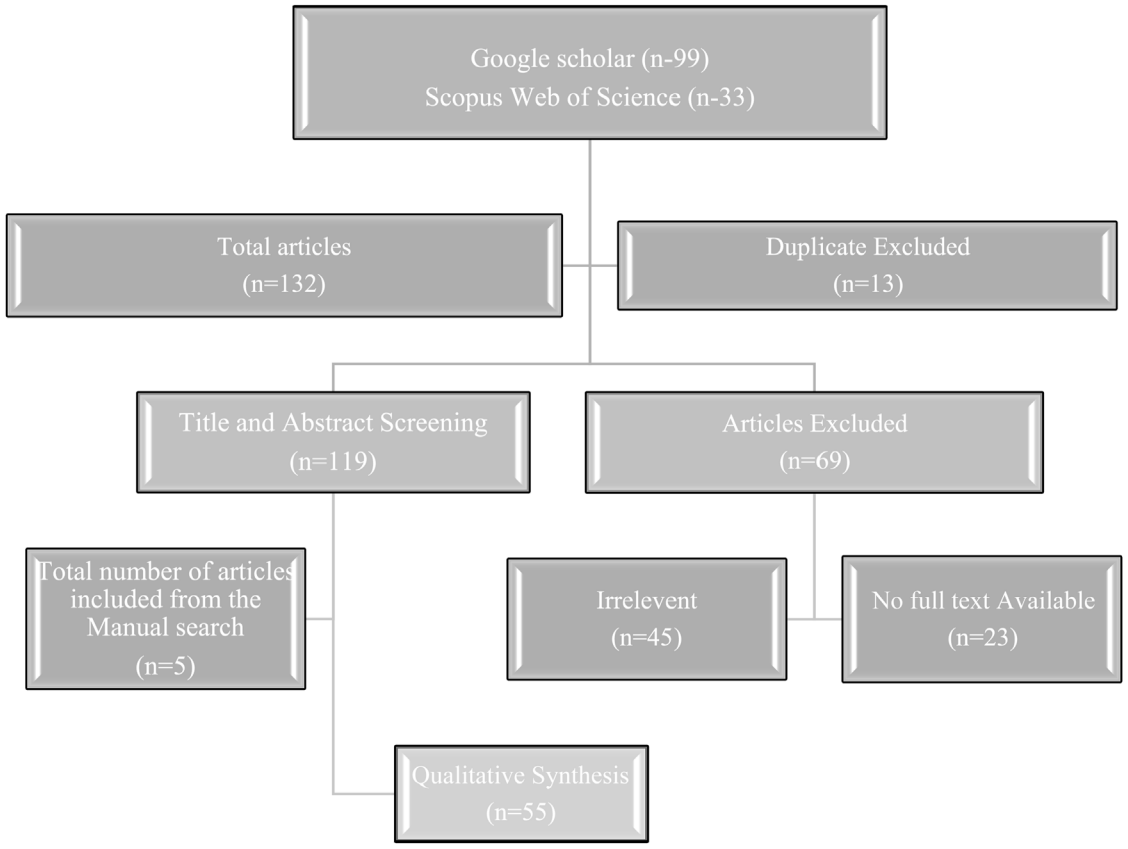

FIGURE 2
Flow diagram of studies' screening and selection (Source: Authors, 2022).

definition has been adopted in this study as the researchers advocate for African bureaucracy to effectively utilize the blockchain to enhance public sector operations in terms of auditing, and proper accounting procedures without altering state records on expenditure incurred.

Resulting of these definitions, many countries harboured the optimism that blockchain technology would be a game-changer in solving problems such as operational and security concerns. This technology can be of value to government agencies in several ways; one way is to boost the speed with which transactions can be managed. One example of this would be transactions registered in a land-use register. Nevertheless, the outcomes of governments integrating blockchain technology into their processes have been inconsistent. According to the findings of Batubara et al. (2018), the ability of blockchain to capture transactions on distributed ledgers presents new opportunities for governments to foster transparency, prevent fraud, and build confidence in the public sector. Batubara et al. (2018) conducted an in-depth analysis of the relevant research to understand the present research subjects, problems, and potential future directions for implementing blockchain technology for e-Government. In a subsequent argument, Batubara et al. (2018) stated that the adoption and usage of blockchain technology in e-Government are underexplored in academic literature. In addition, they mentioned that scholarly literature does not delve into this subject too much. The adoption of blockchain-based applications in e-Government is still in its infancy, according to the study conducted by Batubara et al. (2018), and there is a lack of empirical evidence. According to Batubara et al. (2018), technological traits, including security, scalability, and flexibility, are the main barriers to adopting blockchain. The main barriers to adoption from an organizational perspective, according to Batubara et al. (2018), are the issues with acceptance and the requirement for new governance frameworks. According to research by Batubara et al. (2018), the lack of legal and regulatory support is the main environmental barrier to adoption.

Steenmans et al. (2021) also came in fourth place with their analysis of implementing blockchain technology in the waste management sector. They paid special attention to the consequences of the governance of plastics. According to Steenmans et al. (2021), blockchain technology is becoming increasingly conceivable as a potential disruptor of waste management techniques that influence the governance of plastics. Furthermore, Steenmans et al. (2021) argued that the participation among the waste management community in perspective and foundational changes to complicated managing resources affiliated with blockchain implementation parallels recent research in other industries, such as finance, health, and public administration. The study by Steenmans et al. (2021) highlighted four areas of a blockchain application that are beginning to impact waste management practices. These areas are smart contracts, monitoring and tracking of garbage, payment, and recycling and reuse rewards. Tyagi and Goyal (2021) argued that traditional government services were not available in an electronic form and that citizens were required to visit government

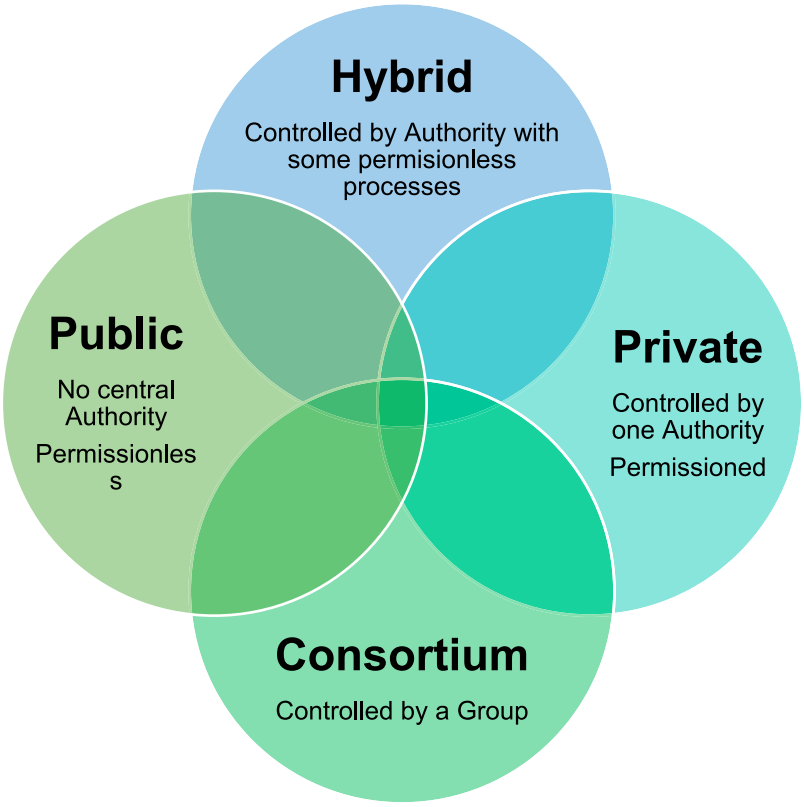

FIGURE 3
Figure 2 Types of blockchain. According to Anderberg et al. (2019) blockchain technology has two types namely: public and private, which are further divided into permissioned and permissionless subtypes.

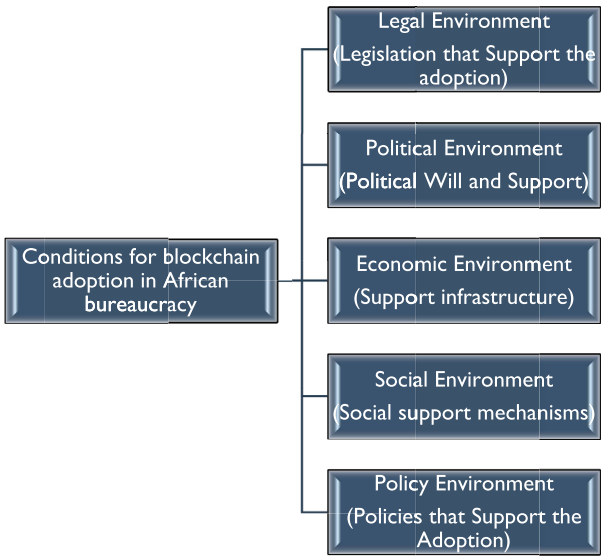

FIGURE 4
Conditions for blockchain adoption in African bureaucracy (Source, Authors: 2022).

offices to receive government services. As a result, there is a potential for citizens to experience a gap in information because traditional government services are not available in an electronic format. However, Steenmans et al. (2021) argue that the government is eager to put numerous government services in electronic form thanks to the rise of the "Internet, web applications, and smart mobile phones" to increase efficiency, transparency, and cooperation between the government, its citizens, and the external agencies with which it interacts.

The researchers Cagigas et al. (2021) conducted the first systematic literature evaluation of utilizing blockchain technology throughout most of the principal public services. Blockchain technology is currently being touted as "the next big thing," potentially bringing about dramatic changes in both societies and the economy in the not-too-distant future, as suggested by Cagigas et al. (2021). Cagigas et al. (2021) have seen that the academic literature on the blockchain has, in recent years, focused exclusively on bitcoin and crypto finance rather than other applications of the technology. On the other hand, they claimed a growing corpus of scholarship on blockchain in the public sector. The properties of blockchain that have made it a promising technology and the ability to alter numerous activities connected to public policy and the provision of public services are described by Cagigas et al. (2021). This category includes activities such as administrative procedures, the provision of social services, and practices connected to regulation. According to Cagigas et al. (2021), governments are proven to benefit the most from advancements in efficiency and traceability. Regulatory uncertainty and uncertainties about scalability represent huge expenses and risks

for governments. According to Cagigas et al. (2021), a key hurdle to adopting blockchain technology is the lack of information and competence. Once more, Cagigas et al. (2021) stressed that citizens, security, and transparency are considered essential benefits, while the hazards are mostly associated with issues about data security.

Various types of blockchain

Blockchain has four main types that include public, private, hybrid and consortium as shown in Figure 3. The implementation of these types depends on the nature of the institution be it government, private organisation or large corporation. These research advocates for the implementation of a public blockchain in each new public sector accounting and auditing. This type of blockchain has its challenges such as privacy which might compromise the integrity of this latest innovation in bureaucratic institutions. As noted by Wegrzyn and Wang (2021) the four types are presented below:

(Source: Wegrzyn and Wang, 2021).

Public blockchain

Permissionless, decentralized public blockchains allow anybody to participate. Public blockchains allow all nodes to access, create, and validate data blocks (Formigi, Braga and Leal, 2017). Public blockchains are mostly utilized for cryptocurrency exchange and mining. Bitcoin, Ethereum, and Litecoin are public blockchains. Nodes "mine" cryptocurrency by solving cryptographic equations to create blocks for network transactions. Miner nodes receive money for their hard work. Miners operate as new-age bank tellers who process transactions and "mine" a fee. As Darlington (2021) holds wide access and anonymous keys are associated with public networks, while controlled keys (requesting permission for transaction registration) are associated with private blockchain networks.

Private blockchain

Private blockchains, often called managed blockchains, are permissioned, single-organization blockchains (Wegrzyn and Wang, 2021) The central authority assigns nodes in a private blockchain. The central authority doesn't always give each node equal function privileges. Public access to private blockchains limits their decentralization. Ripple, a business-to-business virtual currency exchange network, and Hyperledger are private blockchains (Wegrzyn and Wang, 2021). Private blockchains are more prone to fraud and unscrupulous actors than public blockchains, which have lengthier validation processes for new data. Consortium and hybrid blockchains were created to overcome these issues.

Consortium blockchains

Consortium blockchains are permissioned blockchains administered by a collection of organizations. Consortium blockchains are more decentralized and secure than private blockchains (Wegrzyn and Wang, 2021). Creating consortiums can be difficult since it needs cooperation from multiple organizations, which poses logistical obstacles and antitrust risks (which we will examine in an upcoming article). In the government's supply chain problem may occur technology or infrastructure to deploy blockchain tools may not be available due to high cost and the absence of skills (Migliorini and Rocha, 2019). To effectively realize the benefits of blockchain African governments may collaborate with private firms that have stable financial resources. For instance, CargoSmart launched the Global Shipping Business Network Collaboration, a non-profit blockchain consortium, to digitalize the shipping industry and enable maritime industry operators to operate more constructively.

Hybrid blockchains

Hybrid blockchains are owned by a single company, yet the public blockchain validates some transactions. For example, IBM Food Trust is a hybrid blockchain that improves food supply chain efficiency (Wegrzyn and Wang, 2021). While this type of blockchain is common in the private sector, the government can take collaborate with single entities in rendering public services which is crucial for citizens to have value for money. Some private firms have good human and financial resources that can complement bureaucracies to deliver services to the citizens.

The above section describes the various types of blockchains and how they can be used in each sector. Biancolini, Silva, and Osti (2018) examined blockchain's utilization in public administration, highlighting positive and negative aspects. According to the authors, disruptive technology can be used in the public sector to increase tax compliance, transparency, and transaction costs. Bastos, Andujar, and Rode (2018) explored the advantages and disadvantages of blockchain as an auditing tool. The authors found more financial institutions using blockchain through bibliographic research. Bastos et al. (2018) said blockchain enables continuous internal and external audits. Many countries lack regulation and law, they say. Dai and Vasarhelyi (2017) researched blockchain accounting applications to discuss how this technology can support a real-time, transparent accounting ecosystem. The authors suggest blockchain for auditing information. They suggest studying the technology's applications and challenges in government auditing.

Conditions for blockchain adoption in African bureaucracy

The legal, political, economic, social, and policy environment have a role in applying blockchain technology in African bureaucracy. According to McKenzie (2018), neither the use of technology platforms for currency transactions nor the early acceptance of such technologies are new to African countries. It is often said that the extensive usage of mobile technology in Africa gave the continent the ability to catch up to many developed countries. In less than a decade, mobile phone usage rose from less than 3%–80%, and there are now a ton of local smartphone and e-payment systems that have taken advantage of this opportunity to develop ground-breaking solutions to reduce the stress associated with sending money across the continent. Mobile phone usage is one illustration of this. Mobile phone usage rose from less than 3% in 10 years to 80% (McKenzie, 2018; Onsongo, 2019; Markus and Nan, 2020). Customers who use M-Pesa, available

in Kenya since 2007, to send and receive money primarily by mobile phone send and receive more than 25% of the nation's GDP, increasing consumer confidence in financial technologies. This is a fantastic illustration of how utilizing financial technologies can boost customer confidence. One of the leading causes of the enormous growth in the use of mobile money is the confluence of variables primarily driven by the existence of infrastructures and political will, among other socio-economic considerations. Other socio-economic elements are included in several hypotheses. The African continent possesses the optimal confluence of factors that promote the use of blockchain technology, according to a Standard Bank (2021) analysis. Because of this, the prosperity, wealth, and international status of the continent's nations will change quickly. This study demonstrated that Africa is not just a crypto continent but also a world innovator in using blockchain technology as a force for good.

Although strong acceptance rates of cryptocurrencies are being seen in Africa, there is still a lot of work to be done before the widespread use of blockchain technology on the continent, particularly in government, and before it becomes available to everyone and becomes mainstream. According to several academic papers and studies, in addition to the difficulties posed by regulations, Africa also suffers from a lack of infrastructure and other problems, both of which prevent most people from accessing blockchain technology. To begin, blockchain technology requires a reliable internet connection. Without the internet, there is no such thing as a blockchain. Internet penetration in Africa is at a dismal below 1%, which shows a 30x gap to the global average. The continent's internet penetration rate is 43%, which is 35% lower than the world average (Standard Bank, 2021). Many submarine cables are entering the Continent, linking it to the internet backbone successfully; nevertheless, what is lacking are the cables to people's homes. It is considered that most of Africa's broadband issues are present at the last mile distribution. Installing cable networks for last-mile delivery is exceedingly time-consuming, resource-intensive, and difficult for the African continent to manage environmentally. According to estimates provided by the World Bank, it would require an investment of more than a decade and a total of one hundred billion dollars to bring Africa's broadband up to pace.

There has been a recent uptick in the number of research projects that attempt to study the application of blockchain technology within Africa. To give only a few examples, there is De Castro et al. (2020). According to the findings of their research, De Castro et al. (2020) discovered that developing countries are confronted with three primary challenges: high costs associated with adoption, a lack of regulatory framework, and a lack of support from leadership. These are all examples of external environmental factors. The research also acknowledges certain business actors' role in influencing the adoption of blockchain technology. Akaba et al. (2020) conducted interviews with twelve stakeholders using a semi-structured format. According to the findings of Akaba et al. (2020), the obstacles that stand in the way of the widespread application of blockchain are a poorly established infrastructure, a lack of political will on the part of the authorities to incorporate the necessary technological policies, inadequate funding for widespread adoption, a resistance to change on the part of public officials, and a lack of knowledge of blockchain technology among participants in the process.

In addition, Dick and Praktiknjo (2019) discovered that the complexity of the technology, the compatibility of the technology, and the relative advantage that the technology will provide, in comparison to the technology that is currently used in the industry, all play a role in the adoption of blockchain. The additional benefit of adopting blockchain technology is referred to as the relative advantage, and it is measured in comparison to the required expenses of converting to blockchain technology. Dowelani et al. (2022) identified "people, organizations, technology, and industry" as significant elements that are likely to significantly impact the implementation of blockchain technology in South Africa. They were able to accomplish this by conducting data collection among "stakeholders in the clearing and settlement cycle/process of securities" in the South African capital market using interviews that were only partially structured. They identified which aspects of the blockchain technology adoption landscape in South Africa are most significant. Conventional frameworks for blockchain technology adoption in the South African settlement and clearing industry were expanded and contributed to by Dowelani et al. (2022), who added five new factors to the mix, including "trust, load shedding, unemployment/layoffs, current infrastructure, useful life, and educational campaigns." When analyzing the literature and findings of various scholars, the factors influencing the adoption of blockchain technology can be summarized as shown in Figure 4.

Conditions for blockchain adoption in African bureaucracy are more dependent on several factors that have been articulated in various studies. These factors can be summarized in five broad categories: the legal environment, the political environment, the economic environment, the social environment, and the policy environment.

Results and discussion

Findings from the systematic literature review analysis have revealed various challenges and opportunities in using blockchain technology to mitigate bureaucratic inefficiencies in Africa.

Benefits of block chain to Africa

Despite being a relatively new technology, blockchain may offer several advantages to Africa, particularly in the area of reducing the inefficiencies caused by bureaucracy.

Economic improvements in African states

Utilizing blockchain in various sectors, such as procurement and trade, can bring positive economic gains to the government. The analysis of documents has shown that, although the common breeding ground for corruption in African bureaucracy, public procurement systems are often subjected to corrupt activities as technology in this sector is minimal. The study of Khalfan et al. (2022) revealed that many developing countries are not managing development projects due to poor project management, absence of transparency, and poor procurement management. These challenges are also evident in many African states, such as South Africa and Zimbabwe, where cases of public sector corruption are rampant, as noted in their State Capture Inquiry (South Africa) and other case related to various government departments in Zimbabwe. Irregularities in public procurement

systems and allegations have been reported in the South African public sector, while in Zimbabwe, some state departments, including the finance ministry, failed to account for US$10 billion in unauthorized expenditure (Mundeya, 2022) while the public watchdog Zimbabwe Anti-Corruption Commission (ZACC), refused to be audited by the Auditor General, showing the extent of corruption in the procurement systems. Blockchain technology can be used in procurement as it helps with five main aspects: supplier management, fraud and crime prevention, smart contractors, traceability and ledger trusts. Although these advantages can be considered in African bureaucracies to mitigate corruption in procurement systems, lack of transparency and accountability is the greatest impediment. The extended literature analysis has shown that blockchain technology can bring positive improvements in trade in African countries. Regarding opening new markets for trade, blockchain has been regarded as one of the champions for generating government revenue. Mesquita et al. (2020) argue that blockchain can transform how government and markets operate. For instance, Agriledger, a blockchain-based Kenyan start-up, provides farmers access to their buyers and market prices. This is crucial for mitigating market inefficiencies and can revamp the agriculture sector, which is one of the drivers of the Gross Domestic Product (GDP) in Kenya and many other African states. In the same agricultural context, Bitland, a Ghanaian start-up, employs blockchain technology to enhance land registration by making it more secure from hackers. These efforts display how blockchain can be implemented in the private sector, which pays government revenue critical for social and economic development.

Limited accountability and weak bureaucratic institutions

Public organizations sometimes lack proper record-keeping, which triggers low accountability. This is confirmed in a study by Tintswalo et al. (2022), where Statistics South Africa (STATS SA) faced various record-keeping challenges. Although 4IR regards blockchain as one of the beneficial programs to support public procurement, reforms are required in African bureaucracies to fully embrace and integrate the use of blockchain technology across various public sector organizations. The unavailability of blockchain policies and weak institutions is another deterrent to mitigating inefficiencies in African bureaucracy. The literature reviewed for this study has pointed out that blockchain technology demands strong institutions that are well coordinated to allow this technology to improve efficiency without any manipulations or sabotage. A survey conducted by Abdullah et al. (2018) revealed that blockchain technology requires strong institutions that can implement project management which is critical for blockchain implementation. Such institutions will be strategic enough to offer good leadership to liaise with stakeholders to create government value. Non-etheless, it is common across African bureaucracy that, in some cases, the public organization is run by senior officials who may not embrace change and have limited innovative capacities to attract business and stakeholders to the government or spearhead public service delivery using blockchain. Ozkan et al. (2021) argued that the absence of project management skills and relevant policies to support blockchain often results in the government losing money either in dodgy deals that are not appropriately procured or through many loopholes that can be created when oversight institutions are fragile. These observations correspond to the study of Rana et al. (2021), which revealed that when government intermediaries are weak. The internal control systems of government are not empowered, and chances are high that blockchain technology might work to its total capacity as records, for instance, may not be captured well in the systems, or data can deliberately become available, which threatens the use of blockchain eradication inefficiencies in African bureaucracy. Arguably checks and balances are required if African bureaucracy to mitigate public sector inefficiencies. Such institutions should have officials with adequate capacity to play an oversight role while being open-minded to new technologies usher by the 4IR, which may complement blockchain towards improving public service provision.

Blockchain and administrative corruption in Africa

Concerning cryptocurrency and bitcoin, for instance, blockchain has proved to be an innovative technology of the 4IR as governments can use it to mitigate money laundering and corrupt activities (Tshering and Gao, 2020). The analysis of Zheng et al. (2017) has shown that the following advantages can be achieved using blockchain in African government: decentralization, anonymity, persistency, and audibility. Decentralization is attained when each transaction is automatically validated, and no third party will interfere; hence, it curbs errors and hacking and enhances transparency. Anonymity also helps protect financial managers who make transactions using blockchain technology. Audibility entails that all transactions are safely stored sequentially for future verification and tracking using blockchain technology. Persistency includes the recording mechanism where transactions made in government spending may not be erased when using blockchain. Arguing on these many advantages of blockchain, it remains arguable that some challenges, such as financial embezzlement and fraud experienced in African bureaucracies, can be mitigated by employing blockchain technology. While it eases pressure on government auditors, the use of blockchain needs to be emphasized as it can save the government money while ensuring that development is initiated for the benefit of citizens.

Blockchain can lead to transparency and disclosure in the taxation of African bureaucracies. Research confirms numerous benefits of blockchain in taxation. The study by Nuvrianto (2020) revealed that blockchain could be used effectively to ensure security, data transparency, and trust. In tax, the African government can employ blockchain, for instance, in controlling the increase in prices of goods. The Indonesian government once used blockchain technology to control increased excise and taxes on tobacco products. In this study, blockchain was influential in providing real-time data, including tax payments, in a short time, bringing transparency and openness. Apart from taxation, the government can utilize the blockchain to achieve digital identity, which offers the security of personal data. However, as alluded to in extant literature application of blockchain to support governed operations in Africa demands increased funding, institutional readiness, and availability of technical skills. As many African bureaucracies are struggling with traditional skill sets, embracing blockchain requires the retraining of public officials and investment in digital and other soft skills to allow blockchain to improve efficiency in government operations.

The response of African bureaucracy to blockchain technology varies. This is because African bureaucracies function in sophisticated systems of rules and regulations tied to red tape, which in many circumstances derail the provision of public services. While New Public Management (NPM), a growing paradigm, is anticipated to be the game changer and transform the way public administration functions, little has been achieved, as eliminating the traditional bureaucracy is a complex system that may take time. Although technology penetration in African bureaucracy in e-governance using ICTs, various contestations still exist. Some African bureaucracies believe the old is still good, so why replace it with the 'uncertain new.'

The literature assessment has revealed five environments suitable for blockchain adoption in the African government. These include political, economic, social, technological, and environment. Not all countries in Africa can create such environments as they have their various problems such as poverty and inequalities that may require considerable attention, which outweighs blockchain adoption. Notably in African countries such as Rwanda, and Kenya where the technological environment has been institutionalized in these governments to allow the adoption of various technologies offered by the 4IR to influence functions of administrative processes. As captured in the study of Weiss and Biermann (2021), modern ICTs have widely affected administrative processes, including government departments and other civil society organizations. While this study focuses on blockchain, a comparison can be drawn to see how different ICTs relate to blockchain towards curbing inefficiency in African governments. As a form of disruptive technology, the blockchain pose governance challenges to governments not only in Africa but globally to invest more in new ideas, models, and software that support digital technologies. Osborne (2018) argues that promoting an open government practice can allow hierarchical work within public institutions and help develop models that target efficiency and transparency in public engagements.

Threats of block chain to Africa

It is crucial to mention that there are also concerns and challenges associated with the deployment of Blockchain technology in Africa, even though blockchain technology has had some good effects on the African continent. In the next paragraphs, some of the difficulties will be discussedAbsence of digital infrastructure.

One of the threats to the adoption of blockchain technology in African governments is the absence of infrastructure to support blockchain and its applications. Public officials in government are inherently sceptical of whether blockchain can transform the service delivery landscape or its adoption can be ill-planned; hence hesitations may emerge. Mitigating negativity embedded in traditional bureaucracies can hinder African governments from adopting blockchain technology, although literature analysis pointed to various advantages of such modern technology. The infrastructural technology challenges in embracing blockchain were noted in a study conducted by Papathanasiou et al. (2020), where governments tend to hold on to traditions and regard blockchain as a form of technology that may disrupt professional and personal relationships. While this view has loopholes in achieving efficiency, providing infrastructure in the African government is a challenge. Many countries are either confronted with social and economic inequalities, experiencing conflict, or still trying to embrace modern technologies in their government operations. Coupled with poor infrastructure supporting blockchain technology, among other 4IR technologies, a gap exists in technological development in Africa. This calls for the government to revisit its institutional setups to see if they are enabling enough to create a conductive technology environment that promotes development and efficiency in state agencies.

Risk aversion and limited technical skills

Utilizing blockchain in government is associated with risk aversion. This is confirmed in the study of Bustamante et al. (2022) who mentioned that social trust in technology is of concern to public sector employees. The study results pointed out that blockchain can be subjected to manipulation or cyberattacks which may compromise the privacy and anonymity of employees in government. These assertions corroborate the study of Shava and Hofisi (2017) which noted that risk aversion is one of the nightmares of embracing modern digital technology. This view augurs well with many African bureaucracies where adopting blockchain is regarded closely and fears that it might replace accounting and finance jobs. The view that disruptive technology such as blockchain threatens job security is unfounded due to the controversies surrounding the broader concept of the 4IR. While the private sector is risk-taking and embracing modern technology faster than the government, there is a need for transforming the public sector mindset by highlighting the various potential benefits blockchain, among other digital technologies, can have on the functioning of the economy. The negative attitude that may be displayed in government is that African bureaucracy operates slowly, and embracing technology requires a series of pilot projects for the government to be contented with the effectiveness of innovative technologies such as blockchain.

The study of Zambrano (2020) revealed that accountability can be achieved in government by using ledgers which are part of blockchain solutions in improving administrative capacity. The study stressed further that ICTs including other e-government applications help mitigate bureaucratic barriers in government in the Global South. Nevertheless, the absence of technical skills to manage blockchain technology is a deterrent to curbing bureaucratic inefficiencies in the African government. Although many governments have skills training and development programs, many focus more on soft skills. In contrast, technical skills training is lacking as few public servants are skilled in that area. ICT gap is rampant across many African governments; hence blockchain technology can be registered due to the need to retrain officials while delving deeper into public money. Resistance to changes due to skills deficiency is not only a public sector problem but a private sector, as confirmed in the study by Lember et al. (2019).

Conclusion

Blockchain, a disruptive technology proliferated by the 4IR, has various opportunities and challenges in mitigating efficiencies in African bureaucracies. The assessment of extant literature has shown that concerning opportunities, blockchain can enhance the auditing landscape in African bureaucracies as its sophistication can

help reduce errors, manipulations, and corrupt financial activities in government. This assists in saving public money while effectively utilizing public funds for other development programs. Secondly, blockchain helps emerging entrepreneurial businesses in African governments, as evidenced in Kenya and Ghana, which help generate employment and revenue for the government. Thirdly in agriculture, as noted from the analysis, blockchain can assist in identifying new markets and connecting farmers to buyers, which is vital for improving food security, among other benefits of agriculture in African bureaucracies.

Apart from all these benefits of using blockchain in African bureaucracies, there are several challenges governments may encounter in their bid to embrace this technology. The absence of technical skills remains an obstacle for African bureaucracies to adopt blockchain as it requires expert training in this field, which might challenge public officials who view this technology as a threat to their jobs. Further analysis of documents has shown that institutional readiness is another deterrent to blockchain technology, as public administrations regard this technology as demanding since it may require costly change management. The risk-averse attitudes associated with adopting blockchain technology are further compounded by the absence of ICT infrastructure in many African governments. Blockchain penetration requires connectivity to the internet, availability of power supplies, and broadband to function correctly. Since several African governments are still reeling from poverty, inequalities, wars, or famines, providing portable infrastructure to support blockchain remains problematic. Investing in the latest blockchain technology and other supporting software calls for more funding. African governments still rely on organizations such as International Monetary Fund (IMF) and World Bank to finance government operations.

Recommendations

Based on the literature assessment, embracing blockchain technology is still a long way for African bureaucracies, although this technology has merits in improving the functioning of the public sector. To mitigate corruption and financial embezzlement in government, there is a need to utilize blockchain technology that is strategic enough to curb inefficiencies in public finances. However, to effectively see the benefits of blockchain, expert training of finance managers and other relevant public officials is key to utilizing blockchain. This demands the African government invest more in skills development as blockchain requires technical training to effect change in public administration. Raising awareness in the African government is key to embracing 4IR technologies such as blockchain. While sticking to the *status quo* is regarded as efficient, change is needed in how governments are run; hence policymakers need to reconfigure ICT policies to adopt modern technologies that can drive African economies. This study has been limited by its broader focus on blockchain and how it can mitigate inefficiencies in African bureaucracy. It provides a more general analysis of various countries that use or can use blockchain in Africa to improve public service provision. It leaves a broader aspect of other technological innovations of the 4IR, which could be explored in future studies. The analysis of study results has shown scanty information regarding blockchain technology in Africa. Studies are still few to convince African bureaucracies of the benefits of blockchain technology. This calls for further empirical studies to confirm the usefulness of blockchain in curbing financial corruption in government and revenue collection efforts. Such studies will be benchmarks for other studies concerning blockchain technology and public sector innovation.

Author contributions

ES conceptualizes the paper, wrote the abstract, introduction, questions, results and discussion, conclusions and recommendations. DM conceptualizes the paper, wrote the literature review and methodology. All the authors proofread the paper and do references.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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