The Role of Block Chain Technology in Reducing Corruption Within the Local Governance in Egypt

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Abstract. One of the most challenging issues facing municipal governments is corruption. Numerous studies, reports, and analyses highlight the fact that since corruption is by definition hidden from the public's perspective, increasing the transparency and scrutiny of governmental acts can help prevent corruption. Therefore, increasing the transparency of government operations and decision-making should be the ultimate goal of an anticorruption campaign inside a democratic system. In the framework of local governance, we must strengthen the current audit mode, increase accountability effectiveness, further anticipate the trend of covert corruption, identify the traits of corruption as soon as feasible, and promptly regulate the corruption behaviors. The study's findings indicate that the more local executives have authority, the less transparent the information is, the less reliable the monitoring system is, and the more likely it is for covert corruption to proliferate. Only by enhancing audit mode, ensuring data quality, increasing audit efficiency, and reducing audit risk using blockchain technology can the corruption of executives of state-owned companies be effectively stopped.

Keywords: Blockchain Technology · local governance · corruption · transparency · accountability

1 Introduction

The fourth industrial revolution has led to a variety of next-generation technologies that can be applied in a range of industries, including the Internet of Things (IoT), artificial intelligence (AI), big data, and blockchain technology. Blockchain technology has drawn attention as the most important new technology because its core concept—which many academics have sought to implement—is to avoid hacking in different contexts. Studies on how to use it to enhance governance or communication, studies on how to protect transparency using distributed storage technologies, and studies on electronic voting systems using blockchain technology are all related fields of study. In this context, the most important strategies for reducing corruption at the local level

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revolve around increasing accountability, transparency, and effective control. For this reason, blockchain applications are being studied as a way to improve local governance and reduce corruption.

Blockchain is a decentralized, dependable, and difficult technology to exploit for fraudulent purposes. Blockchain technology can therefore be used in a wide range of industries [1]. According to Christian Cachin et al., the four parts of the blockchain that are duplicated are the ledger, cryptography, consensus, and business logic [2].

Before adding the finished database to the blockchain as a whole, a block—the "current" component of a blockchain—keeps track of some or all of the most recent transactions. Every time a previous block ends, a new block is formed. The blockchain contains an endless number of such blocks. Each block contains a hash of the block before it and is linked together (like a chain) in a proper linear, chronological manner [3]. Blockchain is a term used to describe a distributed database of records, or public ledger, of all completed transactions or digital events that are disseminated among users. Most users of the system review each transaction on the public ledger twice. Information cannot be deleted once it has been entered. Every transaction that has ever been made is documented on the blockchain and is both verifiable and definite [4]. The reliability of the blockchain technology itself, which has applications in both the financial and non-financial sectors, is without question [3]. In contrast to a distributed database, users of a distributed ledger must independently verify transactions because they do not trust one another. A "distributed ledger" is a replica, decentralized, synchronized, and cryptographically secured record of data and transactions shared among parties to a contract [5].

Blockchain, for example, can be classified as a distributed ledger technology. All decentralized systems for storing transactions and sharing data across numerous servers, corporations, or countries fall under this category. Although a distributed ledger and a blockchain are both types of distributed ledgers, not all distributed ledgers are built on a blockchain [3]. Blockchain technology has a lot of potential for keeping government data safe and handling transactions in a way that is more effective, responsible, and transparent. Data from recent storage as well as data from prior data points are both present in blocks. As a result, by joining one block to the one before it, a chain of information and data points can be created. The way a block operates as a decentralized form of a public ledger is known as "distributed ledger technology" (DLT) [6]. Data in blocks is time-stamped and cryptographically sealed when new transactions are linked to prior blocks. This process ensures that every piece of data added to the blockchain can be tracked back to the precise instant it was uploaded, preventing any data from being later modified or removed [7]. At its foundation, DLT is a brand-new approach to data storage that offers both benefits and drawbacks. If anti-corruption measures are taken into account during the design phase, data storage on the blockchain can have advantageous benefits. Data audits must be included [6].

Transparency in transactions is required if accountability is to be encouraged. This needs to be taken into account during the application development process as well as the expectation management process. The public sector has a lot of room to improve data management with blockchain. It might be possible to boost public confidence in the government in areas where corruption is rife and confidence is low. On the other hand,

there are difficulties in implementation [7]. Digital government goes a step further by emphasizing the provision of user-centric, adaptable, and innovative government services. Digital technology should be used to enable these services and delivery methods [5]. Blockchain technology has the potential to facilitate direct connections between governmental organizations, people, and commercial enterprises in the framework of digital governance. This suggests improved public services for the simplest forms of registration and information exchange. Governments may not necessarily need to establish information storage and sharing channels on their own in order to foster economic activity in societies [7]. Despite the fact that it is still in its early stages, blockchain technology has already had a big impact on a variety of enterprises and industries. The following list includes some of the most notable advantages of blockchain applications: [4, 7, 8]. • Transparency: A blockchain continuously keeps track of each transaction and simultaneously makes that information accessible to all network users. Transparency is improved since all participants in the transaction may observe any alterations made to any data or recent transactions. • Business Continuity: Every company needs to make sure that their services are provided and will continue to be provided. Because single points of failure are eliminated by blockchain technology, even if some components fail, the system remains operational, ensuring business continuity. Disintermediation: The complete decentralization of the blockchain technology allows for massive disintermediation. In cases where trust is lacking, technology protocols and components can be utilized to substitute intermediaries, increasing efficiency and lowering friction-related direct and indirect expenses for both individuals and organizations. • Trust: The development of a trustworthy record among dubious parties is the essential premise of blockchain technology. The robust architecture and cryptographic properties of the blockchain-integrated protocols support trust and ease verification. • Smart Contracts: The majority of blockchain systems allow the use of scripting languages, which enables the extension of ledger capabilities.

Local corruption can take on a variety of shapes and forms. Municipalities will have different policies. However, accepting or asking for bribes is the most typical form of corruption. Patronage, nepotism, theft of public property, political corruption, and clientelism are all frequently seen to varying degrees at the local level. When officials have extensive discretion and/or frequent face-to-face interactions with the public, corruption is most likely to occur. Even though greater discretion is frequently associated with seniority, it may also be a component of a particular task or function performed at junior levels. Decentralization has frequently increased the burden of revenue-raising, making it a particularly susceptible area. Local corruption in many emerging nations can no longer be considered a collection of individual incidents. The issue has grown and taken on a systemic nature. The study of what are known as “captured states” or “captured economies” has resulted from research to better understand the nature and causes of systemic corruption. This refers to the extent of the “rule of the game” that is established by policy and judicial decision-making that is influenced by private parties.

2 Literature Review

Oliver Meza and Elizabeth Pérez-Chiqués' study from 2021 [9] attempts to establish a comprehensive framework for examining how corruption is institutionalized in municipal administrations. The study's authors contend that by ignoring how corruption becomes the "rule of the game," policies to combat it have been developed that are ineffective because they focus only on dyadic and venal forms of corruption and are overly dependent on formal institutions. According to the findings, corrupt schemes are very adaptable and robust and can get beyond official anti-corruption measures. The findings of the study indicate that, although the amount of the effect is small, audited municipalities do better overall than unaudited towns. Funk, Kendall D. 2020's Erica Owen [10] the article discusses corruption pressures at the local government level using a novel method of empirically evaluating local councillors' subjective assessments of the corruption risks they have encountered. The article provides proof that each local councillor's perception of corruption risk is shaped by their unique personal characteristics, with educational attainment serving as the most important deterrent to corruption risk. Edo Rajh, Jelena Budak, and Sunana Slijepevi (2020), [11] describe the various forms of corruption that exist; it is generally believed that they can be diminished or eliminated in Mexico through effective blockchain management. Examples include public tenders or bids, government purchases and acquisitions (procurement), money embezzlement, and audits of businesses or governmental agencies. In comparison to the standard web-based E-Auction system, Praveensankar Manimaran and Dr. R. Dhanalakshmi's [12] proposed blockchain-based smart bidding system is quite robust and secure. The auction can be conducted even though some of the bidders are unreliable, thanks to the confidentiality and integrity provided by blockchain technology. Other electronic-based systems, including electronic voting, can use this strategy. Chunxiao Mu, Dan Wang, and Jindong Zhao, 2021 [13]. This study introduces a blockchain- and smart contract-based decentralised electronic bidding system. The system processes business logic using chaincode and replaces the conventional database with a blockchain. The anonymity of participants, the privacy of data transmission, and the traceability and verifiability of data are all improved in data interaction when encryption techniques like zero-knowledge proof based on graph isomorphism are applied. Yi-Hui Chen, Iuon-Chang Lin, and Shih-Hsin Chen (2018) [14]. In order to guarantee the anonymity, non-repudiation, and unchangeability of electronic seals, this study offers a blockchain-based e-auction method. Thomas Jensen, Jonas Hedman, Suprateek Sarker, and Stefan Henningsson Learn how to resist corruption through social, digital, and informational resources, including blockchain technology, by 2021 [15]. Produce model illustrates the intricate interactions between identity, institutional actors, technical and other resources, and practises by relying on prior research on corruption. According to Sarker, Henningsson, Jensen, and Hedman (2021), [16] it is possible to fight corruption by using both social and technological resources, such as blockchain technology. Our model, which is based on prior research on corruption, illustrates the intricate interactions between identities, institutional actors, technical resources, and practices. We also create conditions that could help reduce corruption by utilizing technology like blockchain.

3 Defining and Diagnosing Corruption at Local Level

A successful anti-corruption strategy requires a thorough understanding of the types and patterns of corruption that exist in a given area. On what constitutes corruption and how it should be measured, relevant parties (such as government representatives, members of civil society, and the business community) must agree. It is not an easy task. It is challenging to detect and accurately measure corruption. The severity and origin of the issue are frequently disputed. Any participatory and long-lasting anticorruption reform programme must start by reaching agreement among stakeholders on these issues.

3.1 Causes of Corruption

There are numerous and regionally specific causes of corruption. But generally speaking, they fall within the sociological and institutional groups [17].

- Negative opinions held by employees, citizens, corporations, and politicians against local or state government are societal causes of corruption.
- Weak civil society, inefficient media, and a lack of political will to combat corruption are all typical socioeconomic characteristics that foster an environment where corruption thrives.
- Within this category, there may be cultural concerns that contribute to corruption, such as a conflict between the principles of good government and those of the local culture.
- Institutional reasons for corruption typically result from a lack of accountability and transparency.
- Public officials can hide or mask corruption when there is a lack of openness and information available to the general public. The likelihood of corruption rises when government operations are not open to public inspection [17].
- When there is a lack of accountability, wrongdoing by public servants is rarely or never punished.
- Decentralization can be classified as one of the institutional reasons for corruption. If not effectively managed, decentralization can lead to new, unfavorable incentives in local organizations. Unrealistic or increased demands on officials to provide services within the constraints of their resources can have a detrimental effect on how people view the state.

3.2 Procurement Procedures in Local Governments

Local government entities use government procurement processes to carry out their strategies and satisfy the demand for public services. Egypt's Law No. 182 of 2018 governs the contracts that governmental entities enter into.

Figure 1 illustrates these procedures, which start with identifying the requirements of each local unit and end with the execution of the contract. Because so many people are involved in the implementation of these steps and have informal ties with businesses and suppliers, government procurement procedures are one of the most at-risk areas for corruption (as illustrated in the accompanying image).

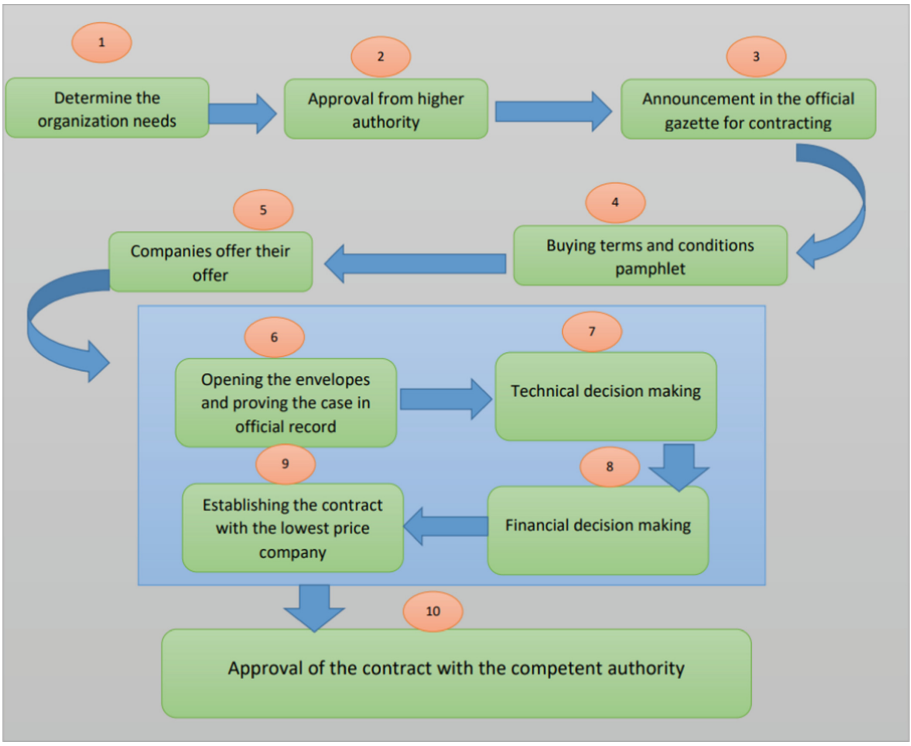

Fig. 1. Procurement Procedure in Local Governments

4 Improve Transparency and Accountability

Increasing the transparency of government operations and decision-making should be the main goal of an anti-corruption effort in a democratic society. A simplified blockchain approach for public procurement may only focus on using hash-function outputs recorded on distributed ledgers to permanently and tamper-resistant record documents and comments that are prone to corruption or removal.

Illegal trades are better known now. With the security of government data at its core, DLT provides an alternative form of data storage that has advantages and disadvantages. If anti-corruption measures are taken into account during the design phase, data storage on the blockchain can have advantageous benefits. Data audits must be included [18]. Initiatives to control land contain some of the most innovative concepts for using blockchain to store public data. Land registration records and land titles can be stored on the blockchain using DLT to protect them against fraud and corruption.

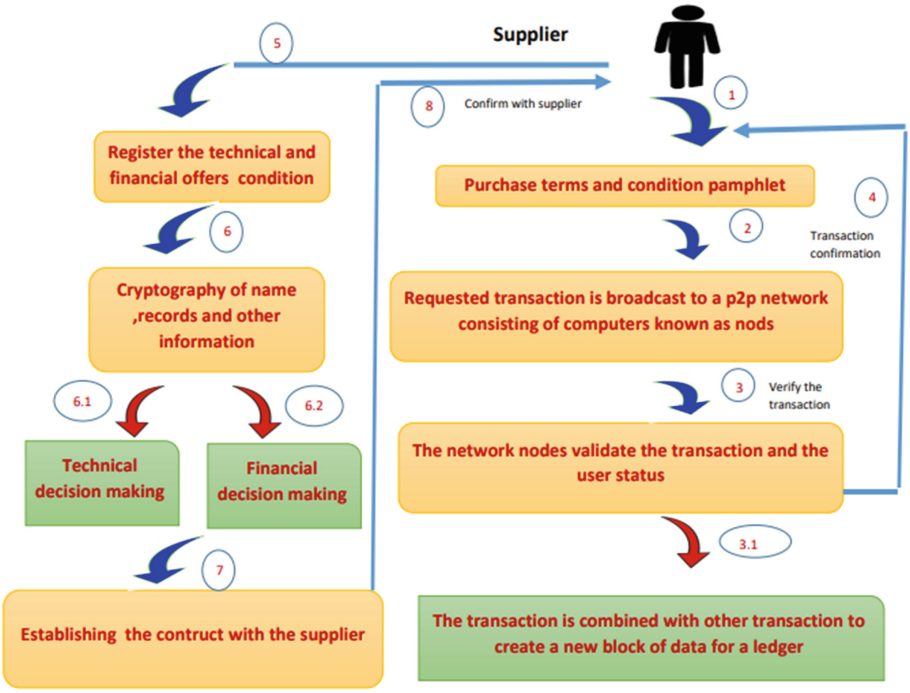

Fig. 2. Modified Procurement Procedure Model

After the supplier purchases the terms and conditions pamphlet, the requested transaction is broadcast to all business-to-business networks to validate the transaction, which is then merged with other transactions to build a new block. There are many sequences in Fig. 2 to increase transparency in the DLT. The supplier can register the technical and financial bids that are processed in cryptographic order once a fresh block has been established.

5 Applying Blockchain to Track Procurement Workflows:

Using blockchain to handle procurement would enable real-time traceability of anomalies, enhancing the immutability of audit trails (Fig. 3). The system will enable real-time auditing to detect corruption and simultaneous viewing of each stage by all stakeholders. Audits may gain credibility as a result of safeguards against unauthorized access and modification of data used for analysis.

Activities start with the provider, and higher authorities are in charge of every function. The first algorithm is used to verify the supplier name and ID associated with the contract that was confirmed by higher authority.

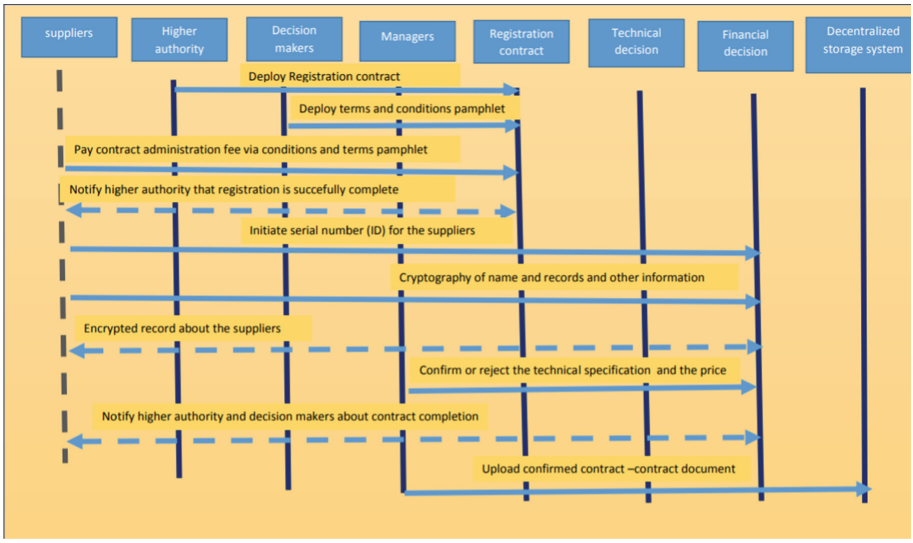

Fig. 3. Tracking Procurement Activities Workflow

6 ALGORITHM: Smart Contract Place Bid

Emerging technical tools like blockchain technology based smart contracts can be utilised as record-keeping systems and as a method to reduce some of the fraud affecting public procurement records. Several applications have already adopted smart contracts' immutability, transparency, dissemination, and automation features to prevent harmful human meddling [19].

Immutability, decentralization, transparency, representation of agreements, self-execution, and verifiability are the key benefits of blockchain-based smart contracts. A pre-written, impenetrable, and unchangeable computer programme that represents an agreement between two or more parties is what we refer to as a "smart contract." A smart contract can take control of and direct the movement of assets with blockchain titles and is stored, copied, and self-executed on a blockchain or distributed ledger. It is triggered by events or conditions that can be digitally verified.

In terms of information decentralization, block chain technology decentralizes the storage and management of all information, distributing it to all network users and reducing government and corporate control over information access [20].

Smart contracts take away a single person's authority from the entire procurement process. The secret entry of a bid is enabled during the bidding phase to prevent privileged access to information or its unwarranted publication. The idea for this came from anonymous auctions. As a result, it is hard for those participating to reveal their bids to rivals.The following algorithm1 illustrate the smart contract place bid [19].

ALGORITHM 1 smart contract place bid	
Input :bidding hash offer hash ,tender , sender	
1	**If status of tender is propose(tender)AND not duplicate bid(sender)**
2	**store(bidding hash)**
3	**store(offer hash)**
4	**lock deposit(sender)**
5	**register bid(sender)**
6	**End if**

Additionally, it is assured that bids cannot be modified once they have been submitted. Because the code of a smart contract is accessible to everyone and there are no vested interests, trust in the process is increased. Regulatory criteria like tax compliance or working condition compliance must be completed during the supplier verification process. The legitimacy of the information is ensured in this subprocess by identities and certificates built on the blockchain. An audit record is always available, so if certifications are issued incorrectly, this can be demonstrated in the future [21].

Therefore, smart contract governance includes decentralised decision-making processes and coordination mechanisms with respect to autonomous data, products, services, and activities in blockchain applications and infrastructure as shown as the following algorithms 2, 3 [21].

ALGORITHM2: SMART CONTRACT SUPPLIER			
	Input: product id ,quantity, supplier name		
1	If sender is a higher authority then		
2		If supplier name is registered in the registration smart contract then	
3			Generate a new contract number
4			Generate a new supplier ID
5			Link new contract number to supplier name
6			Link new supplier ID to supplier name
7			Set contract status to new contract
8			Announce the availability of a new contract for examination
9		End	
10	Else		
11		Revert transaction	
12	Endif		

ALGORITHM3:smart contract order verification
Input :tender

```
1  Prerequisite: only verified supplier ID can execute
2  If status of tender is evaluate
3     Repeat
4        Select supplier ID randomly
5        Wait for validation
6     Until number of all validation reached
7    If all validations correct
8        Release payment
9     Else
10    Terminate process
11    End if
12 END IF
```

7 Conclusion

Corruption in public procurement is a worldwide appearance that causes immense financial and reputational damages. Especially in developing countries, corruption is a widespread issue due to secrecy and lack of transparency. An important instrument for transparency and account ability assurance is the record which is managed and controlled by recordkeeping systems. The discussion ended with the importance of utilizing technology to enhance local governance capabilities in eliminating forms of administrative corruption at local levels. Block chain technology can be used efficiently in limiting the various human interventions with the framework of government procurement carried out by local units, which control potential corruption opportunities. By improving the basic component of internal governance (transparency – accountability-oversight-audit) possible forms of corruption can be eliminated during government procurement processes in local unit and this can have done by using smart contract place bid.

References

1. Pinyaphat, T., Chian, T.: Blockchain: Challenges and Applications (2018)
2. Danda, B.R., Vijay, C., Ronald, D.: Blockchain technology: emerging applications and use cases for secure and trustworthy smart systems. J. Cybersecur. Privacy (2020)
3. Michael, C.N., Pradhan, P., Sanjeev, V., Vignesh, K.: Blockchain Technology Beyond Bitcoin, Sutardja. Center for Entrepreneurship & Technology: Technical Report (2015)
4. Wajde, B., Janet, L., Aniket, M.: Blockchain technology and its applications across multiple domains: a technology review. J. Int. Technol. Inf. Manag. (2021)
5. Exploring Blockchain Technology for Government Transparency. Blockchain-Based Public Procurement to Reduce Corruption, IDB (2020)
6. Niklas, K., Victoria, D.: Blockchain, bitcoin and corruption. A review of the linkages. Transparency International Anti-Corruption Helpdesk Answer (2018)
7. David, A.M., Sobolewski, L.V.: An Assessment of Pioneering Implementations in Public Services. Blockchain for Digital Government. Publications Office of the European Union, Luxembourg (2019)

8. Blockchain for Government Council – Cities Committee Taskforce. Big Innovation Centre (2020)
9. Oliver, M., Elizabeth, P.C.: Corruption consolidation in local governments: a grounded analytical framework. Public Admin. J. **99**, 530–546 (2021)
10. Kendall, D., Funk, E.O.: Consequences of anti-corruption experiment for local government performance in Brazil. J. Policy Anal. Manage. **39**(2), 444–468 (2020)
11. Sunčana, S., Edo, R., Jelena, B.: Determinants of corruption pressures on local government in the E.U. Economic Research-Ekonomska Istraživanja. **33**(1), 3492–3508 (2020)
12. García, H.C.E.: Blockchain innovation technology for corruption decrease in Mexico. Asian J. Innov. Policy. **1**(2), 177–194 (2021)
13. Praveensankar, M., Dhanalakshmi, R.: Blockchain-based smart contract for E-bidding system. In: 2nd International Conference on Intelligent Communication and Computational Techniques (ICCT), Manipal University, Jaipur, 28–29 Sep (2019)
14. Dan, W., Jindong, Z., Chunxiao, M.: Research on blockchain-based E-bidding system. Appl. Sci. **11**, 4011 (2021). https://doi.org/10.3390/app11094011 https://www.mdpi.com/journal/applsci
15. Chen, Y.-H., Chen, Y.-H., Lin, I.-C.: Blockchain based smart contract for bidding system. In: Proceedings of IEEE International Conference on Applied System Innovation. IEEE ICASI 2018- Meen, Prior & Lam (eds) (2018). https://doi.org/10.1109/ICASI.2018.8394569
16. Sarker, S., Henningsson, S., Jensen, T., Hedman, J.: The use of blockchain as a resource for combating corruption in global shipping: an interpretive case study. J. Manag. Inf. Syst. **38**(2), 338–373 (2021). https://doi.org/10.1080/07421222.2021.1912919
17. Maria, G.D.: Reducing Corruption at the Local Level. World Bank (2006)
18. Saikal, A.k., Gregory, J.D., John, A.S.: Chain and silk: alternative futures of blockchain governance in Kyrgyzstan. European J. Futures Res. 1–14 (2022)
19. Weingärtner, T., Batista, D., Köchli, S., Voutat, G.: Prototyping a smart contract based public procurement to fight corruption. Computers 10–85 (2021). https://doi.org/10.3390/computers10070085
20. Myeong, S., Jung, Y.: Administrative reforms in the fourth industrial revolution: the case of blockchain use. Sustainability **11**, 39–71 (2019)
21. Lin, R., Wang, L., Li, B., Lu, Y., Qi, Z., Xie, L.: Organizational governance in the smart era: the implications of blockchain. Nankai Business Review International (2022)