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DIGITALIZATION IN THE FIGHT AGAINST CORRUPTION: FEASIBILITY OF A BLOCKCHAIN-BASED SYSTEM IN TÜRKİYE

YOLSUZLUKLA MÜCADELEDE DİJİTALLEŞME: TÜRKİYE'DE BLOKZİNCİR TABANLI BİR SİSTEM

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ABSTRACT

Corruption is a deliberate behaviour of inefficient use of resources, and this global problem is being tackled with solutions such as blockchain technology. The strong structural features of blockchain technology in terms of transparency and accountability have made it one of the solutions discussed in the fight against corruption in recent years. Therefore, the aim of the study is to investigate the applicability of Blockchain technology in Türkiye's public financial management system using an exploratory and argumentative approach. In this study, the potential of using Blockchain technology in the public sector and especially in public procurement in the fight against corruption is examined. The challenges and opportunities inherent in integrating blockchain technology into the public financial management sector in Türkiye have been thoroughly evaluated. The study's findings indicate that the long-term integration of blockchain technology in Türkiye's public financial management can enhance transparency and accountability. However, it is crucial to address the prevailing legal, technical, institutional, political and social constraints to ensure the successful implementation of this technology.

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ÖZ

Yolsuzluk bilinçli bir şekilde kaynakların etkinsiz kullanımı davranışıdır. Blokzincir teknolojisinin şeffaflık ve hesap verebilirlik açılarından güçlü yapısal özellikleri bu teknolojiyi son yıllarda yolsuzlukla mücadele kapsamında tartışmaya açılan çözüm yollarından biri haline getirmiştir. Bu bağlamda çalışmanın amacı, Türkiye kamu mali yönetiminde blokzincir teknolojisinin uygulanabilirliğini keşfedici ve tartışmacı bir yaklaşımla araştırmaktır. Bu çalışmada blokzincir teknolojisinin kamu sektöründe ve özellikle kamu alımlarında kullanılmasının yolsuzlukla mücadelede potansiyeli incelenmiştir. Blokzinciri Türkiyenin kamu mali yönetimine entegre etmenin zorlukları ve fırsatları değerlendirilmiş ve bu değerlendirmeler sonucunda kamu mali yönetiminde blokzincir tabanlı bir sistemle şeffaflık ve hesap verebilirliği artırmaya yönelik öneriler getirilmiştir. Çalışmanın bulguları uzun vadede Türkiye kamu mali yönetiminde blokzincir kullanımının şeffaflık ve hesap verilebilirliği güçlendirebileceğini; fakat bunun için yasal, teknik, kurumsal, siyasi ve sosyal birtakım kısıtların aşılması gerektiğini göstermektedir.

Keywords: Anti-Corruption, Blockchain, Public Procurement, Transparency, Accountability.

Anahtar Kelimeler: Yolsuzlukla Mücadele, Blockchain, Kamu Alımları, Şeffaflık, Hesap Verebilirlik.

INTRODUCTION

The efficacy of public financial management can be ensured through the principles of transparency and accountability. Whilst significant progress has been made in the institutionalisation of transparency and accountability, innovative approaches are required to prevent human behaviour that prioritises individual interest, such as corruption. Public expenditures, including public procurement, are particularly vulnerable to corruption risk in processes involving various stakeholders. The existence or prevalence of corrupt behaviour in public expenditures leads to public waste through inefficient expenditures, reduced taxable revenue and deviation from the public fiscal balance. This, in turn, creates inflationary pressure and thus economic losses, distorts income justice and undermines public confidence.

In order to prevent the devastating consequences of corruption, it is imperative that various fields work in conjunction to implement preventive measures. The advent of contemporary technological advancements has rendered the integration of transparency, accountability, and citizen participation—which are pivotal to the endeavor of combating corruption—attainable. The strategic implementation of technological innovations has been shown to enhance transparency and auditability, making it easier to prevent corruption before it occurs.

At this point, blockchain technology has started to be discussed as an innovative approach in public financial management, with its structural characteristics for transparency and reliability. The study's focal point is the notion that the distributed ledger structure underlying blockchain technology holds considerable promise as an anti-corruption mechanism in public financial management. This notion encompasses the advantages of immutable data, streamlined transaction monitoring, and fostering trust among parties, which are critical components in ensuring the integrity of transactions. Notwithstanding this potential promise, the integration of this technology into public financial management faces a number of barriers, and this paper comprehensively analyzes its applicability in the Turkish context.

Within this context, the potential application of blockchain technology in combating corruption is examined, particularly in the context of developing an alternative public procurement system in Türkiye. To this end, a scheme has been devised to illustrate the implementation of public procurement and audit processes within a blockchain-based system. The applicability and limitations of this system have been thoroughly examined from a comprehensive standpoint. The study demonstrates that the integration of blockchain technology within Türkiye's public financial management framework has the potential to enhance transparency and accountability. However, it is crucial to acknowledge the necessity of addressing the prevailing legal, technical, institutional, political, and social constraints that currently hinder the full implementation of blockchain-based systems.

The initial segment of the study delineates the notion of corruption and the focal points within the anti-corruption domain. It also explores the role of transparency and accountability in the anti-corruption effort and underscores the imperative for a comprehensive system. The second section expounds on blockchain technology and its implementation in the public sector as a holistic approach to combatting corruption. The final segment discusses the application and limitations of blockchain in the context of anti-corruption measures in Türkiye.

1. CORRUPTION AND THE FRAMEWORK OF AN INTEGRITY SYSTEM

1.1. Conceptual Framework of Corruption

The concept of corruption is perhaps the most important counterargument to the neoclassical notion that individuals are rational and that actions taken to maximise personal utility will also maximise societal utility. Especially in situations where authoritarianism is on the rise (Goel & Nelson, 2021: 1580), moral deprivation is not a personal concern and the judiciary is weak, individuals may ignore the negative externalities of their behavior on society and engage in actions that lead to corruption (Friedrich, 2007: 16; O'Rourke, 2008: 12; Jain, 2001: 77). Judgments arising from subjective logic (de Sardan, 1999: 44) take place in the evaluation of what constitutes moral acceptance and what is excluded from the moral behaviour in question. This renders the definition of corruption particularly challenging within the domain of social sciences (Theobald, 1990: 1).

Whilst it is acknowledged that corruption is a behaviour that can be perpetrated in both the private and public sectors, a review of the extant literature reveals that studies in this field have focused mainly on the public sector (Kurer, 2015: 31; Tullock, 1996; Amundsen, 1999: 3). The crux of the endeavor to combat corruption in any sector is to ensure competition and accountability. Failure to fulfill these conditions can lead to the corruption of economic, cultural, and political cells in a society, with detrimental consequences for both social and economic structures, making anti-corruption a necessity (Amundsen, 1999: 1; Nguyen & Bui, 2022: 5).

In order to effectively combat corruption, it is essential to develop a comprehensive understanding of the underlying causes of this phenomenon. Corruption can be attributed to a multitude of economic, political, legal, and social factors. However, it can be conceptualized as a form of abuse of authority and power. It is therefore imperative to emphasize the significance of accountability and transparency in preventing corruption.

Corruption is principally a type of governmental/non-governmental relationship. The public aspect of this relationship is constituted by non-governmental actors who proffer a form of corruption, such as bribes, in return for receiving benefits. The state side comprises the authority that allocates resources on behalf of the state, including bureaucrats, politicians

and public servants (Kalesnikaite, et al. 2022: 830). Whilst both the state and the non-governmental sector stand to benefit from corrupt behaviour, it is challenging for these benefits to be equally shared. This disparity gives rise to a redistribution of resources from society to the state or from the state to society. In circumstances where resources are redistributed from the non-governmental sector to the state, a select group of government officials at the top accrue the wealth created, while the general population is deprived of this distribution. In instances where financial resources are reallocated from the state to other sectors, the tax exemptions or other privileges granted to certain sectors can result in the inefficient allocation of these resources. The mechanisms through which corruption operates are varied, but the effect on public finances is invariably distorted. The distortion benefits either the capitalist class or certain government officials (Amundsen, 1999: 2-6), while imposing costs on society. To prevent these distorting effects, economic, legal, political and social conditions need to be improved and open to scrutiny. To achieve this, a holistic approach that incorporates all relevant stakeholders-including public institutions, media platforms, and civil society organizations-should be implemented. This approach should be supported by technological advancements to ensure transparency and accountability.

1.2. Integrity System in the Anti-Corruption Practises

The most fundamental way to combat corruption is to ensure transparency in economic and political processes. Transparency can be defined as the open and systematic disclosure to the public of the state's objectives, the activities carried out for these objectives and the information needed to monitor the results of these activities (Atiyas & Sayın, 2000: 28). The establishment of reliable information sharing mechanisms is imperative for the sustenance of transparency. Within the domain of the public sector, the transparent accessibility of information has been demonstrated to both increase the traceability of activities and enable more effective evaluations (Islam, 2003: 2). In summary, the prioritisation of transparency within the public sector is conducive to the prevention of corruption by making government activities auditable and also enables governments to fulfil their accountability responsibilities (Cucciniello, Nasi & Valotti, 2012: 2451).

Accountability, in general, can be defined as the disclosure of activities to a third party. In the context of accountability, individuals or institutions are required to justify and explain their actions to an authoritative figure. Consequently, these individuals or entities are subject to public scrutiny. Transparency is defined as the practice of sharing activities openly and systematically with the public, while accountability is defined as the process of questioning these activities (Akdoğan & Çetinkaya, 2016: 902). Although transparency and accountability are two discrete concepts, they are closely related. Transparency can be defined as the goal to be achieved through accountability (Stirton & Lodge, 2001: 475).

According to Schater, accountability consists of two types: horizontal and vertical. Horizontal accountability refers to accountability to public institutions, while vertical accountability refers to directly to citizens. Since horizontal accountability consists of various public institutions such as courts, supreme audit institutions, restrictive decisions made by these institutions can be seen as a kind of constraint imposed on the government itself (Schacter, 2003: 2-4). Horizontal accountability and vertical accountability should not be regarded as discrete entities; rather, they should be considered as interdependent components of a broader accountability framework. In the context of accountability and transparency, these concepts are mutually reinforcing.

In the context of anti-corruption efforts, the promotion of accountability and transparency assumes a pivotal role, and it is vital that these elements are supported by various constituencies. Pope's argument is that corruption can be classified as a "high-risk-low-return" crime through the establishment of a system of national integrity based on Greek. This system aims to prevent corruption before it occurs, rather than waiting for sanctions to be applied after the fact. The system posits that the columns are independent of one another, yet also provide mutual support. The absence of any individual pillar, therefore, results in a system that is neither balanced nor sustainable, and consequently, the attainment of objectives pertaining to development, the rule of law and quality of life is unattainable (Pope, 2000: 35).

In the contemporary era, the advent of novel technologies has engendered a paradigm shift, thereby allowing for the seamless integration of transparency, accountability, and participation. This paradigm is referred to

as "open government" which encompasses a range of tools, processes, and entities that facilitate transparency, accountability, collaboration, and citizen participation through the strategic application of emerging technologies (Villoria, 2021: 419; Damar et al., 2024). From this perspective, digitalisation is a key strategy for fortifying the temple model proposed by Pope. Technological developments contribute to horizontal accountability by increasing financial transparency and enhancing auditability, and have the potential to provide an important basis for preventing corruption before it occurs.

2. SUPPORTING THE INTEGRITY SYSTEM: BLOCKCHAIN AS PART OF DIGITALIZATION

Traceability of processes is the most significant tool for ensuring transparency and accountability in the fight against corruption. The transparency, auditability and accessibility of public expenditures have been demonstrated to reduce the risk of corruption (Schnell, 2023; Chen & Ganapati, 2023; Castro & Lopes, 2023: 1139). While traditional audit mechanisms and financial reporting processes have achieved a certain level of success in the fight against corruption, innovative approaches that emerged with digitalisation have the potential to make this process more effective by preventing asymmetric information. While theoretical approaches and traditional methods can achieve transparency and accountability, these can only be realised at the highest level by keeping up with the times. Technological developments and the spread of digitalisation in the public sector have particular significance in this regard. Innovations such as digitalization, big data, artificial intelligence, distributed ledger technology, and the Internet of Things, among others, have the potential to create innovative opportunities in ensuring transparency in the public sector (See Table 1). Conversely, adopting these technological advances in the delivery of public services, rather than perceiving them exclusively as anti-corruption tools, will facilitate the development of a preventive solution to those who benefit from corruption from the very beginning and enhance the efficiency of public service delivery.

Table 1: Technologies That Can Be Used To Address Corruption in The Public Sector

Technology Trends	Examples	Opportunities
Digitization/Core Public Sector Enterprise Systems	Digital registries	Improved process controls and transparency
Big Data	Expansion of Data from systems, satellites, smartphones, sensors	Richer feedback and insights from a vast new ecosystem of data
Cloud Computing Platforms	Use of cloud platforms to rapidly scale data integration and analysis	Ability to better leverage conventional core and emerging big data
Artificial Intelligence/Machine Learning	Use of automated/deep learning techniques to identify fraud and corruption risks	Ex Ante or Ex Post risk detection
Biometrics	Unique identification of çivil servants and government program beneficiaries	Civil service registry clearing
FinTech	Dijital money	Cashless transactions, transactiom tracking
Distributed Ledger Technology/Blockchains	Trusted data sources and "smart" contracts	Transparent public spending
Internet of Things	Use of sensor networks	Envioronmental monitoring, public safety

Source: WorldBank (2020).

The utilisation of technological innovations to support the public sector can facilitate real-time monitoring of public expenditures, thereby mitigating the risks of manipulation. In particular, the potential of blockchain technology, with its immutable and decentralised structure, to facilitate the management of the public sector in a secure, transparent and accountable manner is a topic that merits discussion. As a matter of fact the objective of this section of the study is to evaluate the potential of blockchain technology to transform the anti-corruption process.

2.1. Blockchain Technology and Usage in the Public Sector

Blockchain technology emerged with cryptocurrencies as a response to the prevailing distrust of financial institutions and intermediaries. The objective of blockchain technology is to eliminate the costs and problems caused by intermediaries by enabling parties to establish direct relations with each other (Nakamato, 2008: 1).

Blockchain technology provides a decentralized structure as an alternative to a centralized system of records. Control is distributed among users, as opposed to being concentrated in a single center. This objective is to establish a more transparent environment. All transactions are stored in a massive digital ledger that is created with the approval of users and is accessible to all. The process of blockchain technology involves the collection of transactions in a block, which are subsequently appended to the chain in a sequential manner, along with the preceding transactions. Individuals who verify transactions and add blocks to the chain are designated as "miners". Mining entails the resolution of intricate mathematical problems, and the operability of this system is contingent upon the availability of a sufficient number of miners. Once transactions have been validated, they become permanent and unchangeable. In order to validate forged transactions, it would require the simultaneous submission of false confirmation by 51% of all miners. This is considered to be practically impossible due to the significant energy demands of the process (Boucher et al., 2017: 5; Peters & Panayi, 2016: 241).

Blockchain technology is a form of distributed ledger technology (DLT) that facilitates the recording and sharing of data by a multitude of data stores. This technology facilitates the recording, sharing and synchronisation of data and transactions across a distributed network comprising various participants. In essence, a blockchain constitutes a data structure wherein data is stored in a distributed ledger in blocks that successively follow each other in a chain. This process employs cryptographic and algorithmic methodologies to impede data modification and to synchronize this data across all network participants (Natarajan et al., 2017: 1). This particular data structure facilitates a multitude of applications, including cryptocurrency, smart contracts and file storage. DLT can essentially be created in two ways: permissionless (open) and permissioned. An "open system" is characterized by the absence of a central authority, the capability for participants to join the network without the need for approval or review, and the sharing of identical instances of the ledger with participants. In contrast, authorized distributed ledgers are systems that feature a central authority that establishes the rules. This solves problems that may arise due to the use of technology, especially by governments, such as authentication, to whom the license will be granted, and legal ownership of the ledger. This basic feature of permissioned distributed ledgers reduces decentralization, which is the main advantage of blockchains. Nevertheless, it does not require an administrator to execute transactions (Peters & Panayi, 2016: 244).

Of these, permissioned blockchains are considered more suitable for use in the public sector than permissionless blockchains. The latter are encumbered by scalability, security and consensus issues. While these limitations impose constraints on specific functionalities of the technology, they concomitantly enhance its security, transparency, and accountability in terms of auditing and immutability when contrasted with a centralized structure.

The primary characteristics of blockchain technology and their associated benefits can be outlined as follows (Zheng et al., 2018: 357):

- Decentralization: The decentralised nature of blockchain networks obviates the necessity for a centralised approval mechanism, thereby reducing server costs and preventing bottlenecks.
- Persistence: The fact that each transaction requires the approval of a certain percentage of network participants and is recorded in the blocks created ensures that transactions cannot be changed. Consequently, fraudulent transactions are excluded from the system, while authentic transactions that have been validated are retained.
- Anonymity: Each user on the blockchain executes transactions on the system through a digital address, with no centralised entity responsible for the storage of personal information. This ensures the confidentiality of transactions.
- Auditability: Since each transaction in the blockchain is recorded and verified in a specific historical stream, users can access any point in the network to monitor and verify the records that have already been performed. Traceability of data increases transparency.

These inherent features of blockchain allow parties to transact securely without a centrally trusted intermediary or authority, to avoid transaction costs, and to record transactions in an immutable way so that they can be audited at any time (Kosba et al., 2016: 1). In summary, what blockchain basically offers is to eliminate intermediaries and decentralize the entire management system, providing a high level of security and integrity by acting as a database containing records of every transaction performed on the network. Thus, the control of the process is no longer dependent on intermediaries or individuals, but directly on the users (Corrales et al., 2019: 5).

The distinctive features of blockchain and innovations such as smart contracts that have become widespread with this technology have led to a reassessment of potential use cases. According to Kakavand et al. (2017: 18), smart contracts "protocols that facilitate, verify, or enforce the negotiation or performance of a contract, or that make a contractual clause unnecessary". Another definition of smart contracts is given by Wattenhofer (2016: 87) as follows: "an agreement between two or more parties, encoded in such a way that the correct execution is guaranteed by the Blockchain". A smart contract is a code that can be processed into the blockchain. It is able to decide between options as conditions arise without the need for a central authority, perform the desired tasks, and make new contracts when needed. To illustrate this, consider the potential of a smart contract to facilitate public payments to those in need in the aftermath of a natural disaster in a given country. The verification and automation of such payments can be realised through the utilisation of smart contracts (Şat, 2019: 127).

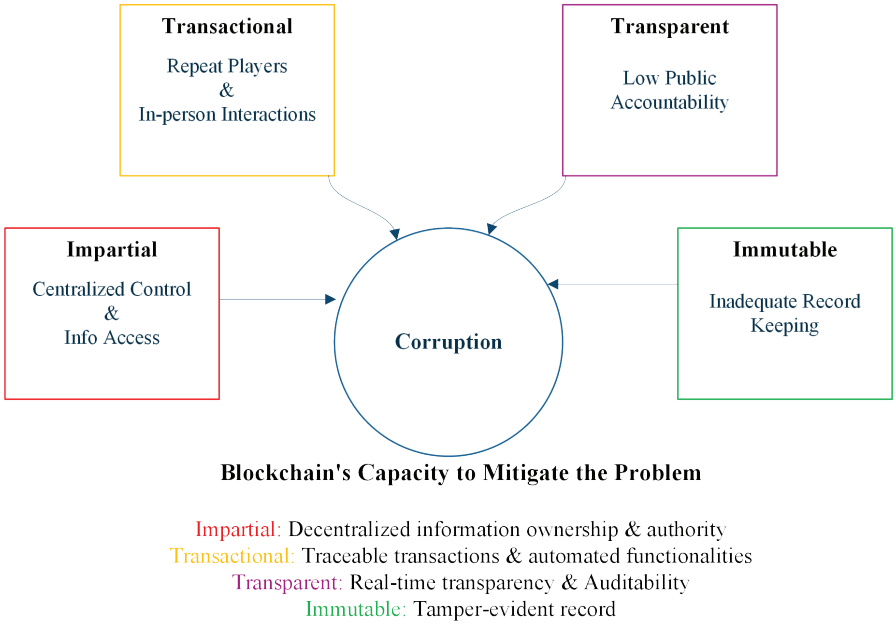
The characteristics of blockchain technology and the trust provided by smart contracts have enabled the implementation of this technology in various applications, platforms, information storage and distribution systems in the public sector (Corrales et al., 2019: 3). Areas where blockchain is used in the public sector also include identification, personal records, financial services and banking, land registry, social benefits, voting, tax revenues and public spending (Berryhill et al., 2018: 25). This study will focus on the use of blockchain technology as an anti-corruption tool in the public sector.

2.2. Using Blockchain Technology as An Anti-Corruption Tool in The Public Sector

From an economic perspective, a contractual arrangement in the classical sense has the potential to give rise to agency problems in two respects. The first of these is the moral hazard, which is based on one party's lack of observation and verification of the other party's actions. Secondly, there is the issue of asymmetric information arising from one party's lack of access to all the information about the contract. The low risk and trustworthiness of contracts between parties in all sectors is contingent on the parties' access to information. In the public sector, a lack of information or access to information may result in corrupt behaviour. A world in which the same individuals are in constant one-to-one communication, public accountability is low, control and

access to information is centralized, and record keeping is inadequate create space for corruption. The previously summarized features of blockchain technology create a mechanism with incentives to fight corruption (Trequattrini et al., 2022: 5) (See Figure 1).

Figure 1: Blockchain Solutions to Several Drivers of Corruption



Source: Davidson Raycraft & Lannquist (2020).

The immutability of blockchain provides a robust security measure against any attempt to modify data that has been processed and validated. Once data has been added to the blocks, it is considered to be beyond the reach of any potential tampering. This attribute of blockchain technology is particularly beneficial in the context of combatting corruption. The distribution of control across multiple parties ensures consensus on all data, thereby promoting transparency (Zbinden & Kondova, 2019: 62). The transparency of blockchain has the potential to enhance the transparency of public services and increase their auditability. The immutability of blockchain renders the censorship and modification of records added to the blockchain impossible, thereby precluding the corrupt intentions of a centralized structure or intermediaries (Sanka & Cheung, 2019: 4). Smart contracts, which are open

and self-executing, can also provide a solution to corruption violations by increasing transparency and public accountability, as once executed, they can make information available to all parties and prevent asymmetric information (de Souza et al., 2018: 2).

In conventional methods, the outcome of financial transactions is ascertained only after the transaction has been completed. To illustrate this point, consider the instance of budget final account proposals or audit reports. It is conceivable that transactions have not yet been completed, and therefore have not been incorporated into the relevant documents or reports. Information regarding these transactions can only be obtained upon their completion. However, the advent of blockchain technology has rendered it possible to monitor transactions that have not yet been documented. Conversely, the ability to trace completed transactions back to their origins is also facilitated. The technology facilitates the discernment of alterations made to transactions during the course of the process, including the parties responsible for these modifications. In terms of accountability, it is imperative that transactions are stored in a secure manner, making them more resilient to corruption or destruction than traditional methods (Eroğlu, 2023: 200). From a public accountability perspective, the utilisation of distributed ledgers and programmable smart contracts has the potential to reduce bureaucracy and discretion, thereby mitigating the risk of corruption. Furthermore, it can enhance the automation, transparency, auditability and accountability of information in government records, serving the public interest. Ultimately, this can lead to an increase in trust (Allessie et al., 2019: 10).

In brief, the most substantial advantages of blockchain technology in the effort to combat corruption can be categorized into two distinct groupings. The initial concept is the decentralization of information. This approach is predicated on the notion that it can enhance public accountability. The second is the transparency in information flows. Transparent monitoring of processes will not allow for any interference and will also pave the way for auditability. In addition to these benefits, smart contracts are designed to ensure that the parties involved adhere to the relevant legislation. This development is expected to lead to a more automated and streamlined process, enhancing efficiency and reliability (Dağlıoğlu Şanlı, 2024: 93).

A plethora of blockchain initiatives have been developed on an international scale with the objective of combating corruption within the public sector. In 2018, the Canadian Industrial Research Assistance Program (NRC IRAP) established a blockchain-based program in collaboration with SMEs. This program encompassed the recording of substantial financial transactions necessitating transparency and public disclosure (Canada, 2018). In a collaborative endeavour between the Inter-American Development Bank (IDB) and the Office of the Inspector General of Colombia (Procuraduría General de Colombia), a project has been initiated with the objective of investigating, conceptualising and evaluating the potential of blockchain technology in the context of public processes that are susceptible to corruption. The project has been conceived with the objective of procuring the Programa de Alimentación Escolar (PAE), the public school meal programme, a programme of high-priority that provides meals to the country's most vulnerable children in order to prevent corruption in procurement (Lannquist & Raycraft, 2020: 4).

In the Republic of Korea, a blockchain-based system was developed with the objective of ensuring transparency and reliability in the process of public tenders. The objective of the system was to address the lack of confidence in the award of public contracts by parties that typically do not secure the tender. The system has been designed to digitise the evaluation process by utilising blockchain technology to record the outcomes of the evaluation process in a transparent and verifiable manner. This has been done to ensure the procurement procedures are conducted with the utmost transparency, integrity, and auditability, thereby enhancing the comfort level of evaluation committee members (WorldBank, 2021: 92).

In Mexico, the HACKMX project, initiated in 2017, sought to enhance transparency and trust, and to optimise public procurement processes by leveraging blockchain technology to organise public tenders (Zbinden & Kondova, 2019: 62). In the Aragon region of Spain, a blockchain-based bidding process was developed as a solution to the rising level of corruption (Zbinden & Kondova, 2019: 62). This innovation has effectively eliminated the need for a third party to evaluate bids in bidding processes. Following the official launch of the system, more than 25 tenders were organised within a year (WorldBank, 2021: 91). Another area where blockchain technology is used in the context of corruption is land registry records. In this context, pilot projects have been developed by some countries, including Sweden and Georgia (Kossow & Dykes, 2018: 10).

Despite the inclusion of blockchain technology in various strategic documents in Türkiye (Can & Akman, 2024: 199), no projects have been developed in this field, particularly in the context of combating corruption in public procurement. However, a study by Eroğlu (2023) prepared an exemplary financial process diagram that will ensure public financial audit and transparency. This diagram was prepared by using blockchain technology over the functions of the institutions involved in the budgeting process.

In addition to these practices and projects that experiment with blockchain technology, there are also criticisms that the technology is difficult to use. At its core, corruption is predicated on close relationships, centralisation and the abuse of power. The potential of blockchain to combat corruption in the public sphere is contingent on the specific blockchain structure employed, such as a permissionless distributed ledger. Conversely, the utilisation of permissioned blockchain can be regarded as imposing a form of centralized constraint on the autonomous nature of the technology.

In the context of public procurement, the blockchain structure to be utilised assumes significance, with the implementation of a permissioned or permissionless structure proving to be a strategic imperative. While the permissionless structure is decentralised and transparent, it has the potential to give rise to legal challenges. Conversely, the adoption of a permissioned structure, while potentially addressing these concerns, comes at the cost of enhanced transparency. The World Bank (2021: 74) asserts that, with control being vested in a designated authority, the identity of the participants may be known, which can potentially give rise to a trust problem.

Another point of criticism of this system stems from smart contracts. The immutability of smart contracts necessitates a comprehensive examination of all potential scenarios. The programming of these contracts necessitates a comprehensive economic perspective (WorldBank, 2021: 50). In addition to the economic perspective, it is imperative that the legal perspective is incorporated into the code language in meticulous detail, as fundamental rights pertaining to personal data, intellectual property, and trade and industrial secrets (patents) necessitate protection. The complexity of contracting processes creates significant challenges in completely excluding self-interested behaviour from public procurement processes (Carvalho, 2019: 225). Conversely, while the human element cannot be entirely eliminated, legislative frameworks and

regulatory mechanisms are instrumental in determining the extent of the technology's proliferation. A regulatory legal approach that preserves the innovative spirit of blockchain technology without ignoring the crises and risks that it can create, can provide a balance (Yeoh, 2017: 204).

Another obstacle to the widespread use of blockchain is the lack of standardisation. Achieving standardisation would facilitate interoperability, scalability, auditing, and the potential regulation of the technology. In this context, the removal of security and privacy risks necessitates the establishment of an internationally valid standard (König et al., 2020: 2).

Regardless of the field, it may require time to adapt to technological innovations. It is evident that the public sector will encounter impediments, including an initial reluctance to adopt blockchain technology, challenges in integrating it with existing legacy systems, and the financial implications of adoption (Williams-Elegbe, 2019: 18). While the utilisation of digital tools in the endeavour to combat corruption is not anticipated to entirely eradicate the issue, more efficacious outcomes can be attained in the long term if these impediments are surmounted and an utilisation domain is forged within the pertinent sector.

3. APPLICABILITY OF A BLOCKCHAIN-BASED SYSTEM IN TÜRKİYE

Since the use of blockchain in the public sector is a relatively new idea, the research is exploratory in nature. The study aims to create a scheme for the use of blockchain in public procurement within the scope of anti-corruption. For this purpose, a scheme is constructed based on the literature given above and the applicability and limitations of the scheme in Türkiye are discussed.

3.1. Blockchain Application in Türkiye

It is important to implement new anti-corruption reforms, strengthen oversight mechanisms and adopt innovative approaches to increase budget transparency. While each of the four pillars of Pope's anti-corruption strategy can be strengthened, the addition of a new pillar, such as technology, can also help to increase support for the others.

Within the scope of the study, a public expenditure example will be created through public procurement via open tender method that everyone

can participate by using blockchain to fight corruption in Türkiye. Public procurement is a vital component of public financial management, as it involves the acquisition of goods and services necessary to fulfil the functions of the state and optimise public welfare. Public procurement plays a pivotal role in the delivery of public services. However, the process entails significant potential for corruption through various means, including bid rigging, collusion, manipulation of engineering specifications, over-invoicing, under-procurement of materials and outputs, and wholesale diversion of centrally budgeted funds (Azfar, 1999: 13). This is the primary reason why this study focuses on public procurement through tenders as an example.

Corruption in public procurement is considered to be the result of asymmetric information, divergent preferences, varied risk assessments and conflicts of interest that distort the principal-agent relationship. Many stages of the procurement process are susceptible to manipulation from various angles, including purchasing decisions, bid evaluation and project approval. These include a lack of transparency, the prevention of competition, the acceleration of the contracting process beyond its intended duration, and the failure to disclose decisions or provide justification (Yukins, 2010: 66). Additionally, the implementation of contracts and the payment stages have been identified as areas that are susceptible to corruption (Williams-Elegbe, 2019: 10).

In Türkiye, when it is necessary to make expenditures that are not within the scope of legally mandatory expenditures but arising from need, an appropriation is allocated according to the needs of that year with the proposal of the institution. The use of these appropriations is within the scope of the public procurement process (Altuğ, 2019: 92). The current procurement process in Türkiye has been carried out digitally through the Public Procurement Platform (EKAP) since 2010. The use of the EKAP system provides instant access to the tender processes monitored by the Public Procurement Authority and accelerates the processes. Another contribution of EKAP is that it facilitates access to specifications. Pursuant to Law No. 5018 on Public Financial Management and Control, all administrations designated as spending units, as well as administrations not subject to this law, are required to register with EKAP if they conduct tenders under Public Procurement Law No. 4734. In addition, EKAP enables the query of banned contractors; thus, public institutions prevent banned contractors from participating in tenders (Durdu & Gökçe, 2022: 45). A comparison of the features of EKAP and Blockchain can be found in Table 2.

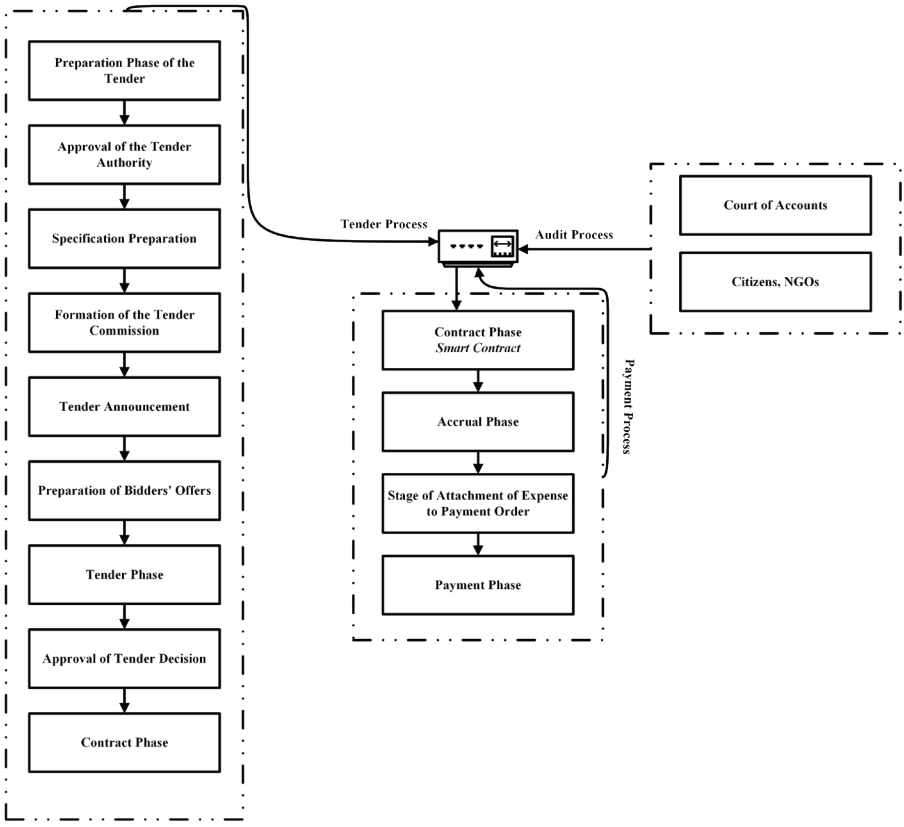
Table 2: Differences between EKAP and Blockchain

Feature	EKAP	Blockchain
Centralized - Distributed Structure	Centralized	Distributed
Persistence	Data can be changed	Data cannot be changed
Transparency	Level of transparency determined by public institutions	Traceability by all parties registered in the network
Data Security	Provided by the central authority	Provided by Cryptography
Audit	Public authorities	Network members
Processing Speed	Depends on the capacity of the central system	Depends on the blockchain network and block transaction times. Can be slower than centralized system

Source: Created by the author.

EKAP enables the digital execution of the procurement process. Its features have been effective in making this process transparent and facilitating process management. In addition, legal validity and transaction speed are important advantages. While the transparency offered by EKAP is satisfactory in terms of tender processes, a model in which the audit mechanism is simultaneously included in the system can strengthen it. In this context, a blockchain-based example has been created in Figure 2. This example does not envisage blockchain technology as a digital system that can replace EKAP, but as an innovation that will strengthen this system.

Figure 2: Blockchain-Based Public Procurement Case



Source: Created by the author.

The public tendering process is comprised of three fundamental steps. The initial stage is the tender process, which commences with the identification of the need. The subsequent stage is the execution of the winning contractor's work, followed by the institution's remuneration. The final stage is the auditing of all these stages. In the event that the initial two phases are documented on the blockchain network, the audit mechanism can be performed in a continuous manner through the network.

Figure 2 provides a visual representation of the relationship between these three steps and blockchain technology. The initial step in this process is the initiation of the tender process. During this process, all transactions are meticulously documented on the blockchain network, including the collection of preparatory documents, approval processes, announcements, incoming

bids, and the contracting of the winning contractor. Consequently, the selection criteria and all bids received in accordance with them are systematically documented.

The second stage of the process, which will henceforth be referred to as the payment process, is the entering into of a contract with the winning contractor. Within this payment process, smart contracts consisting of predetermined conditions are utilised. The disbursement of payment is initiated upon confirmation that the stipulated conditions have been met, as governed by the terms of the smart contracts.

In the audit phase, if all records are kept on the blockchain, the Court of Accounts can access the data instantaneously, thus meeting the requirement for centralized audit. The proposed scheme's innovative nature lies in integration of decentralized oversight mechanisms through non-governmental organizations (NGOs) and citizens within the audit system. For a systematic and secure engagement to take place, it is necessary to identify new participants in the oversight mechanism according to transparent and predefined criterias. These criterias may include the legal status of the organization, its expertise in the procurement subject matter, its history of public participation, and its independence from tender participants. A decentralized registry maintained on the blockchain has the potential to list NGOs and citizen groups that meet these criterias, thereby enabling active matching according to the subject matter of the tender. The integration of NGOs and citizens within the pertinent domain can be facilitated by the implementation of smart contracts. Upon the initiation and validation of a new tender on the blockchain, a smart contract is capable of automatically evaluating which groups meet predefined criteria and offering access rights accordingly. These access rights delineate the extent of data access permitted for each group and specify the categories of data that can be accessed. Additionally, smart contracts have the capacity to automate feedback loops, enabling a select group of NGOs and citizens to submit comments directly to the system. These transactions can be recorded and chronologically validated on the blockchain, thereby creating an immutable audit trail. This configuration enhances transparency and mitigates the risk of closed audit circles by facilitating pluralistic and dynamic oversight.

The utilisation of blockchain technology in the domain of public expenditures has been purported to facilitate the realisation of principles such as transparency, competition, equal treatment, security, confidentiality, and openness to public scrutiny (Altuğ, 2019: 93). The transition of the existing system to the blockchain network, a digital ground, serves to prevent non-transparent tender processes. The presence of smart contracts ensures that payments are approved by verifiers, thereby preventing the misuse of public funds. The immutability of records within the Blockchain system renders reports generated after the completion of a project resistant to manipulation. The Court of Accounts, NGOs and citizens can all access the system, thereby increasing transparency and preventing irregularities. While the advantages of blockchain technology in the fight against corruption are significant, there are some limitations in its implementation in Türkiye.

3.2. Applicability and Limitations

The following discussion will address the applicability of the aforementioned sample expenditure system in Türkiye, taking into consideration the prevailing legal, political, institutional, technological and social conditions, as well as the constraints that may be encountered therein.

Legal Applicability and Limitations:

Despite the establishment of legal regulations in Türkiye pertaining to crypto-assets, including licensing and the designation of authorised institutions, no legal regulation has been instituted with regard to blockchain technology. In order to implement the blockchain example given above regarding public tenders, it is first necessary to establish a legal infrastructure for this technology.

The initial legislative framework for blockchain in the context of public finance is the Public Financial Management and Control Law No. 5018. This legislation stipulates the principles for the effective, transparent and accountable utilisation of public resources within the Turkish jurisdiction. Regulations to be made in the said law in terms of both public expenditures and public revenues in terms of blockchain will serve to strengthen the guiding mechanism of the law.

In the context of Turkish public procurement legislation, the expenditure of funds allocated for specific needs is governed by the Public Procurement Law. The Public Procurement Law No. 4734, the Public Procurement Contracts Law No. 4735 and the State Procurement Law No. 2886 are complementary legislation to which the public sector is obliged to adhere during the course of its procurement processes (Altuğ, 2019: 93). These legal instruments stipulate the establishment of a blockchain-based procurement system and delineate the modalities of its utilisation in the context of public procurement processes.

It is imperative that a further legal update be made for the Court of Accounts Law No. 6085. This legislation must delineate the methodology for conducting real-time audits through the blockchain network. The persistent nature of blockchain technology serves to reinforce the efficacy of the audit mechanism, whilst the utilisation of smart contracts serves to mitigate the risk of document misplacement or forgery, thereby facilitating the expeditious execution of audits. Consequently, while the audit process is expedited, the risk of error is concomitantly diminished.

Legal regulations should not be limited to public expenditures, procurement and audit processes. The open nature of blockchain technology may conflict with the Law No. 6698 on the Protection of Personal Data. In order to prevent this a two-tier system can be set up. While permissioned blockchains are frequently prioritized in public administration due to concerns regarding data security, this does not inherently contradict the transparency objectives of the proposed anti-corruption scheme. Indeed, the system can be configured with multiple tiers of access levels, wherein fundamental transactional data is accessible to a broader audience, while sensitive personal or confidential information remains restricted. The utilization of smart contracts facilitates the allocation of access rights based on roles without compromising security protocols. This two-tier system enables meaningful public oversight while protecting the integrity and confidentiality of the system. In addition, legal arrangements should be in line with international public procurement standards.

Institutional Viability and Limitations:

Türkiye has made notable progress towards digitalisation in the public sector, evidenced by the introduction of e-Government applications. The nation

has also incorporated blockchain technology into its latest development plans, with the objective of integrating such applications into both corporate and social spheres. The e-Government platform currently in use can be integrated into a blockchain-based network. This would provide a transparency system that citizens can access within a certain authorization level.

In addition to the utilisation of e-government platforms, a range of digitalisation initiatives are underway to shape the future. One such initiative is the research and development (R&D) work initiated by the Central Bank of the Republic of Türkiye (CBRT) in 2020 for digital currency. It is evident that the integration of innovation into a system necessitates extensive research and the involvement of the individuals and institutions that will utilise the system. The applicability of blockchain technology at the corporate level will also require time. The widespread adoption of this technology is predicated on the successful completion of pilot projects. In terms of the tender process, a blockchain-based centre can be established where institutions such as the Court of Accounts, the Ministry of Treasury and Finance, and the Public Procurement Authority come together under a common roof to manage the three steps mentioned above, consisting of tender, payment and audit. However, it should be noted that such integration processes would not only be time-consuming, but also incur significant costs in terms of technological development, digital integration, and personnel adaptation.

Technological Feasibility and Limitations:

Although digitalisation is not a novel concept within the Turkish public sector, the unique characteristics of the technology present considerable challenges to its implementation on a broad scale. To illustrate this point, consider the challenge of processing a high volume of transactions in public expenditures on a daily basis. This may impede the efficacy of blockchain technology in managing such extensive data on the network. In such circumstances, the deployment of a permissioned distributed ledger designed for a specific task can facilitate technology management. Conversely, the processing of such extensive data on a single historical chain can also give rise to challenges. To circumvent these challenges, the deployment of sidechain solutions can be employed to alleviate the data load. It is imperative to emphasise that the implementation of these solutions necessitates a substantial degree of technical expertise.

One of the reasons for the limited use of blockchain technology in the public sector is that there are too many personnel to be trained in public services and public institutions work with citizens' personal data. A technical problem in the blockchain training of the staff in a government institution can result in data breaches, which increases the size of the risk (Bozdoğanoğlu, 2023: 376). Given that civil society organizations and citizens are also the building blocks of the proposed system, the technological constraint is not limited to the digital literacy of public officials. Rather, it requires that NGOs and citizens also have the competence to play an effective role in the use of technological innovation. A dual strategy is required to address this issue. Initially, the interface layer of the blockchain system must be designed to be user-friendly, thereby allowing non-technical users to monitor key indicators and access relevant data. Secondly, the development and institutionalization of digital literacy programs focusing on educating these individuals and groups on fundamental blockchain principles, data interpretation, and related concepts is imperative. The implementation of public education campaigns, in conjunction with collaborative efforts with academic institutions and technology NGOs, has been identified as a potential strategy to support capacity building. In the absence of these investments, there is a concern that the proposed decentralization of oversight may become more symbolic than effective.

A failure to provide technical expertise can also pose a significant threat to cyber security. As a fundamental component of blockchain, the confirmation and recording of a transaction is contingent upon the concurrent approval of 51% of all miners in the system. It is imperative that robust verification mechanisms are developed to ensure that this 51% confirmation cannot be sabotaged by malicious users.

Political Limitations and Social Integration:

As technological innovations become a part of everyday life, it is also time-consuming for people to adapt to this innovation. Furthermore, conflicts of interest may result in individuals exhibiting resistance towards the adoption of this technology. The study posits that corruption is essentially a result of behaviour that seeks to maximise personal interests. The widespread adoption of an audit mechanism of this nature may encounter resistance from politicians, bureaucrats and other interest groups, as it would hinder the benefits accruing from corruption.

Furthermore, it will require a considerable investment of time before this innovation is fully integrated into societal norms. Organising training and awareness-raising activities is recommended, with the objective of inculcating in citizens the importance of individual accountability and transparency in the fight against corruption. Such activities should also encourage citizens to question and follow up, and to use technology for this purpose.

CONCLUSION

This study employs an explanatory and argumentative approach to examine the use of blockchain technology in the fight against corruption in public expenditures, and its applicability in Türkiye. Corruption is a global behaviour with disruptive effects on economic, financial and social scales; therefore, solutions are sought through different means to prevent it. According to Pope's holistic approach, the combination of different mechanisms, such as the legislature, the public sector, the media and NGOs, will make corruption a high-risk and low-return crime. The proposed model draws inspiration from the architectural design of Greek temples, with each mechanism interdependent, akin to the pillars that uphold the structure. This study proposes a digitalisation pillar as a support system for these mechanisms. In addition to this proposal, the study explores the applicability of blockchain technology by assessing the current state of digitalisation in the context of combating corruption in public expenditures in Türkiye, with a particular focus on procurement processes. The study further proposes a sample scheme, illustrating a method by which public procurement and audit processes in Türkiye can be executed in a Blockchain-based system.

It is hypothesised that the structural characteristics of blockchain technology, namely immutability, decentralisation, and the ability to trace transactions, have the potential to contribute to the reduction of corruption in public expenditure, due to the transparency and accountability that blockchain technology engenders. When these structural characteristics are combined with smart contracts, there is a possibility that they can play a role in ensuring public trust. Blockchain technology can provide increased levels of information and vertical accountability in the public sector, while at the same time changing administrative processes and eliminating 'middlemen'

with discretionary authority over resources, thus preventing opportunities for corruption. However, blockchain technology, whose anti-corruption impact has not been sufficiently tested, is also the focus of some criticism. One of the main criticisms is that the technology requires proper data entry in order to be used effectively. Incorrect recording of transactions, for example, calls into question the reliability of the technology. Moreover, since the technology is also the basis of cryptocurrencies, it may allow for completely anonymous and encrypted cryptocurrency transactions to be used by corrupt actors for embezzlement or fraudulent deals.

In Türkiye, as in the rest of the world, digitalisation has become an integral part of different areas of the public sector, including tender processes. The EKAP, which has been in use since 2010, facilitates processes such as auditing and public disclosure, and tenders are now conducted electronically. While this transition represents an important step towards increasing transparency and accountability, encouraging innovative initiatives in the fight against corruption creates an environment for more robust steps to be taken in this direction. This forms the basis of the present study. In line with this objective, a plan has been developed to conduct procurement, payment and audit processes through a blockchain network in order to increase transparency and accountability in public procurement. The rationale behind this approach is to ensure that each stage of the process can be systematically tracked, thereby facilitating transparency and accountability in the fight against corruption. The utilisation of a unified mechanism, such as the blockchain network, for the execution of the tender, payment and audit processes is anticipated to serve as a bulwark against data manipulation and irregularities, thereby ensuring transparency and accountability in public procurement.

The study introduces new audit elements, including NGOs and citizens, to the fight against corruption. To ensure the effective implementation of this proposed social audit mechanism, the selection of NGOs and citizen auditor groups is based on transparent and predefined criterias. Organizations that possess expertise directly related to the subject of the tender, that are impartial, and that operate in the public interest will be automatically identified by the system. The management of this process and the allocation of data access rights will be facilitated through the implementation of smart contracts. Consequently, structures predicated on a dynamic and pluralistic

audit network will be supported, not only on centralized audit.

Türkiye's utilisation of digital instruments such as E-Government and EKAP within the public sector, in conjunction with the pervasive adoption of blockchain technology in recent development plans, signifies the nation's openness to transformative innovation. However, there are various limitations in terms of the applicability of these systems. Primarily, the necessity for legal frameworks to ensure the seamless integration of blockchain technology is paramount. There is a necessity for the harmonisation of legislation, including but not limited to laws concerning tender processes (Law No. 5018), the use of personal data (Law No. 6698), and the Court of Accounts Law No. 6085 on auditing, with the aforementioned technology. The capacity of institutions, staff and citizens to adapt to technology, the establishment of the necessary technical infrastructure and the estimation of the costs to be incurred should be evaluated in conjunction with criticisms of technology. These challenges necessitate the formulation of long-term and comprehensive road maps to facilitate their navigation and overcome them.

The agility, expertise and infrastructure of the private sector can be utilised in the planning of these roadmaps. It is recommended that the roadmap be tested in small-scale pilot projects prior to its integration across the entire public sector. Furthermore, it is imperative to raise public awareness of the importance of technology in the fight against corruption, and to organise training programmes to increase technological literacy.

The study shows that a well-designed blockchain network can be an important tool in the fight against corruption in public expenditures. It also provides significant support for the temple approach developed by Pope and the use of blockchain technology in Türkiye can prevent corruption in public expenditures. Considering the criticisms of blockchain technology, it is clear that legal, technical and administrative reforms must be made for these. Future studies must delve deeper into these reforms, assess their applicability to public revenues or different public services, and determine whether the technology can boost efficiency in the public sector.

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YOLSUZLUKLA MÜCADELEDE DİJİTALLEŞME: TÜRKİYE'DE BLOKZİNCİR TABANLI BİR SİSTEM

Ezgim YAVUZ

GENİŞLETİLMİŞ ÖZET

Asimetrik bilgiye dayalı bilinçli bir davranış olan yolsuzluk, kaynakların etkinsiz kullanımı sonucu ekonomik büyüme, gelir dağılımı, kaynak tahsisi gibi çeşitli alanlarda bozucu etkiye sahiptir. Bireysel çıkarları gözeterek yapılan bu eylem toplumsal refahtan uzaklaşılmasıyla sonuçlanmakta, tam da bu nedenle yolsuzlukla mücadeleye yönelik çalışmaları gerekli kılmaktadır.

Yolsuzlukla mücadele, şeffaf ve hesap verilebilir bir ortamın sağlanmasıyla mümkündür. Bu ortam ise birden fazla paydaşın yer almasıyla kuvvetli bir şekilde kurulur. Şeffaflık, hesap verebilirlik ve vatandaş katılımının entegre olarak çalışması günümüzde teknolojik ilerlemenin sunmuş olduğu yeniliklerle daha mümkündür. Dijitalleşmenin bu alanda sunmuş olduğu yeniliklerden bir tanesi de Blockchain teknolojisidir.

Blockchain teknolojisinin temel özellikleri olan adem-i merkeziyetçilik, işlemlerin kalıcılığı, anonim yapısı ve denetlenebilirliği şeffaflık, hesap verebilirlik ve farklı kesimlerin denetim sürecine katılmalarını oldukça kolaylaştırmaktadır. Bu çalışmada da blokzincir teknolojisinin belirtilen özellikleri kapsamında yolsuzlukla mücaadelede nasıl kullanılabileceği hem teknik olarak hem de dünya örnekleri üzerinden incelenmiş, buna ek olarak Türkiye'de uygulanabilirliği tartışılmıştır.

Çalışmanın sonucu detaylı bir şekilde planlanmış blokzincir sisteminin yolsuzlukla mücadelede kullanılabilecek önemli bir araç potansiyeli taşıdığını göstermektedir. Söz konusu yenilik farklı kesimler için yolsuzlukla mücadeleyi destekleyip, güçlendirebilecek ve tüm kesimlerin entegre çalışmasına olanak tanıyacak mekanizmaya sahiptir.

Öte yandan blokzincir teknolojisinin yukarıda sayılan temel özellikleri yolsuzlukla mücadalede yeterince test edilmediğinden eleştirilere de açıktır. Verilerin değiştirilmezliği nedeniyle en başta doğru veri girişini gerektirmesi ya da blokzincir temelli olan kripto paraların yolsuzluğun önünü açması bu eleştirilerin başında gelmektedir.

Kamu sektöründe dijitalleşmenin arttığı Türkiye'de de yolsuzlukla mücadeleyi destekleyici yeniliklerin takip edilmesi önemlidir. Bu kapsamda çalışmada, örnek bir blokzincir tabanlı kamu alım şeması oluşturulmuş ve bu şemanın hukuki, kurumsal, teknolojik uygulanabilirliği ile siyasi kısıtları ve toplumsal entegrasyonu tartışılmıştır. Bunun sonucunda Türkiye'de yolsuzlukla mücadelede blokzincir teknolojisinin kullanımının avantajlı olabilmesi için uluslararası standartlarla uyumlu mevzuat düzenlemelerinin yapılması, bu sistemin kurulması için teknik uzmanlardan faydalanılması, verilerin kapsamlılığının yaratacağı sorunların önüne geçmek adına destekleyici zincirler (sidechain) kurulması gibi uzun vadeli çalışmalar gereklidir. Bunlara ek olarak kişisel menfaatlerin engellenmesi nedeniyle çıkar grupları tarafından dirençle karşılaşılabilir. Ayrıca toplum genelinin djital bir denetim mekanizmasına adapte olması ve bunun alışkanlık haline gelmesi eğitim ve farkındalık çalışmaları gerektirdiğinden uzun vadeli planlamalar şarttır.