THE USE OF BLOCKCHAIN TECHNOLOGY IN PUBLIC ADMINISTRATION: IMPLICATIONS FOR TURKEY

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ABSTRACT

THE USE OF BLOCKCHAIN TECHNOLOGY IN PUBLIC ADMINISTRATION: IMPLICATIONS FOR TURKEY

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This study aims to evaluate the academic literature and current blockchain implementations in public administration in the Republic of Korea, Estonia, Australia, United Kingdom and Israel, to discover possible opportunities, challenges and implementation areas of this technology for Turkish public administration. The selection of the countries is based on the UN EGDI and the OECD STI Scoreboard. In the first part, the features of blockchain technology and the academic literature were analyzed. Then, strategic documents and examples of blockchain implementations in public administration in the above-mentioned countries were examined. According to analyses, the potential advantages of blockchain for Turkey, possible implementation areas, and challenges of blockchain implementation in Turkish public administration were identified. The study suggests that Turkey is in the preliminary stage for the implementation of the blockchain technology. Potentially, blockchain can be implemented in the areas of land registry education, voting, identity management, healthcare, supply chain management, energy, IoT, and public finance management in Turkey. Additionally, it may be applicable to certain e-

government services, such as drivers' license renewal or obtaining vaccine passports. On the other hand, the permanent and unalterable storage of sensitive citizen information can threaten privacy in different ways. In addition, there can be organizational challenges in implementation due to the bureaucratic culture. Therefore, usage areas should be considered in detail before implementation. Country examples reveal that conducting proof of concept and pilot studies in Turkey has importance for the implementation of the blockchain and ICTs, especially regarding the initial coin offerings and digital money.

Keywords: Blockchain, E-Government, Technology, Public Administration, Turkey

ÖZ

KAMU YÖNETİMİNDE BLOCKCHAIN TEKNOLOJİSİNİN KULLANIMI: TÜRKİYE İÇİN UYGULAMALARI

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Bu çalışma, Kore Cumhuriyeti, Estonya, Avustralya, Birleşik Krallık ve İsrail'deki kamu yönetiminde akademik literatürü ve mevcut blok zinciri uygulamalarını değerlendirmeyi, bu teknolojinin Türk kamu yönetimi için olası fırsatlarını, zorluklarını ve uygulama alanlarını keşfetmeyi amaçlamaktadır. Ülkelerin seçimi, BM EDGE ve OECD STI Skor Tablosuna dayanmaktadır. Birinci bölümde blockchain teknolojisinin özellikleri ve akademik literatür analiz edilmiştir. Ardından, yukarıda belirtilen ülkelerdeki kamu yönetiminde blok zinciri uygulamalarına ilişkin stratejik belgeler ve örnekler incelenmiştir. Analizlere göre ışığında blok zincirinin Türkiye için potansiyel avantajları, olası uygulama alanları ve Türk kamu yönetiminde blok zinciri uygulamasının zorlukları tespit edilmiştir. Çalışma, Türkiye'nin blockchain teknolojisinin uygulanması için ön aşamada olduğunu göstermektedir. Potansiyel olarak blockchain, tapu eğitimi, oylama, kimlik yönetimi, sağlık, tedarik zinciri yönetimi, enerji, IoT ve kamu maliyesi yönetimi alanlarında Türkiye'de uygulanabilir. Ayrıca ehliyet yenileme veya aşı pasaportu alma gibi bazı e-devlet hizmetleri için de geçerli olabilir. Öte yandan, hassas vatandaş bilgilerinin kalıcı

ve değiştirilemez bir şekilde saklanması, mahremiyeti farklı şekillerde tehdit edebilir. Ayrıca bürokratik kültürden dolayı uygulamada o organizasyonel zorluklar yaşanabilmektedir. Bu nedenle uygulama öncesi kullanım alanları detaylı olarak düşünülmelidir. Ülke örnekleri, özellikle ilk dijital para arzı ve dijital para ile ilgili olarak, blok zinciri ve BİT'lerin uygulanması için kavram kanıtı ve pilot çalışmaların Türkiye'de yapılmasının önemli olduğunu ortaya koymaktadır.

Anahtar Kelimeler: Blok zinciri, E-Devlet, Teknoloji, Kamu Yönetimi, Türkiye

To Mustafa Kemal ATATÜRK

"If one day, my words are against science, choose science."

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I would like to express my deep and sincere gratitude to my advisor for her guidance, support, and patience. Thanks to her constructive criticisms, research motivation and valuable feedbacks, I could finish this thesis.

I would to like to thank my family and my friends for listening to my unending complaining.

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LIST OF ABBREVIATIONS

APS	Australian Public Sector
ATO	Australian Taxation Office
BCTR	Blockchain Turkey Platform
BEIS	Department for Business, Energy and Industrial Strategy
BEST	Blockchain-based Decentralized Energy Market Design and Management Structures
BoE	Bank of England
BoI	Bank of Israel
BoK	Bank of Korea
BZLab	Blockchain Research Laboratory
CBA	Commonwealth Bank of Australia
CBDC	Central Bank Digital Currency
CPS	Cyber-Physical Systems
DAOs	Decentralized Autonomous Organizations
DISER	Department of Industry, Science, Energy and Resources
DLT	Distributed Ledger Technology
DWP	Department for Work & Pensions
EKTA	Estonian Institute of Cybernetics
ETCB	Estonia Tax and Custom Board
EU	European Union
FCA	Financial Conduct Authority
GDP	Gross Domestic Product
GDPR	General Data Protection Regulation
HMRC	Her Majesty's Revenue and Customs
ICO	Initial Coin Offering
ICT	Information and Communication Technologies
IP	Internet Protocol
ISA	Israel Security Authority

IoT	Internet of things
ITA	Israel Tax Authority
KCS	Korea Customs Service
KSI	Keyless Signature Infrastructure
LCT	Luxury Car Tax
MIT	Massachusetts Institute of Technology
MSICT	Ministry of Science and ICT
NDIA	National Disability Insurance Agency
NDIS	National Disability Insurance Scheme
NPM	New Public Management
OIT	Open Innovation Team
POC	Proof of concept
R&D	Research and Development
RPF	Regulators' Pioneers Fund
RTGS	Real-Time Gross Settlement
TCMB	Central Bank of the Republic of Turkey (Türkiye Cumhuriyet Merkez Bankası)
TCP	Transmission Control Protocol
TUBITAK	The Scientific and Technological Research Council of Turkey (Türkiye Bilimsel ve Teknik Araştırma Kurumu)
UKEF	UK Export Finance
VAT	Value-Added Tax

CHAPTER 1

INTRODUCTION

Advancements in technology pave the way for significant changes, which fundamentally transform all the elements of human relations in economics, politics, and society. The first industrial revolution introduced steam power instead of man-power. The second industrial revolution laid the foundations of mass production. After that, with the third industrial revolution, humanity met with automation and computers. The first three industrial revolutions gave new directions to the world, and in the 21st century, the fourth industrial revolution shaped the world again, in a significant way. The fourth industrial revolution includes advancements in information technologies, the Internet of things (IoT), and the development of cyber-physical systems.

In all industrial revolutions, digitalization and innovation that started in one area created a need for change in another. For example, along with the smartphones coming into our lives in the early 2010s, many services from banking to purchasing products are currently provided to service users through mobile applications. Numerous digital devices have been integrated into daily life, and they have become an inseparable part of human lives. As a result, all the aspects of life like trade, transportation, health sector, production have been affected and transformed, and digital footprints and data accumulation have become tremendous.

Similarly, technological transformations in the world also require governments to change. This requirement is due to the needs of citizens and the advantages of digitalization for governments. As an example, when banking transactions are made through online applications, citizens' expectations of an online system for

tax payments will indispensably rise. Also, the Covid-19 pandemic, a more recent example, has made online education compulsory in the world. As a result of the digitalization of government, concepts like smart cities, big data management, e-education, and e-government have gained popularity in the public administration area. Some scholars called Digital Era Governance to this period (Dunleavy et al., 2006). With the fourth industrial revolution, governments have also started to consider using more advanced technologies in public administration, such as artificial intelligence, the Internet of things, and blockchain.

According to many scholars (Burger et al., 2016; Wong et al., 2020; Politou et al., 2019), blockchain technology is a breakthrough for the world. The reason is that blockchain is an immutable, transparent, decentralized, and secure distributed ledger technology, so it has a great potential for solving problems that come with digitalization. It can be stated that blockchain technology is very promising for the public administration area. Especially in privacy and data security, blockchain-based technologies can offer new solutions for existing problems and improve governance among public institutions and organizations. According to many scholars (Şat, 2019; Karahan and Tüfekci, 2019; Takaoğlu, Özer and Parlak, 2019; Tekin Bilbil, 2019), blockchain can improve public services.

Although blockchain technology has been recognized in the finance sector at first, many countries, including Turkey, pay attention to the developments related to this technology and carry out intensive studies to understand and implement it in different fields. In line with this, in Turkey's 11th Development Plan published in 2019, it is emphasized that one of the main objectives is building a research and development (R&D) ecosystem and strengthening information and communication technology infrastructures; in that context, the use of blockchain applications is also encouraged (T.C Cumhurbaşkanlığı Strateji ve Bütçe Başkanlığı, 2019).

Despite the growing interest, studies especially in relation to blockchain use in public administration are recently emerging. Accordingly, this study aims to examine the current place of blockchain technology in the public administration field, review how public institutions can benefit from the blockchain, and evaluate the potential of blockchain technology for Turkey's public administration.

This thesis is an exploratory study that has twofold importance. The first one is to evaluate the application areas of blockchain in the field of public administration in the world and the current position of Turkey about the usage of blockchain. Although the number of studies about blockchain has increased globally, there are limited studies in the Turkish literature, most of which are related to finance (Kıymık, 2019). Especially in the literature, there is a lack of a comprehensive study on blockchain policies and applications in Turkey in the field of public administration. The second one is to understand and explore Turkey's potential for integrating blockchain-based technologies into the public administration system. Digitalization of the world assigns governments new roles, and the implementation of new technologies is quite essential. The contribution of this study that differs from other studies is that potential usage areas are discussed in addition to analyzing existing applications. Therefore, this study can light the way for future studies and policies.

The study's main research question is "How can blockchain technology be possibly implemented in the field of public administration in Turkey?". There are four sub-questions: What are the current positions of Turkey and other countries about the blockchain use? What are the possible opportunities, challenges, and limitations of blockchain in the public administration area in Turkey? How can blockchain possibly enhance public services in Turkey? What outcomes in terms of policy and practice can we infer from other countries' experiences for Turkey?

As a methodology, the study reviews research on blockchain use in the digitalized countries along with an analysis of the academic literature to draw conclusions about how blockchain can be used for public administration in Turkey. In doing so, it also evaluates the developments in Turkey in relation to ICT implementation in the public sector and the future blockchain strategies by looking at the current projects and the development plans.

The research questions of the study are answered in five main chapters. In Chapter 2, the definition, history, and basics of blockchain technology and its place in the literature are examined. The theoretical positions regarding blockchain in the public administration literature are also analyzed in this section. Then, in Chapter 3, countries that apply in the e-government area are studied in terms of blockchain applications and policies. Republic of Korea, Estonia, Australia, United Kingdom, and Israel hold the higher ranks in the UN E-Government Development Index. According to OECD STI Scoreboard, their R&D Budgets for Industry and Development are higher then OECD Total (OECD STI Scoreboard, 2021), so their current blockchain-based applications and researches are analyzed. Then, in Chapter 4, Turkey's position in blockchain-based technologies in the governmental area is investigated. Current policies and implementations, advantages and challenges, as well as potential usage areas are studied. Finally, in Chapter 5, the summary of findings is presented, and recommendations for policy and research are discussed.

CHAPTER 2

CONCEPTUAL FRAMEWORK

Blockchain technology is a nascent and exciting development for many areas. To understand and analyze blockchain technology in the context of public administration, the question of "What is blockchain technology and how does it relate to the fourth industrial revolution?" should be answered first, along with reviewing its evolution and the basic features. Next, reviewing the related academic studies and theoretical approaches in the public administration field would provide insights about its potential for this area.

2.1. Industry 4.0

To better understand the evolution of Blockchain technology, it is essential to discuss how it is related with Industry 4.0. Industry 4.0 is basically the fourth industrial revolution. The term Industry 4.0 is first used in 2011 at Hannover Fair. Industry 4.0 starts with the development of automation technologies and usage in the manufacturing industry (Xu et al., 2018). It contains Cyber-Physical Systems (CPS), the Internet of Things (IoT), blockchain, cloud computing, and related technologies (Hermann et al., 2015). It can be said that Industry 4.0 is born out of the increasing need for information and communication.

It is called Industry 4.0 because there are three industrial revolutions before the fourth industrial revolution. Theoreticians developed several theories and concepts to explain major shifts in technology, and economists and economic historians generally accept three major shifts in technology (Taalbi, 2019). The first industrial revolution transformed manpower to steam power. It started at the end of the 18th century and spread the world. During the first industrial

revolution, new machines were invented, and production increased. The second industrial revolution began in the late 18th century and continued during the early 19th century. In the second one, manufacturing technology was gone one step further, and electric energy started to be used in production. Thus, production increased in a massive amount. In other words, the second industrial revolution was the beginning of mass production. The third industrial revolution started in mid of the 20th century, and it consisted of technologies like the Internet, automation, and microelectronic technology (Xu et al., 2018). In other words, these technologies can be gathered under the name of Information and Communication Technologies (ICT).

ICTs brought new interdependencies between industries and caused a significant shift (Taalbi, 2019). With the evolution of ICT technologies, the adaptation of computers and industrial robots to production prepared the proper ground for the fourth industrial revolution (Xu et al., 2018). In 2011, the term "fourth industrial revolution" was used, and then in 2013, it took part in the High Tech Strategy 2020 Action Plan of the German Government. Industry 4.0 technologies decrease the difference between the physical and virtual worlds and create a new ecosystem for manufacturing. It concentrates on the machine to machine communication, cognitive computing techniques, end-to-end digitalization, and integration of digital ecosystems (Xu et al., 2018). In a word, these technologies are CPS (cyber physical system) technologies which could be defined as computer-based algorithms (Xu et al., 2018).

In CPS technology, computational entities effectively connect with the physical world, presenting interoperability between operations (Monostori et al., 2016). Specifically, interoperability is monitoring, controlling, coordinating, and integrating the operation (Qin et al., 2016). On the other hand, CPS technology changes enterprise architecture and decentralizes the organizations at both intra- and inter-organizational levels (Xu et al., 2018). Traditional organizations'

architectures and organizational integration have to change in time for the successful application of Industry 4.0.

There are three types of integration in Industry 4.0; horizontal integration, vertical integration, and end-to-end integration (Qin et al., 2016). Horizontal integration is the integration of CPS to the business planning stage, business value network, and manufacturing stages between different companies (Qin et al., 2016); Xu et al., 2018). Vertical integration is the integration of CPS to hierarchical levels in a manufacturing system (Qin et al., 2016). End-to-end integration means products' entire value chain (Qin et al., 2016). These integration processes create new working areas.

Industry 4.0 takes part in enterprises' strategic action plans and research agendas. Generous budgets are allocated for Industry 4.0 transformation. Blockchain is one of the Industry 4.0 technologies, and many enterprises like IBM and governments started to integrate it.

2.2. Conceptualization and Development of Blockchain Technology

Blockchain is simply a distributed ledger technology, which is developed by Satoshi Nakamoto. In 2008, Satoshi Nakamoto, published an article about peer-to-peer electronic cash systems, specifically Bitcoin. In the article, the main objective was stated as removing the weaknesses of commerce on the Internet and making transactions without a trusted third party. Trusted third parties bring an extra financial burden to transactions and make small casual transactions almost impossible (Satoshi Nakamoto, 2008). Bitcoin technology was developed to increase transactions' security and facility of payment. It is a combination of earlier innovations like hash-based proof of work, distributed ledger, b-money, and is a Blockchain application.

A blockchain is a chain of blocks that consists of any information (Zhao et al., 2016). A block can be imagined as a page, and on this page, any kind of data can be recorded, such as medical records, fingerprints, agreements. If data is changed after consensus, links between blocks will break explicitly. Once data is stored, it is almost impossible to change them. This feature of blockchain makes it unique and has improved the potential usage areas. Blockchain technology was born with cryptocurrencies, but blockchain technology usage areas extend far beyond cryptocurrencies.

Blockchain splits into three generations; Blockchain 1.0 for digital currency, Blockchain 2.0 for digital finance, and Blockchain 3.0 for digital society (Zhao et al., 2016). Satoshi Nakamoto's article is the origin of Blockchain 1.0, and Bitcoin has been accepted as Blockchain 1.0 (Colomo-palacios et al., 2020). The development of 1.0 was gradual. At first, Bitcoin and blockchain were not thought to be separate, and the main aim of Bitcoin was to create a currency that was independent from countries (Satoshi Nakamoto, 2008).

Blockchain 2.0 started with Ethereum in 2013 (Colomo-palacios et al., 2020). Vitalik Buterin published a white paper and the Ethereum project (Frontier) was launched in 2015. Frontier is a simple command-line which developers can use for creating, testing, deploying, and using decentralized applications on the Ethereum blockchain ("Ethereum Frontier", 2015). In this new generation, smart contracts are developed and applied. Smart contracts are computer codes. When software is compiled and deployed in the system, nobody can uninstall or change it (W. Cai et al., 2018). Further, smart contracts establish public trust, because of theirs self-executing feature (W. Cai et al., 2018). Smart contracts pave the way for Decentralized Autonomous Organizations (DAOs) (Rikken et al., 2019). Wang et. al. (2019) stated, "DAO is a blockchain-powered organization that can run on its own without any central authority or management hierarchy" (p. 871). However, DAOs were not so developed in the beginning stages. Correspondingly, blockchain 2.0 had many restrictions. Mainly, interoperability,

scalability, governance, and sustainability were major limitations for applying blockchain to other areas.

Analyzing these problems and identifying new solutions led to blockchain 3.0. Blockchain 3.0 pertains to solve problems which restrain blockchain technology from applying industry and social life (Colomo-palacios et al., 2020). Solving these problems carried blockchain to another level, but DAOs had to be coded manually and this complicated the process. In 2018, Aragon which is a project built on the Ethereum enabled to deploy a configurable code instead of manual code (Rikken et al., 2019). This outnumbered DAOs.

These stages are also reflected in the conceptualization of blockchain in the related academic publications. The first academic publication on Web of Science database on the topic of blockchain appeared in 2013. As shown in Figure 1, the Web of Science documents published between 2013-2016 were mostly about computer science and engineering. There are a few records that are related to the fields of economics, business finance, law, and social sciences.

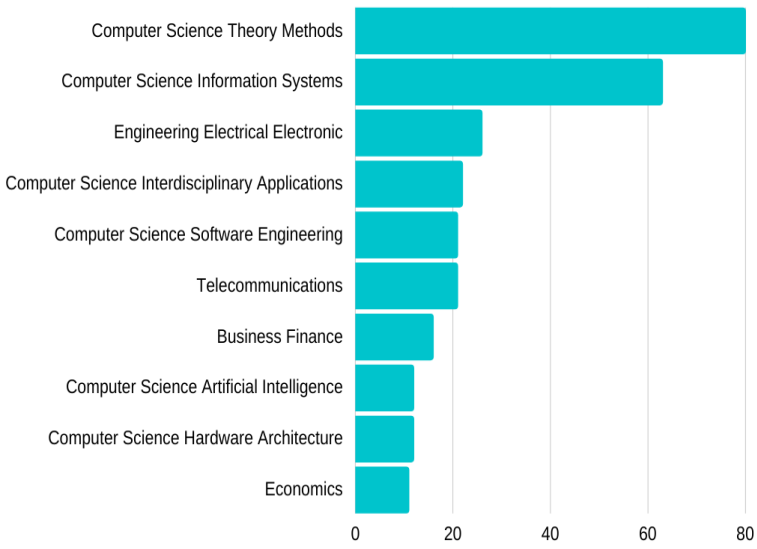

Figure 1. Publications about blockchain between 2013-2016 at Web of Science

Source: Retrieved from web of science- numbers and areas of documents about blockchain which are published between 2013-2016

Many experimental projects about blockchain have emerged after 2015, and it has started to make a real technological and economic impact (Zhao et al., 2016). With blockchain 2.0, articles in the literature concentrated on the potential of blockchain for different areas besides the computer science and engineering. Usage of smart contracts and developing decentralized applications has an important impact on this rise. As a result of that, the number of research and publications in other fields besides computer science has increased. As shown in Figure 2, the most published Web of Science Categories on blockchain includes management and business between 2017 and 2021.

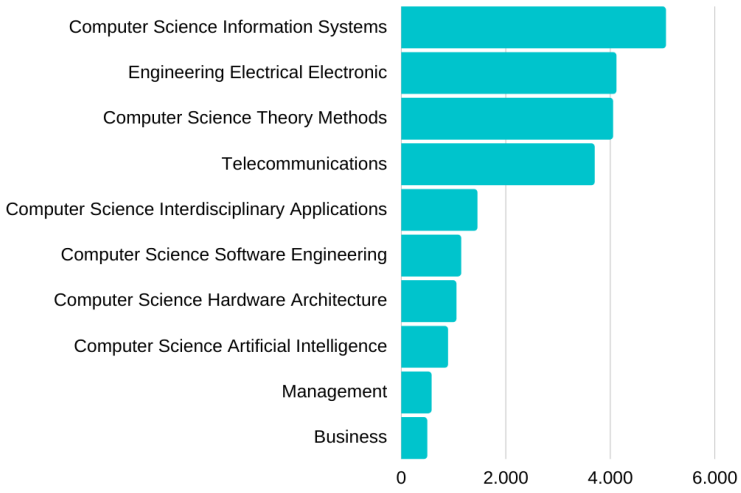

Figure 2. Publications about blockchain between 2017-2021 at Web of Science

Retrieved from web of science- numbers and areas of documents about blockchain which are published between 2017-2021

While 180 documents about blockchain were published between 2013 and 2016, this number dramatically increased in 2017, and continued to increase in the years that followed. Specifically, there are many studies in various areas ranging from education (Bhaskar et al., 2020), health (Sharma & Joshi, 2021), supply chain management (Dutta et al., 2020), public sector (Rodríguez Bolívar & Scholl, 2019), energy sector (Andoni et al., 2019), identity management (Sullivan & Burger, 2017), smart cities (Sun et al., 2016), to voting (Hjalmarsson

et al., 2018; Bulut et al., 2019; Turhan, 2018). The application of different blockchain types for different situations paved the way for researches.

2.3. Basic Features of Blockchain

2.3.1. Distributed Ledgers and Data Storage

Distributed Ledger Technology (DLT) is one of the things, which makes blockchain unique. It changed the requirements for a third party. Before DLT, with the development of Transmission Control Protocol (TCP) and Internet Protocol (IP) technologies, centralized systems evolved (Akhtar, 2019). TCP and IP are simply protocols that provide communication and transactions between computers. In the internet ecosystem, money's area of usage is controlled by third parties because they ensure the security of transactions between different parties and prevent their customers from fraud. They use centralized servers for transactions to have all customers' data and records and earn money from providing security services (Akhtar, 2019). Blockchain changed the indispensability of third parties by using consensus systems, smart contracts, cryptography, and hashing in DLT.

DLT is an evolved form of ledgers. Ledgers whose history extends back more than 2000 years are used for recording. The first ledger in history is single entry ledgers, an accounting system based on the only one-sided entry for each transaction. With the development of the economy and growing companies, people started to use double-entry ledgers. The difference of double-entry ledgers is that it tells the story of both sides. Transactions of both sides are recorded in the ledgers of the two sides. Thus, both sides have records of transactions. On the other hand, in triple entry ledgers, there is a third ledger shared with a third party (C. W. Cai, 2019). Blockchain takes this third ledger and shares it with everyone in the ecosystem, so every user has an immutable

and transparent copy of transactions. In other words, blockchain is a type of distributed ledger.

In the blockchain, a notification is made for a transaction or a record, and everybody has a copy of it. It is possible to trace that creation point of every piece of information.

2.3.2. Cryptography

Decentralized storage methods were used before blockchain, but data could be tampered with easily. Therefore, cryptographic technics are now used to protect privacy, transactions, and data consistency (Zhai et al., 2019).

Firstly, blockchain systems use asymmetric cryptography, which means public and private keys are used for encrypting and decrypting public and private keys (Bashir, 2017). A public key is used to encrypt, and a private key is used to decrypt the data(Bashir, 2017). A public key can be thought of as a bank account or e-mail, and everybody can reach it, and a private key can be thought of like a secret ID. They are associated with each other. The public key creates an algorithm that only can be solved with the private key of the user (Zhai et al., 2019).

Secondly, the zero-knowledge proof is used in blockchain. Zero-knowledge proof is a method by which parties prove they know the data without revealing it (C. W. Cai, 2019). It is explained with a locked door metaphor. For example, there is a locked door and two parties; the prover and the verifier. The proverb says that s/he has the door's key. If s/he goes out through the door, the verifier will know s/he has the key without seeing it. For Blockchain systems, the door is a sophisticated math function. The verifier knows the results of it, and the prover has to give a number that provides the function. The computer algorithm takes the number, changes the function mathematically, and controls whether or not

the number can provide the function. Zero-knowledge proof is seen as an important method because the development of technology restricts the people's private spheres and creates security risks(C. W. Cai, 2019). Some of the biggest companies like JP Morgan started to test the method.

Thirdly, the hash function, which is a cryptographic method, is used for blockchain security. In the blockchain system, new blocks are added to the system, and a new block is connected to the previous block with a hash(Akhtar, 2019). In other words, every block is chained with the previous block in that way. When data is recorded on a block and added to the chain, the system gives a hash that contains 32 characters. If the data is changed, no matter how small in a block, the hash function changes. This change breaks the connection between blocks, and it is quickly distinguishable. Hashing makes blockchain tampered proof, immutable and trustworthy.

2.3.3. Transparency and Immutability

Transparency is an essential word for modern governments because accountability comes with transparency. Therefore, in the literature, transparency is closely linked with democracy. In public administration, transparency comprises disseminating policy documents, audit reports, government strategic plans, etc., and digitalization creates pressure on governments to share these documents (Erkkilä & Erkkilä, 2020). On the other hand, privacy becomes a more contentious issue because of the massive amount of data collected by the government. Bureaucrats' accessibility of private data and their boundaries create questions.

In traditional database systems, CRUD system is used. CRUD means create, read, update and delete. In this system, data can be deleted permanently, and even experts can only save some amount of the deleted data. Additionally, users can see updated versions of data. The first version cannot be reached after the

update. The data which government collects and shares is thought to be a traditional database that is centralized and needs more protection. On the other hand, in a blockchain system, data is decentralized, and users can only create a new block and read older ones. They cannot change or delete something on the blockchain. Every block is connected with each other, and if data is tampered with on a block or is deleted, the blockchain is broken. It affects the rest of the blocks after broken blocks, so it is easily distinguishable. In other words, this feature makes blockchain immutable.

There are two types of blockchain; public and private. In a public blockchain, all data can be read by every user. It does not create a security issue because, in a public blockchain, everybody is anonymous. Therefore, public blockchain is more beneficial for documents that government publishes for accountability. In a private blockchain, members are known, so the openness or closeness of data can be controlled. This feature of private blockchain makes it more suitable for public administration.

2.3.4. Smart Contracts

Smart contracts are computer codes on the blockchain. Executable codes make it easier to execute the terms of an agreement and enforce the parties to follow (Alharby & Van Moorsel, 2017). Smart contracts could be thought of as some set of rules, which are applied in decided situations at any time. They are not a new technology, but blockchain technology makes them visible (Alharby & Van Moorsel, 2017). Today, many apps (especially decentralized apps) use smart contract technology (Rikken et al., 2019). Thus, the need for third parties is reduced or removed(Rikken et al., 2019).

2.3.5. Consensus

In a decentralized system, consensus mechanisms are needed for ensuring the nodes on the final state of data (Bashir, 2017). There is more than one consensus mechanism because different types of blockchain require different consensus mechanisms. For example, a simple consensus mechanism for private blockchain will be enough, but for public permissionless blockchain, there should be a more sophisticated mechanism for consensus(Bashir, 2017). Some of the consensus mechanisms are proof of work, proof of stake, delegated proof of stake, and proof of importance.

-Proof of Work: In the proof of work mechanism, miners solve a complex math problem. For this mechanism, powerful computers and a massive amount of electricity are required. Cryptocurrencies like Bitcoin, Litecoin are using proof of work mechanisms.

-Proof of Stake: There are no complex math problems or computational cycles in proof of stake. In this mechanism, a node or user (validator) owns a sufficient stake. The algorithm selects and assigns a validator randomly and takes his/her funds. After validation is completed, the validator takes back his/her staked funds. Thus, if the validator tries to abuse his/her mission, s/he loses his/her staked funds.

-Delegated Proof of Stake: In a delegated proof of stake mechanism, there is an election. Users give votes for a validator, and the weight of their votes is based on their stakes.

-Proof of Elapsed Time: It is introduced by Intel(Bashir, 2017). A new block is produced according to users' waiting time. The algorithm gives a random waiting time for every user, and the one whose waiting time is over first produces the new block.

-Proof of Importance: In proof of importance, the algorithm is using for finding the eligible users. The number of transactions, the usage, and movement of tokens are some criteria for detecting eligible users and producing (harvest) new blocks.

Many consensus mechanisms are being produced as technology develops. Blockchain systems are using these mechanisms according to their needs.

2.3.6. Types of Blockchain: Public Blockchain, Private Blockchain, Consortium Blockchain

Blockchain technology consists of three main types; public blockchain, private blockchain, consortium blockchain. Public blockchain and private blockchain can be permissionless or permissioned. On the other hand, consortium blockchain is a model that aims to increase governance.

For understanding the terminology that is often used, the concepts of public and private blockchain should be defined. Firstly, public blockchain does not belong to anyone. In other words, anyone can join the network. Public blockchains could be permissionless or permissioned. A public permissionless blockchain is called the real blockchain. In permissionless type, anyone can read, write or validate a block, and everybody has an anonymous identity (Rikken et al., 2019). It is really decentralized, and no entity has power over it. Bitcoin and Ethereum are examples of public permissionless blockchains. On the other hand, public permissioned blockchain is different in terms of validation. Public permissioned blockchain is open for reading, but it is not open to everyone for writing and validating. Control of the system belongs to a third entity. Public permissioned blockchain looks like public services. There are scarce resources and everybody has right on it. However, somebody has to regulate access and usage.

Secondly, a private blockchain is knowns as enterprise blockchain. In a private blockchain, reading, writing and validating acts are subject to permission, and it is not decentralized. Generally, enterprises use private blockchains for sharing data. The private blockchain is naturally permissioned. Permissioned users read, write and validate blocks. On the other hand, private permissionless blockchain should be open for validating, but close for reading (Rikken et al., 2019). It is a controversial model, and there is no example of it.

Thirdly, the consortium blockchain model is very similar to a private blockchain. The thing that makes consortium blockchain different is that when there is one single party that is controlled in a private blockchain, there are multiple parties that are controlled in consortium blockchain. The main goal is to reach a more decentralized private blockchain.

2.3.7. Governance of the Blockchain

Systems that are developing and have more than one party need effective governance. Blockchain technology, like every other technology, is a developing system day after day. In other words, it has to change because the conjuncture of the environment constantly changes. For example, smartphones are an inseparable part of people's lives. Daily services, needs, and activities have moved to the online world as smartphones become more and more involved in daily life. Another critical issue about change is that while technological improvements allow the discovery of new potential services, new methods for hacking the systems are also developing simultaneously. As a result, online systems need to renovate their software and hardware to protect themselves. Therefore, blockchain systems need new qualifications for adaptation to the new environment. Adding new qualifications basically requires a working stage, a trial stage, and an implementation stage. For getting to the implementation phase, some decisions should be taken and how these decisions are taken brings

the questions of “Who governs the blockchain?” and “What are the governance strategies of blockchain?”.

When blockchain strategies are examined, it is realized that four strategies are commonly used. The first strategy is a benevolent dictator for blockchain. In political science, the concept of benevolent dictatorship means that when there is a dictatorship or authoritarian regime, the ruler of the regime looks after the interest of different parties instead of only his/her interest (Q. Wang & Jap, 2017), and the benevolent dictatorship governance is that final saying belongs to authority. In a blockchain, generally, the creator of the blockchain is the final authority such as Ethereum, so changes and improvements are approved by the final authority. The second strategy is the core development team. There is a core development team that decides what could be done or could be applied. The third strategy is open governance. In an open governance strategy, the users decide the members of the core development team. In other words, it is like representative democracy. Corda uses open governance strategy. The final and the most novel strategy is on-chain governance. On-chain governance is a model in which the rules are integrated into the nodes of the blockchain (Dursun & Üstündağ, 2021). In other words, rules and regulations are articulated as smart contracts, and when consensus is needed for new improvements, users easily vote for the changes (Dursun & Üstündağ, 2021). Thus, the emergence of a hard fork is avoided. If the first three governance strategies and on-chain governance are compared, it can be said that the first three governance strategies are more traditional governance strategies. On the other hand, on-chain governance is a novel strategy for governance.

In a blockchain, the need for change and improvement can be met at a point. One of the things which blockchain technology makes secure and immutable is its protocol. When these changes are within the boundaries of the blockchain protocol, they can be handled via different governance strategies. However, if these changes pass the boundaries of the blockchain protocol, a hard fork will

emerge. A hard fork is a fundamental change that can make blockchain protocol invalid, and the nascent blockchain is different from the first one after the change. Therefore, it is called a hard fork, and all the nodes on the blockchain do not have to follow a new version. Some of them may choose to stay in the old version. This can be seen in the DAO hack. The DAO is an abbreviation of Decentralized Autonomous Organization, and it is basically a fund organization that is established over Ethereum infrastructure. In 2016, Ethereum was hacked via the DAO because of a code deficiency in the DAO (Sharma, 2017). Then, Ethereum took the decision of changing the protocol of Ethereum, so a hard fork emerged. On the one side, some of the users followed the new version of Ethereum, and on the other side, some of them chose to stay in the old version. Thus, Ethereum Classic was created.

2.3.8. Initial Coin Offering (ICO)

Initial coin offering (ICO) is basically an instrument for fundraising or attracting investment. In the ICO system, companies create their tokens, and they find investments through selling these tokens. The thing that makes ICO different in the financial world is that tokens that companies are selling are based on blockchain technology and are digital assets (Fisch & Momtaz, 2020). Generally, new start-ups prefer ICOs for fundraising, and publish a white paper of their projects. White papers include the architecture of their blockchain-based systems, what companies are aiming for, and how they will reach it. Companies also could provide some services and products which tokens may be used in.

In 2013, ICOs were started to be created (Bellavitis et al., 2021), and the exchange of them became to get easy for people. Cryptocurrency markets started to be created, and a number of them increased day by day. As a result, ICOs drew the interests of governments because of people's large-scale investments. Some of the countries regulated the ICO market, and some of them directly banned it. As an example, China and South Korea banned ICOs for protecting

people (Kim, 2017; Forbes Technology Council, 2017). On the other hand, some countries have positive attitude for cryptocurrencies. El Salvador legitimatized Bitcoin usage as a legal tender (Tidy, 2021). The main reason of different steps is ICO market is a highly speculative market. Technological companies easily create their own tokens, and it can cause a financial bubble. In 2018, cryptocurrency market had a big crush (Patterson, 2018). The lack of regulation and bubble companies in the market is seen as the main reasons of the crush. On the other side, despite the disadvantages, countries like Estonia, Switzerland, and Singapore regulated the ICOs and provided some tax concessions to the ICOs.

2.4. Review of the Literature on Blockchain and Public Administration

Governments often seek to find new methods in providing public services to bring down the costs and solve organizational problems (Huang& Karduck, 2017). Along with New Public Management reforms that started in 1980s, the use of information and communication technologies (ICTs) in government agencies has grown rapidly to increase government efficiency, effectiveness, transparency, accountability, and government-citizens interaction (Robertson & Vatrapu, 2010). In this digital era, citizens' needs have also transformed and become complicated. Transformation, which is based on technological development has stimulated wide circulation in the economic system, and it has required an advanced system for managing huge amount of data (Muellerleile & Robertson, 2018). As a result, digitalization has given new forms and meanings to state-society relations, state institutions, and bureaucracy of the state.

Starting from the 2000s, ICTs have gone beyond being a branch of New Public Management reforms and caused major changes in the public institutions, civil society and private sector. Dunleavy and Margetts (2006) called this change “Digital Era Governance”. Digitalization of operations, reintegration of public institutions and citizen-based holistic digitalization are the fundamental features of the model of Digital Era Governance (Dunleavy et al., 2006). Firstly,

digitalization of operation means integration of digital technologies to the public institutions and getting embraced by them. In other words, paper works, transactions, and other public services are done by computational systems. Secondly, reintegration of the public institutions is that the fragmented structures of public institutions have come together and created a new kind of centralization in the government. Finally, citizen-based holism is to redesign and to organize holistic public services according to citizens' perspective. The goal is creating more agile and effective government that quickly answers the needs and problems of citizens.

It can be stated that, as a form of ICT, the blockchain technology may also create a proper ground for Digital Era Governance. When the features of Digital Era Governance are considered, the blockchain technology can provide a secure and immutable environment. The blockchain technology can pave the way for the reintegration of public institutions via creating a national infrastructure. Thus, it can create a citizen-based holistic government and make the digitalization of public services easier. In this respect, it can accelerate citizen-based digitalization of the public administration, and increase the communication and governance between public institutions.

When the literature about the blockchain in public administration is examined, scholars' discussions mainly gather around three aspects; organizational structure, governance and data management (Gün et al., 2020; Lindman et al., 2020; Ølnes et al., 2017; Rodríguez Bolívar & Scholl, 2019; Reddick et al., 2019). Fundamentally, the blockchain technology is based on distributed ledger technology, and decentralization is the essence of it. Therefore, organizational structures and traditional models of governance that depend on centralized hierarchical systems can be affected through different architectural designs of blockchain (Cagigas et al., 2021; Reddick et al., 2019). Security, immutability and authenticity mechanisms could make the adaptation of citizen-centric approaches to the public services easier, and these mechanism could provide

effective data management (Gün et al., 2020; Rodríguez Bolívar & Scholl, 2019). According to scholars, it could breathe new life into organizational structures, governance and data management (Reddick et al., 2019; Rodríguez Bolívar & Scholl, 2019).

Research shows that blockchain can be applicable to many areas about government like land registry (Mendi, 2021; Mendi et al., 2020; Ameyaw & de Vries, 2020), voting (Shukla et al., 2018; Turhan, 2018; Bulut et al., 2019), governance (Rikken et al., 2019), education (Ikizoğlu, 2019) and smart cities (Bhushan et al., 2020; Fu & Zhu, 2020; Xie et al., 2019; Wong et al., 2020; Akkaya, 2021). Topics like security (Ayaz, 2020) (Fang, 2020; Ølnes et al., 2017), trust (Biggs et al., 2018), privacy (Kshetri, 2017), big data (Es-Samaali et al., 2017), sustainability (Choi & Luo, 2019) (Wong et al., 2020), and governance (Dursun & Üstündağ, 2021) have been studied about blockchain in public administration context.

Especially, becoming more and more digitalized society increased privacy concerns among the public, organizations, and government. Every year, many data breaches occur. One of the most serious data breaches is Cambridge Analytica incident. User profiles from Facebook are harvested without users' consent by Cambridge Analytica, which is a consulting firm (Cadwalladr and Graham-Harrison, 2018). Therefore, some other scholars have emphasized blockchain's decentralized database as a big advantage in this context. According to Kshetri (2017), the most promising thing about blockchain is that users can control their own personal data.

On the other hand, beside potential positive impacts, scholars also pointed out challenges and limitations of the blockchain like novelty of it, scalability, interoperability, resistance of civil servants and organizations (Cagigas et al., 2021; Choi & Luo, 2019; Xie et al., 2019). According to scholars, successful adaptation of the blockchain is also closely related to political stability,

effectiveness of governments and security goals of governments (Reddick et al., 2019).

In addition to organizational structure, governance and data management issues, blockchain is also discussed in relation to political approaches in the public administration literature. In line with that, scholars indicate that blockchain technology has the potential of strengthening liberalism, socialism, or anarchism. According to liberal thought, an increase in the hegemony of an actor leads to setting up rules that the hegemon can benefit from, so liberal values are threatened by the increase in hegemony (Reinsberg, 2020). In other words, when a party in the system gains power, it tends to break rules. Reinsberg (2020) stated that a blockchain-based governance system, to a global extent, could develop collaboration. Blockchain can solve information problem between the parties with distributed ledgers and provides reliable information. In addition, it can present a more efficient and secure system for payments of the part of agreements. The reason is that, after settling the smart contracts, they have to be executed by codes. Therefore, after settlement, making concession for any party is avoided. Besides these, execution of smart contracts enhances the credibility of commitments. Thus, it is expected that blockchain enhances liberal values via enhancing collaboration between the parties.

On the other side, according to Huckle and White (2016), blockchain technology can be applicable to different forms of socialism. Some scholars pointed out that blockchain technology is developed for Libertarian ideals, but it is suitable for Socialist ideals because blockchain technology enables a consensus-driven model of collaboration and distributed autonomy (Huckle & White, 2016). Likewise, Filippi and Loveluck (2016) stated that blockchain could cause major power shifts. Elimination of trusted third parties and setting their own rules on the blockchain redistribute the power relations (Filippi & Loveluck, 2016).

Although blockchain is a nascent area, countries around the world have recently realized its potential for public administration. Accordingly, studies have also focused on analyzing governments' experiences in implementing this technology. The next section reviews blockchain use in public administration with some examples around the world.

CHAPTER 3

BLOCKCHAIN IMPLEMENTATIONS IN PUBLIC ADMINISTRATION IN THE WORLD

Blockchain technology was first introduced for the purposes related to the finance. In time, it has affected many different areas as much as the finance area thanks to its applicability to other fields and the advantages it brings. Studies on blockchain are carried out in many fields, especially in computer science, and its potential effects, advantages, and disadvantages are analyzed with case studies as well as detailed theoretical discussions. Public administration is one of the areas that come under the influence of blockchain technology. Governments seek to answer the questions "Could blockchain technology provide advantages for public services and institutions?", "How could blockchain technology be adapted to the current administrative mechanisms?" and "What are the potential usage areas of blockchain technology?".

In this chapter, major countries that implement blockchain technology at the governmental level are examined, along with the examples of use. Many of the countries started to run projects, but for understanding the potential of blockchain, specifically digitalized countries are analyzed. In selecting the countries for analysis, the following criteria were considered: According to OECD STI Scoreboard (2021), Republic of Korea, Estonia, Australia, United Kingdom, and Israel have higher R&D budgets for Industry and Knowledge than the OECD Total. Republic of Korea, Estonia, United Kingdom, and Israel are also considered to be among the countries that have the best practices about blockchain (Berryhill, J., Bourgery, T., & Hanson, A., 2018). In addition, the first four countries are Republic of Korea, Estonia, Australia, United Kingdom, which are among the highest ranked countries in the E-Government

Development Index and the E-Participation Index in 2020 (UN E-Government Knowledgebase, 2021). The E-Government Development Index and the E-Participation Index are developed by United Nations for assessing e-government capacities of countries and participation of citizens (UN E-Government Knowledgebase, 2021). The E-Government Development Index is based on providing online services, human capacity and connectivity of the telecommunication. On the other hand, the E-Participation Index depends on accessing information, consultation to citizens for public services and e-decision making. The fifth country is Israel, which has lower ranks than the first four countries in the E-Government Development Index and E-Participation Index, but is chosen due to having an advance position in blockchain use. According to Bianchini and Kwon (2020), Israel created a suitable ground for start-ups, so it has a great blockchain ecosystem.

3.1. Republic Of Korea

Republic of Korea ranks 2nd in the E-Government Development Index and E-Government Participation Index (UN E-Gov Knowledgebase Korea, 2021). When the history of Republic of Korea is examined, it can be seen that Republic of Korea was a developing country after the Korean War, having an underdeveloped economy and lacking a scientific infrastructure. Today it becomes a significant hub in Asia and in the world. According to some scholars, the success of Republic of Korea depends on two main factors; investing in human development and forcing Korean companies to race with global companies (Chung, 2007). The development of Republic of Korea in many areas also improves the public administration and public services.

Today, in the e-government area, Republic of Korea uses the latest technologies and effectively responds to the needs of citizens. One of the latest technologies which is used in the public administration is blockchain technology, and Republic of Korea has made huge investments to the pilot projects. Therefore,

Republic of Korea is actively adopting blockchain technology to some of the public services while many of the countries are just starting to the pilot projects and trials. It can be said that Republic of Korea is one step ahead from most of the countries.

3.1.1. Strategies of the Ministry of Science and ICT

In 2018, Republic of Korea took a big step in understanding the usage areas of blockchain technology. The Ministry of Science and ICT (MSICT) developed a future strategy on blockchain for seeing the potential usage areas in both industry and government. In the development strategy, allocating a budget of around 9 million dollars was planned for 6 pilot projects (Young-sil, 2018; Zhao, 2018). The main focus areas of these projects were supply chain management, voting, customs clearance services, shipping logistics, buying and selling real estate, and management of international e-documents (Young-sil, 2018). Additionally, because of the increasing knowledge of blockchain technology and preparing the conditions for future development projects, MSICT tried to work with other government agencies in these projects.

Blockchain Technology Development Strategy became an initial step for MSICT and then MSICT presented Blockchain Technology Diffusion Strategy in 2020. It was a new version of Blockchain Technology Development Strategy. The difference is that MSICT planned to go beyond the small pilot projects and adopt blockchain technology into government services. The Diffusion Strategy planned to adopt blockchain technology to seven sectors in order to benefit from the main advantages of blockchain like developing trust, minimizing human contact in economy, and enhancing efficiency (Korea Plans, 2020). These seven sectors include online real-time accessible voting system, establishing a donation platform as a trial, blockchain-based individual development accounts, energy sector, pilot project for digital currency, records of real estates' trade, uniting customer service systems for some services (Korea Plans, 2020).

MSICT presented 2021 Action Plan for Digital New Deal on 6th January 2021 (2021 Action Plan, 2021). In the action plan, for the digitalization of society, industry, and government, necessary steps and actions are explained in detail. With infrastructure investments, smart cities are planned to be created. Blockchain technology continues to be a part of digitalization plan for governmental services, as used in the driver license service.

3.1.2. Driver License Service: PASS

Three big mobile service companies; LG Uplus, SK Telecom and KT in the Korea with the collaboration of The Korean National Police Agency started to make authentication of citizens' driver licenses through mobile app; PASS (Aiying and Jihae, 2020). Application of PASS is using blockchain technology for simultaneously verifying the license from the records of the Korea Road Traffic Authority and The Korean National Police Agency. On the application screen, there are just a QR code and barcode (Eun-jin, 2020). The main aim of this application is to remove the necessity of showing personal information when driver licenses are controlled. As a disadvantage, citizens' data recorded immutably, so it may create challenges in the future.

3.1.3. Blockchain-Based Export Declaration and Logistic Services

In 2018, Korea Customs Service (KCS) started a blockchain pilot project for the purpose of standardization of customs services', flourishing foreign trade, and enhancing the prestige of Korean e-government (Korea Customs Service, 2019). The main aim of the project is to decrease paperwork and bureaucracy, and improve validation. With the blockchain application, firstly, paper works became easier. Blockchain brought real-time accessibility to trade papers that are between the parties such as shipper, forwarder, carrier, customs broker, customs service, and error margin of work decreases. Secondly, smart contracts automatize (Korea Customs Service, 2019). After validation of KCS, necessary

documents are automatically generated through smart contracts. 52 companies joined the trials and %81.27 of them were satisfied (Korea Customs Service, 2019). Additionally, human contact decreased to a certain extent because of automation. When we look at its disadvantages, automation of the process can cause job losses.

3.1.4. ICON

The Seoul Government-run ICON is a pilot blockchain project for administrative works such as publishing documents, evaluation, and recording information (Young, 2019). Within the scope of the project, a blockchain governance team was selected and m-Voting that is a blockchain-based online voting platform was created (Andrews, 2019). However, acceptance of usage by all the parties is a challenge for the project. Studies continue for applying blockchain to other public services.

3.1.5. Vaccine Passports

Republic of Korea started to create blockchain-based COVID-19 vaccine passports. It is called Green Pass, and vaccinated people can certify their vaccination status through an application (Cha, 2021). The fact that blockchain technology has important features such as immutability, security and real-time accessibility affected the choice of this technology for this project. Korea plans that its citizens easily and safely travel to other countries and the risk of infection is minimized.

3.1.6. Digital Currencies and Taxation

Republic of Korea's approach to digital currencies is highly cautious. Despite showing positive attitude to blockchain usage in other areas, Korea does not have the same attitude to digital currency issue. Government sees

cryptocurrencies as crypto assets because they don't have characteristics of currencies. High volatility of the market and potential of the market manipulation risk pushed the Korean Government to take some measures about it, so ICOs were banned in 2017 (Amstad et al., 2019). The government especially emphasized that ICOs do not share the information which people need or details about their business. Additionally, amendments about Anti Money Laundering that can make through cryptocurrency are accepted (Nelson, 2021). Different from point of view to cryptocurrencies, government has relatively positive thoughts about a central bank digital currency (CBDC). The Bank of Korea (BoK) published working papers about CBDC in 2019 and in 2020 (Amstad et al., 2019) (Kwon et al., 2020). In 2018, the BoK run a trial about CBDC and results were positive (Amstad et al., 2019), and in 2021 an other pilot project was started to carry out by the BoK (Kim, 2021).

Before taxation, Korea wanted to regulate the cryptocurrency market. However, finance minister of South Korea announced that capital gain tax will be collected from cryptocurrencies in 2022 (Reuters, 2021).

3.2. Estonia

Estonia is one of the leading countries in the area of information technology not only in Europe but also in the world. In the UN E-Government Development Index in 2020 (UN E-Gov Knowledgebase Estonia, 2021), it is in the third place, and it has the first place in the E-Government Participation Index.

In 1970s and 1980s, microelectronic technology was a problem for Soviet Union (Dyker, 1996). EKTA, which is a department of the Estonian Institute of Cybernetics, started to focus on microelectronic technology area (Dyker, 1996; EKTA, 2020). Therefore, some scholars think that Estonia case proved that IT infrastructure is a critical factor for e-government (Kattel & Mergel, 2019). Technological development is one dimension of Estonian experience. From a

political point of view, IT initiatives were politically supported in the 1990s. The main reason of that is IT development became a complementary element for neoliberal state policies (Kitsing, 2008).

Estonia is the first country that used blockchain technology at a national level (E-Estonia, n.d.). The usage of blockchain extends to a wide range of public services such as registries, security (E-Estonia, n.d.; Castaños, 2018). While many of the countries are still discussing and concentrating on case studies and proof of concepts, Estonia has been using blockchain technology. According to European Commission Case Study Report (Castaños, 2018), blockchain technology provides integrity of records and solves data governance problems. Additionally, in the report, it is highlighted that the Estonian KSI Blockchain system is also used by NATO and the US Department of Defense (Castaños, 2018). On the other hand, when demographic characteristics of Estonia like population and the literacy rate are considered, it can be said that national-level policies is more manageable.

3.2.1. Keyless Signature Infrastructure (KSI)

Keyless Signature Infrastructure (KSI) is a blockchain system that records large-scale information and provides verification (E-Estonia, n.d.). In 2007, Estonia started looking for new ways to strengthen their structures and to make provision against cyber-attacks, so the Estonia Government started to carry out trial of blockchain technology (Guardtime, n.d.). Estonia was the first country to use blockchain technology in the government. The main advantage of KSI is to bring data integrity. Additionally, trust and transparency to the government data increased. Today, Ministry of Justice, Ministry of Economic Affairs and Communications, Ministry of Finance, Ministry of the Interior and Ministry of Social Affairs are using KSI.

3.2.2. E-Health Record

E-Health Record is a system where different institutions about health can keep their records (Healthcare E-Estonia, n.d.). Thus, a common database for every patient is created. E-Health has features of central databases, but the integrity and security of the system is provided by KSI. Blockchain has made the healthcare record system more effective. All medical records of a patient are kept in a single file, and if the patient changes his/her doctor, new doctor can access previous records of the patient. However, immutability is also a disadvantage for delicate data.

3.2.3. E-Residency

In 2014, the Estonian government realized the project of e-residency, and Bitnation, which is a blockchain initiative, was included to the project in 2015. The main goal of Estonia is to eliminate barriers in front of the people who want to do commercial activity (Sullivan & Burger, 2017). E-residency is not a citizenship or passport, but it is kind of an international passport in the digital world for entrepreneurs (Sullivan & Burger, 2017). In the system, public key infrastructure provides data authenticity and security. E-Residency gives the chance of establishing an online Estonian company and running it from anywhere in the world (Priit Martinson, 2019). Within this scope, entrepreneurs can open business bank account, use online banking and international services for payments, have a digital signature, and declare their taxes digitally. It is also thought that e-residency can help to solve the migration crisis.

3.2.4. Digital Currencies and Taxation

Estonia’s enthusiasm about blockchain usage in governmental services continues for Central Bank Digital Currency (CBDC) too. In 2020, Eesti Pank that is Central Bank of Estonia announced to launch a two-year CBDC research project

(Eesti Pank, 2020). Eesti Pank runs this project with Guardtime and SW7 which are the long term partner technology companies of the Estonian government. Decision of the project have taken after Governing Council of the European Central Bank announced carrying out the coordinated projects for CBDC, possible digital solutions and specifying what are the advantages and disadvantages of it. While CBDC project was continuing, Eesti Pank issued its 2021-2025 Strategy (Eesti Pank Strategy 2021-2025, 2021). In the Strategy, Eesti Pank pointed out a decrease in cash usage and digitalization of people's daily lives. Therefore, CBDC has growing importance for Eesti Pank and European Union (EU).

Tax policies in Estonia were regulated to encourage to cryptocurrencies. Cryptocurrencies are subject to income tax and Estonia Tax and Custom Board (ETCB) explained in detail which situations or acts are included in the scope of tax law (ETCB, n.d.). According to ETCB (n.d.), exchanging cryptocurrency, mining, renting cloud storage, and payments are subject to income tax because these events create income. Cryptocurrencies are not subject to value-added tax (VAT).

3.3. Australia

Australia, like Estonia, is at the top of the E-Government Indexes. In 2020, it ranks 5th in the E-Government Development Index and 9th in E-Government Participation Index (UN E-Gov Knowledgebase Australia, 2021). In innovation and technology area, Australia is a developed country. Gross Domestic Spending on R&D is %1.8 of GDP, and %86.1 of the households has internet access (OECD Data, 2021). In 2018, Australia published Digital Transformation Strategy 2018- 2025 (Digital Transformation Agency, 2018). In this strategy, Australia pointed out the importance of user-centric public agencies and present new strategies about using emerging technologies. Blockchain is one of these emerging technologies, and different public agencies started to carry out pilot

studies. From most of the pilot studies, Australia had positive feedbacks, so in a few years, the Australian government can start to use blockchain technology in public agencies at a national level.

3.3.1. The Australian Public Sector Blockchain Network

The Australian Public Sector (APS) Blockchain Network is actually a communication network between public servants to make discussions and learn from each other's experiences (APS, n.d.). Australian Department of Industry, Science, Energy and Resources (DISER) announced the national blockchain roadmap in February 2020, and one of the signposts for the future in the map is related to establishing a blockchain network (Australian Government DISER, 2020). In November 2020, DISER established the blockchain network. The main aim of the network is increasing blockchain literacy and awareness.

3.3.2. Australian Taxation Office

Australian Taxation Office has carried out a blockchain pilot study for Luxury Car Tax (LCT) designed by James Murtagh (Digital transformation Agency, n.d.). In the project, higher transparency and making ownership records tracking easier for car companies and government agencies have been targeted with the blockchain system. As an advantage, the project has worked and reached its aim, and communication and transparency of records increased (Digital transformation Agency, n.d.). However, it's pointed out that technologies related with blockchain and development instruments have not been mature yet.

3.3.3. Making Money Smart (NDIS Trial)

Commonwealth Bank of Australia (CBA), CSIRO's Data61, NDIS (National Disability Insurance Scheme) and NDIA (National Disability Insurance Agency) run a blockchain proof of concept together (Commonwealth Bank, n.d.). Proof of

concept (POC) can be defined as a small experiment for a design or a new concept. CSIRO is Australia's national science agency and Data61 is data science-related part of CSIRO (CSIRO Data61, n.d.). Main goal of CBA and CSIRO's Data61 is to create a smart money and analyze functionality of it. On the other hand, NDIS's goals are enhancing public policies, helping individuals to plan their budget, and increasing transparency (CSIRO & CBA, 2018).

In the first step, an application was designed and private permissioned blockchain model was chosen. 10 individuals participated in the trial. In the second step, payments were made through the application, and users started to use smart money. In the third step, participants started to spend their money through application. The spending system details could be seen below (at Figure 3).

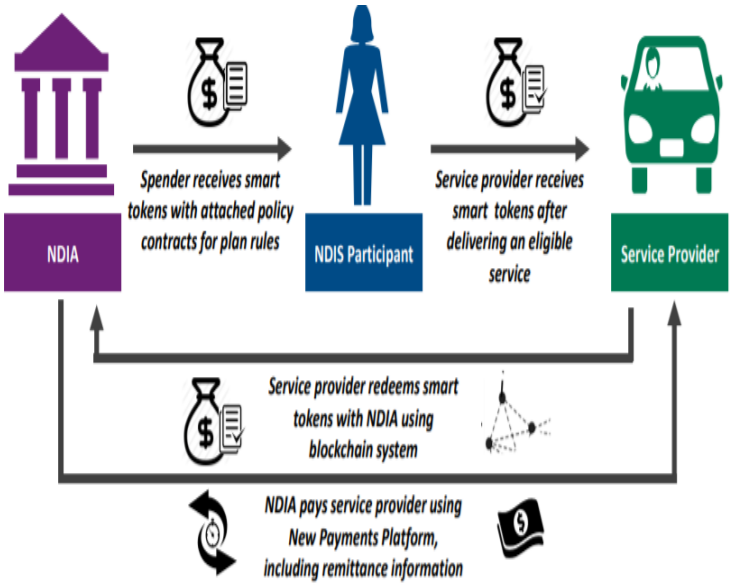

Figure 3. Exchange of tokens for New Payments Platform payments

Source: Making Money Smart. (2018). https://www.commbank.com.au/content/dam/commbank-assets/business/industries/2018-11/making_money_smart_report.pdf, p.42

At the end of the trial, Making Money Smart (2018) report was published. According to the report (2018), the application brought some advantages to the participants. Firstly, they can keep their records in the application, and see details of their spending. Secondly, they can pay via application. Thirdly, the application automatically records receipts. %89 of the participants gave positive feedback about the application. In the report, the project team emphasized some points as a result of the trial. Blockchain technology can increase citizen satisfaction with public policies, and help people to control, plan and manage their spending and saving. Additionally, it reduces some costs and increases transparency. However, privacy of the users is an argumentative issue because of immutable records. In the long run, blockchain technology has great potential for smart money.

3.3.4. National Blockchain Roadmap

In February 2020, Department of Industry, Science, Energy and Resources (DISER) published National Blockchain Roadmap of Australian Government. In the roadmap, it is highlighted that digital currencies and the economic growth that they create led to economic transformation, and the effect of blockchain will go beyond the digital currencies (Australian Government DISER, 2020). For long term development and adaptation, The Australian Government's blockchain strategy covers three main areas; regulation & standards, skills, capability & innovation and international investment & collaboration, and it proposes 12 signposts for the future (Australian Government DISER, 2020). Some of the signposts are already started to put into practice. Also, in the roadmap, examples in private sectors like the wine sector and the ways these examples possibly could apply to the government are attention grabbing.

3.3.5. Digital Currencies and Taxation

In Australia, cryptocurrencies are subject to tax law. In 2014, the Australian Taxation Office (ATO) published a general guidance on it (Chandrasekera, Lodha, 2019). According to the guidance (Australian Taxation Office, 2020), activities of cryptocurrencies like transacting, selling, buying, making businesses, paying salaries and mining on a business scale are taxable events. ATO emphasizes that cryptocurrencies do not depend on central banks or any other governmental institution. For this reason, it can be considered that cryptocurrencies are seen as assets.

Digital Currency issue is a hot topic in Australia too. Economic References Committee of the Senate prepared a detailed report on digital currency and how it should be regulated in 2015 (Economics References Committee of the Senate, 2015). Government and institutions in Australia run proof of concept trials for seeing possible consequences of Central Bank Digital Currency (CBDC). However, for adaptation of CBDC, a comprehensive change of financial system and new monetary policy are required (Richards et al., 2020). Additionally, demand side of CBDC has not been researched yet. Therefore, CBDC is still a research subject for Australia.

3.4. United Kingdom

UK is an advanced country in many respects. In 2020, the rank of UK at E-Government Development Index is 7 and it ranks 6 at E-Participation Index (UN E-Gov Knowledgebase UK, 2021). Both high participation rate and the development of e-government technologies create a convenient base for developing and testing blockchain technologies on government. In UK, specifically, there are hot debates about the usage of blockchain in public services in the UK parliament (Hansard HL Deb., 2017). One side of these arguments focuses on the advantages of blockchain, such as security, trust,

transparency (Hinds, 2016). The other side of the argument points out that recording the data indelibly could be a disadvantage (Hansard HL Deb., 2017).

3.4.1. Regulators' Pioneers Fund (RPF)

Department for Business, Energy and Industrial Strategy (BEIS) of United Kingdom (UK) established a fund called Regulators' Pioneers Fund (RPF) to support high technology applications that can serve the market and industry in 2018 (Department for Business, Energy and Industrial Strategy [BEIS], 2021). The value of fund is £10M. BEIS makes a call for RPF, and projects are submitted to RPF. In 2021, one of the final pilot studies in 2020 April to May period was about blockchain. The final pilot study of Ofcom aims to find out solutions about portability of numbers, impostures, and unwanted, hoax calls through blockchain (Evaluation of RPF, 2021). Ofcom is a regulatory authority in UK that is legally responsible for telecommunication, broadcasting and postal service (Ofcom, 2021). Main duties of Ofcom include researching the satisfaction of citizens and making recommendations to businesses. According to Ofcom (Evaluation of RPF, 2021), their study is a proof of concept study. In other words, they researched how implementing blockchain technology could affect telecommunication services. The project consists of a platform for telephone management and digital identity wallet that can increase the accuracy of calls. As a result, blockchain technology increased transparency and coordination between users. Additionally, updates and old records were seen simultaneously. According to Ofcom, project results give a more holistic approach to the application of blockchain technology (Evaluation of RPF, 2021).

3.4.2. UK Export Finance

UK Export Finance (UKEF), Open Innovation Team (OIT), which is a cross-governmental unit in the UK, and University of Southampton worked together to develop a blockchain system for using the exportation process (Carpenter, 2019;

Davies, 2020; Margheri, n.d.). The exportation process requires close collaboration of banks, governments and exporters. In UK, banks and UKEF obtain and evaluate exporters' applications independently from each other, so exporters have to go through two separate processes, and it creates inefficiency. For increasing efficiency, a prototype was built. Andrea Margheri from University of Southampton assumed that there are three fundamental actors; UKEF, banks and exporters (Carpenter, 2019). According to these actors' needs, Corda's prototype was chosen. Corda provides verification of users, data accessibility with respect to position, and interactions on the basis of smart contracts (Margheri, n.d.). This prototype shows the potential of blockchain technology for increasing the efficiency in the government.

3.4.3. Government Distributed Ledger Community

Government Distributed Ledger Community was established for increasing knowledge of distributed ledger technology (DLT) and sharing that knowledge after recommendation of the UK Government Chief Scientific Adviser report (Government Distributed Ledger Community, n.d.). The community creates an information network between academy, government and private sector, and improves flows of DLT information.

3.4.4. Department for Work & Pensions (DWP) Blockchain Trial

In 2016, DWP started a pilot project called GovCoin trial about making welfare payments through a blockchain system (Hinds, 2016; Hansard HL Deb., 2017). The scope of DWP'S authority involves policies about welfare, child support and retirement allowance, so adapting new technologies for increasing citizen experience is one the main goals of DWP. In the project, DWP collaborated with GovCoin, which is a technology company, and private permissioned distributed ledger technology and proof of concept were used in the creation of blockchain (Malthouse, 2018). 12 people joined the project at the beginning. An app was

designed for the users so that transactions from DWP and spending of users can be stored on the blockchain by their consent. DWP tried to analyze the applicability of blockchain and its effects to payment system. However, the project brought heated debates with itself. On the one hand, Hinds (2016) and Malthouse (2018) emphasized that personal data of users was not or will not be shared with the government and GovCoin. On the other hand, in the both houses of the parliament, debates on privacy and freedom of choice sparked off. House of Lords (Hansard HL Deb., 2017) opened GovCoin trial up for discussion.

In the debates of House of Lords, Lord Henley and Lord Holmes of Richmond emphasized that blockchain technology has a huge impact area on the industry, and initial results of the project show that main goals of DWP like reducing costs of welfare payment, helping citizens for planning their budget and creating strong relationship between citizen and government are more achievable (Hansard HL Deb., 2017). Conversely, Baroness Lister of Burtersett pointed out the possibility that the government may use this technology to access private information like how citizens spend their welfare payment in the future, and Baroness Sherlock said that lack of any regulatory law or organization raised concerns about scrutiny (Hansard HL Deb., 2017). The supporters of blockchain technology in the House of Lords strongly repeated that government has no access to personal information and blockchain technology can reduce the costs. Likewise, some of the House of Commons shared the same concerns about blockchain technology. The main characteristic of blockchain technology is that data on the blockchain cannot be deleted or changed, but according to Onwurah (2019), blockchain is not completely understood, and this feature of it can lead to violation of private data.

3.4.5. Real-Time Gross Settlement System

Real-Time Gross Settlement (RTGS) is basically a transfer method that provides the transfer simultaneously between banks. The RTGS's difference from EFT is

that it is used for large amounts of money transfers and there is no waiting period. Generally, central banks of countries administer RTGS transactions. Bank of England started to test distributed ledger technology on the system of RTGS on March 2018 (Bank of England, 2018). Distributed ledger technology was applied as a proof of concept technology. Bank of England collaborated with technology and innovation firms; Baton Systems, Corda, Clearmatics Technologies, and Token (RTGS, 2018). The POC designed as a cloud-based system, and an application was created for transfers. In July 2018, the POC was finished, and documents about results were published. In the feedbacks of the firms, there were critics about functionality of application interface and emphasis on importance of following and adapting new technologies to the system. As a result, the Bank of England (2018) stated that they were going to research cryptographic proofs and applicability of different structures of distributed ledgers.

3.4.6. Digital Currencies and Taxation

Digital currencies and their taxation are among the issues that occupy the agenda of government and parliament. Bank of England (BoE), Financial Conduct Authority (FCA), the government and Her Majesty's Revenue and Customs (HMRC) did studies and published reports and guidance.

In March 2018, the UK Cryptoassets Taskforce was established while debates about digital currencies in UK parliament was going on (Financial Conduct Authority (FCA), 2019). Cryptoassets Taskforce published a report that includes impact position of the UK market, cryptocurrencies on finance, potential risks and benefits, and recommendations to BoE, FCA, HMRC after a few months (Taskforce, 2018). In 2019, HMRC published policy papers about crypto assets and taxation for individuals and businesses (HMRC, 2019). According to HMRC (2019), cryptocurrencies have 3 main types: exchange tokens, utility tokens, security tokens, and it is more proper to call them crypto assets because they

don’t have all the characteristics of currency (Bank of England, n.d.). HMRC (2019) pointed out that crypto-assets are subject to taxation because acts of individuals and businesses with crypto assets cause tax liability. Taxes like income tax, capital gain tax, inheritance tax, national insurance, and corporation tax can be collected. For instance; exchanging or mining crypto assets bring profits like exchanging in the stock market. Apart from HMRC, FCA published a guidance on crypto assets and its feedback in 2019. In the first version of guidance, the effects of UK's Brexit process and implementation of EU law on the UK was emphasized (Financial Conduct Authority (FCA), 2019). In 2020, as a result of a case, cryptocurrencies were accepted as property by High court (Rosenblatt, 2020).

Bank of England is interested in creating digital currency like other central banks. In 2020, a discussion paper on central bank digital currency was published (Bank of England, 2020). On one side, in the discussion paper, it is emphasized adaptability of central banks to the novel technologies is important for maintaining stability, because of changing payment structures and new needs of humans (Bank of England, 2020). On the other side, Andrew Bailey, who is Governor of the Bank, shared privacy concerns about the digital currencies in World Economic Forum (Ledger Insights, 2021).

3.5. Israel

Israel is a strategic and appealing country to make technological and innovative investments. In addition to having a deep entrepreneurial culture, it creates a suitable environment for operational tests. 4.9% of its GDP is directly used for Research and Development (R&D) in 2018 (OECD STI Scoreboard, 2018). However, the rank of Israel at E-Government Development Index (EGDI) is 30 (UN E-Gov Knowledgebase Israel, 2021). Correspondingly, E-Government Development Index (EGPI) rank of Israel is 66 (UN E-Gov Knowledgebase

Israel, 2021). Therefore, for the development of the country, Israel runs many ICT pilot projects and blockchain technology is one of them.

3.5.1. Greeneum Project

Greene is a global public blockchain platform operating in the field of energy (Greeneum, 2019). It records, validates and trades production and consumption of energy. To clarify, Greeneum uses algorithms which have the ability to distinguish Green and non-Green energy according to some data and certificates and manages demand and supply of the energy (Greeneum, 2019). In other words, it improves sustainability. In Israel, Greeneum runs a pilot project on micro-grids (Greeneum, 2019) ("SolarCoin Founders", 2017).

3.5.2. Digital City Currency Pilot

Tel Aviv-Yafo Municipality gave a start to Digital City Currency Pilot with other cities on 5 May 2019 (Lindman et al., 2020). "Digital City Currency Pilot" is a project that aims to see the usefulness of digital currencies. Additionally, Tel Aviv-Yafo aspired to reinforce local enterprises, increase citizen awareness and be involved in an interaction with citizens (Solomon, 2019; Lindman et al., 2020). The project sets up with Colu, which is a blockchain start-up. According to the project, users who make five transactions by using the project's app earn extra digital currency as a reward (Solomon, 2019). The reward digital currencies, seen as a subsidy, are provided by the municipality budget. The project was called off in September 2019. The main reason is the amount of reward currencies in the Jaffa area increased, so the subsidy budget run out (Chaimovich, 2020).

3.5.3. Israel and Commonwealth Bank of Australia

In 2015, Israel Ministry of Economy signed an agreement with the Commonwealth Bank of Australia for accessing the technologies related to blockchain in the Israel's blockchain ecosystem (Ojo & Adebayo, 2017). The aim of the agreement is to establish close connections between R&D companies in Israel and other countries as well as making Israel a hub for Blockchain (Ojo & Adebayo, 2017; Shamah, 2015). Thus, blockchain start-ups have contribution to the economy.

3.5.4. Blockchain Ecosystem in Israel

Israel allocates a considerable fund for R&D from the budget, and 4.9% of its GDP was invested in R&D area in 2018 (OECD STI Scoreboard, 2018). 4.9% of the GDP is well above the average of OECD countries as shown in Figure 4 below. Israel supports technological investments as well as creating a pleasant environment for companies from home and abroad. Correspondingly, entrepreneurial culture in the country and friendly environment compel companies' attention to make investment. According to data on Israeli Blockchain Association (2021), 206 blockchain start-ups operate their business activities in Israel. In the first place, distributed ledger initiatives in Israel mostly carried on a business in the financial sector (Bianchini & Kwon, 2020)

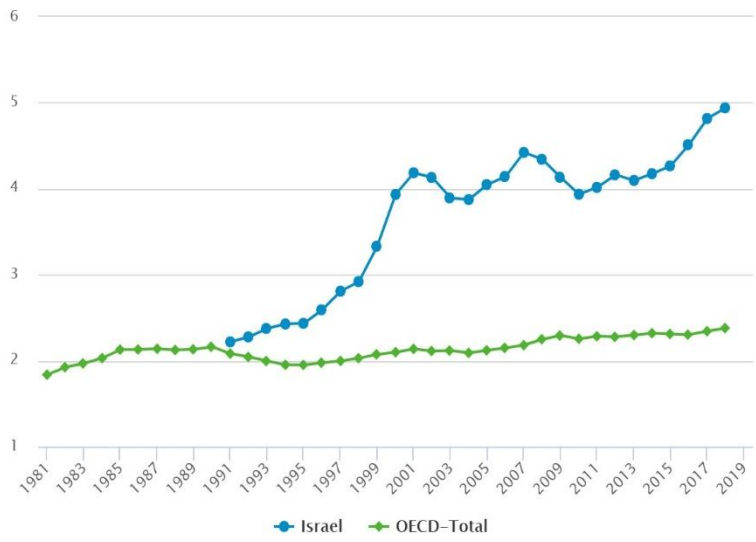

Figure 4. Israel's Gross Domestic Expenditure on R&D

Source: OECD STI Scoreboard.(2018). https://www.oecd.org/sti/scoreboard.htm.

In the following period, blockchain companies went far beyond the financial sector, and Israel created a powerful blockchain ecosystem. Many of the global firms collaborated with Israeli blockchain companies.

3.5.5. Digital Currency and Taxation

Digital currency and its regulation are argumentative topics in Israel. Israel takes an action as cryptocurrency usage becomes widespread in the country and the world. Firstly, Israel Security Authority (ISA) started to research and analyze the cryptocurrency issue because of potential risks and advantages. In 2017, The Committee to Examine the Regulation of Decentralized Cryptographic Currency was set up by ISA ("ISA Committee", 2018). Committee published a report about currency issuance in 2018. According to the report, risks of digital currencies are arrayed, and recommendations are offered to remove existing uncertainty. Secondly, Bank of Israel (BoI) established an inter-ministerial committee for virtual assets in 2018. Israel was more interested in applying blockchain to areas other than money-related issues, so the committee of BoI

consisted of people who has experience in different areas (Bianchini & Kwon, 2020). Thirdly, Israel Tax Authority (ITA) published circulars about digital tokens and ICOs. According to ITA, cryptocurrencies have to be seen as assets, not property. Therefore, if people make a profit on ICOs as an asset, Capital Gains tax can be applied as long as it is not becoming a business company (Bianchini & Kwon, 2020). Taxation issue of digital currencies was solved within the scope of capital gain tax law.

In 2018, there were other disputes about ICOs. Authorities argued whether ICOs should be included in Tel Aviv Stock Exchange or not, and then ISA imposed restrictions to cryptocurrencies because of protecting exchange market from speculation of cryptocurrencies. It created a binary situation because on the one hand, ISA supported innovation of blockchain technology and a friendly environment, but on the other hand, cryptocurrencies were detained from the exchange market. When debates continued, the bubble of ICOs popped and may of the ICOs lost their values. This situation pushed the authorities to analyze and rethink the issues of ICO and digital currency. Now, Israel carries on a work to establish an infrastructure for security.

3.5.6. Israel Security Authority (ISA)

ISA adopted blockchain technology to the information system of ISA. In the first place, blockchain technology applied to Yael system which is an e-mail system in 2018 (*Annual Report of ISA*, 2019). ISA communicates through Yael system with the agencies that are subject to the regulation of ISA (Staff, 2018). Then, in 2019, ISA implemented the blockchain technology to voting system called "Hatzba-Hon" which enables enterprisers to join and vote at meetings, and trading system called MAGNA, which allows to see electronic reports (ISA, 2018; *Annual Report of ISA*, 2019). MAGNA improved governance in ISA.

According to ISA (2018), blockchain technology makes Yael system more secure, keeps records of all the e-mails, prevents authenticity and removes the possibility of excuses like undelivered e-mails. Likewise, voting system and trading system become more efficient. Users ensure anonymity of their votes in the voting system, and the trading system disseminates and records all the information which is coming from an authorized person or an agency (*Annual Report of ISA*, 2019).

3.6. Discussion

Republic of Korea, Estonia, Australia, United Kingdom and Israel are the pioneer countries in the field of blockchain usage in government. When the use cases are examined, it can be said that blockchain is a new technology and it both offers advantages and disadvantages. On the one hand, security, immutability, transparency, less bureaucracy and coordination between different groups can be listed as the advantages. On the other hand, privacy, interoperability, and integration to the current administrative and legislative systems are the potential challenges.

In general, studies show that governments especially try to benefit from the immutable decentralized database of blockchain. One of the main reasons of this is that government databases are number one target of cyberattacks. The other reason is protecting citizens' privacy against public servants as well. Therefore, the areas that include keeping records appear to have priority about the implementation of blockchain. Overall, governments aim to implement blockchain in a variety of public services or administrative processes. They also try to incorporate the technology to the existing e-government systems.

Aside from directly implementing blockchain to the government services, taxation and regulations are important issues for the governments reviewed above. Blockchain technology emerged in the finance area at first, so

cryptocurrencies and several start-ups that develop their own currency have become a huge market. Many people do trade and invest in start-ups via cryptocurrencies. Therefore, when there is a conflict or manipulation of the market, people need a legal framework. In addition to this, to attract investment of blockchain start-ups, blockchain companies' position in the legal framework has an importance. Because of these needs, governments are taking steps about adapting blockchain to the current legal framework.

Considering the fact that blockchain is a new emerging technology, the potential of blockchain for governments and its scope of application will be understood with the trials. Therefore, countries tend to carry out pilot projects and proof of concepts. Although some of the projects couldn't meet the expectations, they provided insights about blockchain's possible usage areas in public administration and led to comprehensive data accumulation for these countries. It is also necessary to consider that every country has different demographics, conjunctures, systems, and cultures, thus a blockchain application may not always give the same results for every country.

To conclude, for a clearer vision about blockchain use in government, it is both necessary for governments to learn about other countries' experiences and run their own trials. The next section presents the case for Turkey and by considering the Turkish context, it discusses the lessons that can be drawn for Turkish public administration based on the results of the academic studies and the other countries' implementations of blockchain.

CHAPTER 4

TURKEY AND BLOCKCHAIN USE IN PUBLIC ADMINISTRATION

One of the main goals of public administration is to provide public services to citizens, and respond to the changing and evolving needs of society. Along with the developments in technology, public administration systems have changed and incorporated technological improvements into their administrative and policy processes, which has transformed public administration into digital government or e-government. According to UN (2021), "E-government has been employed to mean everything from 'online government services'' to 'exchange of information and services electronically with citizens, businesses, and other arms of government'."

Incorporating new technologies to the provision of government services is one the aims of the e-government. Along with that, the digitalization of public services also creates a pressure on governments for transparency, and correspondingly accountability (Erkkilä, 2020). Therefore, the technological innovations like blockchain, artificial intelligence, robotics, drones, virtual and augmented reality have become hot topics for e-government-related policies recently (Millard, 2017).

Blockchain is one of the innovations that governments are interested in, particularly in implementing their e-government projects, due to its features such as being a distributed immutable ledger technology. E-government systems use the government databases and these systems are the main targets for cyber-attacks, because of the enriched data. As a recent example, the systems of Turkey Ministry of Agriculture and Forestry were attacked on 31 July 2021 (TRT Haber, 2021). Therefore, governments search for effective solutions for the

security problem in the digital environments, and blockchain proposes a new type of secure database. In addition to this, automation of certain services can ease the workload of public servants and accelerate the bureaucratic processes.
In line with the goals of digital governance, blockchain offers new ways and conveniences to the management of big data, creating smart cities, and achieving transparency and accountability. Especially, in the governance side, communication, interaction, and cooperation among the government, private sector, and the citizens can increase, and these parties can get involved in decision-making process actively (Kassen, 2021).

This chapter first reviews the development of e-government in Turkey to provide a framework for the blockchain related discussions and the potential usage areas in Turkey. Then, based on the review of the literature and the country examples in the earlier sections, it evaluates how blockchain can possibly be used in the public administration area in Turkey and what kind of advantages it can bring in providing public services. Thereafter, possible challenges and shortcomings of blockchain for Turkey are discussed.

4.1. E-Government Development in Turkey

While the Internet was first introduced in Turkey in 1993 (Baykal, 2018), the implementation of e-government projects started as early as 2000s following a few earlier trials in tax area. In 2003, Turkey took a big step about e-government, and launched the digital transformation project. The project's action plan included the ICT goals of Turkey, in the light of the EU requirements (Devlet Planlama Teşkilatı Müsteşarlığı, 2004). In fact, the main motivation of Turkey for e-government initiatives was based on the EU membership criteria (Üstüner and Yavuz, 2017). Therefore, in the project, increasing public participation, transparency and accountability of the government had the priority (Üstüner and Yavuz, 2017).

Before the project, some of the public institutions already had their own websites, but these websites performed one-way. The institutions could share data, but citizens could not interact with the institutions via their websites. Additionally, data that were shared by the institutions depended on their initiative, and there was no connection between the websites. Starting with the project, progress was made in areas like substructures, identifying the main institutions and training civil servants. More importantly, e-government gateway (portal) of Turkey was established in 2008 (T.C. Cumhurbaşkanlığı Strateji ve Bütçe Başkanlığı, n.d.), and provided access to the main public services and information such as education, citizenship, military, etc. The main advantage of e-government portal is that the citizens can reach many of the e-government services from a single website.

According to OECD Data (2021), %90.7 of the households in Turkey has Internet access, and high rank of accessibility is an important element for the efficiency of e-government. Today, e-government portal is managed by Digital Transformation Office of Turkey. There are 56.030.215 users, 814 institutions, and 5907 services are provided over this national portal (Digital Transformation Office of Turkey, 2021). When we look at the E-Government Development Index, Turkey is ranked the 53 in 2020 (UN E-Gov Knowledge Base Turkey, 2021). On the other hand, E-Government Participation Index is 23 in 2020 (UN E-Gov Knowledge Base Turkey, 2021).

In comparison to the older ranks of Turkey, it shows progress, but there are still major problems in the e-government implementation. In the three sub-categories that generate The E-Government Development Index, Turkey's value of Telecommunication Infrastructure Index is quite lower than the other two sub-categories, which are Human Capital Index and Online Service Index. Additionally, in the UN Member States Questionnaire for the E-Government Survey, it can be seen that Turkey does not have a legal framework concerning digital government as a citizen right and there are deficiencies about the future

strategies on new technologies (United Nations E-Government Survey 2020, 2020). On the other side, bureaucratic culture, the need to get approval from an authority, lack of qualified staff and integration challenges are some of the problems that affect e-government development in Turkey (Arpacı, 2010).

When Turkey's e-government journey is evaluated, it can be seen that Turkey is open to new technologies and innovation. However, for overcoming current challenges in the e-government and technology implementation in general, public policies need to focus on the specific problems mentioned above.

4.2. Blockchain-Related Developments in Turkey

In Chapter 3, use cases in Korea, Estonia, Australia, United Kingdom and Israel have shown that the integration of blockchain technology to the public administration has actively started. Pilot studies are important in terms of seeing the advantages and disadvantages, because blockchain technology can be considered as a nascent technology. Although Turkey has not been to the pilot test stage yet, it has begun to take some steps about utilizing blockchain technology in general and in public administration. The following sub-sections review these developments.

4.2.1. Blockchain Turkey Platform

Blockchain Turkey Platform (BCTR) was established in 2018 by the Turkish Informatics Foundation (BCTR, 2019). The main purpose of the platform is to make Turkey a pioneer in blockchain technology in its region (BCTR, n.d.). To increase the awareness level about blockchain, BCTR organizes events and educational programs, and publishes reports about blockchain technology. When memberships and collaborations are examined, there are 67 membership and 20 collaborations, and it can be seen that public institutions, private companies and

universities are in the BCTR. Especially, with collaborations, BCTR tries to create a blockchain ecosystem.

4.2.2. TUBITAK Blockchain Research Laboratory (BZLab)

TUBITAK is the abbreviation of Scientific and Technological Research Council of Turkey. Main mission of TUBITAK is to support the development of science and technology, and researches. There are many research centers and institutions in various fields within TUBITAK. The one of them is National Research Institute of Electronics and Cryptology. For conducting research projects and meeting the need of accurate knowledge about blockchain technology, in 2017 Blockchain Research Laboratory was established within the structure of National Research Institute of Electronics and Cryptology (BZLab, 2017). In the lab, current literature about blockchain is followed, and various studies and workshops are done. Thus, it aims to increase blockchain technology use in different sectors and provides support for the trials.

4.2.3. Creating A National Blockchain Infrastructure

In 2019, the Ministry of Industry and Technology issued "Industry and Technology Strategy 2023" report, which included creating the National Blockchain Infrastructure as a goal (TC Sanayi ve Teknoloji Bakanlığı, 2019). In the strategy, there are five main components, and blockchain is under the infrastructure section as a subtitle (Blockchain Türkiye, 2019). For creating a national blockchain infrastructure, encouraging steps will be taken by the ministry. The Ministry highlighted that in the first place, more suitable public services like land registry, diploma, and customs services will be determined for the pilot blockchain implementation cases (TC Sanayi ve Teknoloji Bakanlığı, 2019). After the trial stage, it plans to create a "regulatory sandbox", which is a safe operating environment for successful trials.

4.2.4. The 11th Development Plan 2019-2023

Blockchain technology and the actions to be taken were first included in the 11th Development Plan of Turkey, which was prepared by Turkey's Department of Strategy and Budget (T.C. Cumhurbaşkanlığı Strateji ve Bütçe Başkanlığı, 2019). In the plan, it was stated that necessary investments for blockchain infrastructure like power grids, power stations, hardware, and software would be made. In addition, the areas of custom services and transportation would be given priority about the implementation of blockchain. Besides the future actions and infrastructure investments for blockchain technology, it is also planned to launch Central Bank Digital Currency (T.C. Cumhurbaşkanlığı Strateji ve Bütçe Başkanlığı, 2019).

4.2.5. Ministry of Trade of Turkey

In 2019, Ministry of Trade established the first official blockchain unit within the body of the ministry (Anadolu Ajansı, 2019). The main reason is that while the private sector is developing and applying new technologies, the ministry as a key public institution should not fall behind the private sector. In the first place, the blockchain unit will focus on the import and export applications (UTICAD, 2019). The ministry signed a service procurement contract with ATEZ, which is a software technology company, to benefit from its international experiences, learn about successful application examples, and to develop cooperation regarding blockchain systems (ATEZ, 2020). In addition to this, the ministry is the first member of Blockchain Turkey Platform as a public institution.

4.2.6. Laws and Regulations Related to Blockchain

In Turkey, laws and regulations on blockchain technology are at infant stage. Most of the discussions about regulations of blockchain are held around the financial markets. The main reason for this is the emergence of blockchain

technology in the financial field at first, as well as the high rate of cryptocurrency use in Turkey. Turkey is in the fourth place in the world in the usage of cryptocurrency (Buchholz, 2021). Although, recently Turkish authorities have a prohibiting tendency against cryptocurrency, the documents and reports which were published by the public institutions display a more enthusiastic point of view at the first stage.

However, it can be stated that Turkey followed a wait and see strategy because authorities did not take an action about cryptocurrencies for a long time. In 2016, a report from Capital Market Boards of Turkey pointed out that if payment systems like bitcoin become more widespread in the financial markets, they will gain strength and be resistant to speculations (Çarkacioğlu, 2016). In the reports from public institutions, it is emphasized that regulations in that area can give an advantage to Turkey (Çarkacioğlu, 2016; Üzer, 2017). Capital Market Boards of Turkey announced their plan to regulate cryptocurrency markets. According to 2018 financial stability report (TCMB, 2018), Central Bank of the Republic of Turkey carried out researches on Central Bank Digital Currency. Additionally, for a developed economy, implantation of a blockchain based central bank digital currency takes place as a goal in the 11th Development Plan of Turkey (T.C. Cumhurbaşkanlığı Strateji ve Bütçe Başkanlığı, 2019).

While the researches and debates about CBDC and regulations of blockchain was going on, negative experiences of cryptocurrency market changed many countries' point of view, including Turkey. In 2018, cryptocurrency market crash led to losing market's reliability. Then, in 2021, the owner of Thodex which is cryptocurrency exchange market fled abroad with 2 billion dollars (Independent Türkçe, 2021), and cryptocurrencies started to lose value in the world (Haar, 2021). These kinds of developments pushed the Turkish authorities to take precautions against cryptocurrency market. After a while from these developments, Turkey banned the usage of cryptocurrency for payments (Ödemelerde Kripto Varlıkların Kullanılması, 2021). According to the statement

made by Central Bank of the Republic of Turkey (2021), risks in the market are too high because of possibility of usage in illegal activities, speculations in the market, and lack of central control mechanism.

4.3. Potential Advantages of Blockchain Use for Public Administration in Turkey

As shown in the earlier sections, blockchain offers several opportunities for the public administration area, besides its use in the finance sector. This section presents in detail what potential advantages blockchain technology may offer for public administration in Turkey. It considers some of the problems of public administration in Turkey relevant for blockchain use, as well as the technological vision in the current strategic plans of Turkey. Implications from the literature and the country experiences reviewed above also provide insights for the discussions in this section.

4.3.1. Enabling Big Data Use

The digital revolution that comes with technological progress leads to the emergence of new areas in the public administration. One of these areas is big data and management of big data. Before the digital revolution, the data collected was limited and management side of the data was not so complex. Big data is a broad term for massive amount of digital data that is collected and it cannot be managed with traditional data management technics (Kim et al., 2014). Governments and private companies are collecting and recording tremendous amount of data every day from people. Cell phones, computers, social media accounts, and any service that a person can benefit from have become a great source of data. There are three outstanding characteristics of big data; volume, velocity, variety (Kim et al., 2014). Specifically, these characteristics can be summarized as tremendous amount of data, which has high speed and various categories. Therefore, traditional data analysis technics are insufficient for the

management of big data. Evaluation and getting meaningful results from data require specialization.

Big data is a more complex and delicate issue for governments than for companies because mission of government is quite different from companies. Main mission of the government is to promote public welfare, so the major expectation from big data is to improve government's capacity to serve citizens. For that purpose, addressing problems in several areas like health, education, security, environment with the effective usage of big data becomes a public policy in many countries.

In Turkey, the development of e-government stimulated the big data initiatives as a related area. The strategy documents, development plans, and action plans included the first steps of big data awareness (Okuyucu, 2018). Policies that were directly about big data were formulated in the 2015-2018 Information Society Action Plan and 2016- 2019 e-Government Action Plan (Okuyucu, 2018). B3LAB of TUBITAK, MHRS and e-Nabız applications of Ministry of Health, MEBBIS application of the National Education Ministry are some examples of big data applications in Turkey (Okuyucu, 2018). When the current point of Turkey is evaluated, it can be stated that Turkey's awareness and implementation about big data are developing and it has become a hot topic.

Although big data policies and related studies in Turkey are growing each day, there are specific problems and challenges about big data alongside the general problems about big data in the world. When the main problems about big data are analyzed, the four common problems are identified (Es-Samaali et al., 2017; Fan et al., 2019; Karafiloski & Mishev, 2017). The first problem is security of data. The government is first target of the hackers because of the sensitivity and confidentiality of the data (Karafiloski & Mishev, 2017) (Kim et al., 2014). The second problem is that the network between government agencies is too loose in some points (Fan et al., 2019). The databases of the government agencies are

centralized and separate from each other's. Therefore, citizens are faced with problems and experience unnecessary bureaucracy because of lack of information. The third problem is privacy of citizens (Kim et al., 2014). Violation of personal data is a serious problem for citizens because digitalization pushes the limits of the right of privacy. As an example, government agencies can easily reach one of the citizen's daily visited websites. The fourth problem is ineffectiveness of information sharing (Fan et al., 2019). In a centralized system, technical and governance sides of information sharing are not as effective as a decentralized system, and they bring additional costs. Similarly, according to Okuyucu (2018), public institutions in Turkey are not willing to share their data and data driven decision-making are at the low levels. Additionally, there are problems about lack of skilled public servants, interoperability and standardization of data, security, and automation of the big data analysis process in Turkey (Okuyucu, 2018).

To address these problems, some scholars think that blockchain technology has a considerable potential. Because of the complicated bureaucratic relationship between governmental organizations, blockchain technology can offer new ways for the above-mentioned problems about big data. First of all, blockchain technology provides decentralized data storage and multiple layer cryptography such as asymmetric cryptography, digital signatures (Es-Samaali et al., 2017; L. Wang et al., 2019). Additionally, hashing mechanism between the blocks provide to be realized any breaches on the system. Thus, it can ward off possible data breaches and attacks and can make the system more secure (Fan et al., 2019) (L. Wang et al., 2019). On the other hand, when some applications of blockchain in healthcare registries are examined, blockchain presents a chance to the citizens to control their data at some level (Karafiloski & Mishev, 2017). Especially, it can be used in the healthcare applications. This situation strengthens the confidence between the government and the citizens. Secondly, blockchain technology potentially increase the information sharing and governance between governmental agencies with providing a decentralization

(Fan et al., 2019). In a blockchain that is shared irreversible data, consensus mechanisms can enhance the governance because multiple parties exist together in a system. Additionally, improvement of data sharing paves the way for data driven decision-making.

To conclude, when the problems of big data in Turkish public administration are considered, blockchain can remove the hesitations by improving security and privacy, and accelerating automation of the data analysis. Big data opens a new room for government, and to benefit effectively from it, governments have to develop new methods. Although blockchain is a nascent technology, it is a promising for big data challenges.

4.3.2. Building Transparency

The concept of transparency refers to the right to know of citizens, and involves building trust between government and citizens (Erkkilä, 2020). These actions are basically coming from the concept of power (Blomgren, 2007). In a monarchy, the king has limitless power and s/he does not have to explain the reason of his/her actions because the legitimacy of the system does not come from the citizens. Therefore, state's actions are unquestionable. On the other hand, in a democracy, the executives have to explain the reasons of their actions because the legitimacy is coming from the citizens. In other words, the citizens have the right to know to balance the power of the state.

Although transparency is thought to be a new concept that came with New Public Management (NPM) for the public administration, its history goes back to 1950s. The beginning of the globalization at the end of Cold War and rapid development of the internet put further pressure on public administration about transparency (Erkkilä, 2020). Especially, NPM promoted the concepts like transparency, accountability, good governance and their associations, arguing that these concepts will increase the performance (Blomgren, 2007). Therefore,

many countries adopted transparency-related laws and regulations during 2000s. Although there are arguments about transparency, its boundaries and effects of it, it has become a key governance principle for many countries. To be more transparent and to eliminate corruption, governmental agencies do performance analysis, share annual reports about what they do, and enable public monitoring and scrutiny about governmental decision making. Especially, in the area of public procurements, transparency has additional importance. The high monetary value of the public procurements, close interaction of parties, and their high complexity make them more open to corruption.

According to Corruption Perceptions Index of Transparency International (2020), Turkey's rank is 86 among 180 countries and its score is 40. While its score is higher than the average scores of the regions; Eastern Europe and Central Asia, Middle East and North Africa, and Sub-Saharan, it is lower than Western Europe and EU, Americas, and Asia Pacific (Corruption Perceptions Index, 2020). Based on these information, it can be said that Turkey is an average country about transparency. Although Turkey is developing policies that support transparency, there are some problems (Akpınar, 2011). The general problems in the world like alteration of records, security and immutability of data are also challenges for Turkey. On the other hand, one of the major problems in Turkey about transparency is the sense of privacy in public institutions (Akpınar, 2011).

The features of blockchain like security, immutability, and decentralized public ledgers may promote transparency via eliminating concerns of privacy and security in institutions in Turkey. Firstly, everything that is written on the blockchain cannot be deleted and changed by anyone. After the creation of a block, it cannot be changed or deleted thanks to cryptographic hashing. Secondly, written things can be updated through adding new blocks. Thus, users can see old blocks. In classical database systems, the things that are written can be changed and deleted, or old version of something changed cannot be reached.

Governments for enhancing transparency and building trust can create applications and several databases that citizens can reach. For example, in Estonia, the Estonian Ministry of Justice records every draft law, and citizens can read them (e-law, n.d.). The information about the submission and status of the law can be read on the KSI Blockchain System. In this system, citizens are only readers, but more active roles can be given to the citizens in different types of blockchains. On the other hand, when the human factor is thought, blockchain applications provides transparency to the some point. According to report of World Economic Forum (2020) about public procurement, blockchain technology could bring automation, transparency of the process and tamper evident recording, but blockchain technology cannot restrain parties from bribery. Necessary institutions may exist or lose their functions, and society may not react to bribery. Therefore, blockchain can provide certain things but human factor is also important.

4.3.3. Creating Smart Cities

Cities are complicated systems where different interest groups are coming and living together. The development of ICTs also affects the governance of cities as it affects other fields. Smart city is a concept that has emerged in this process, which originates from IBM's smart earth concept (Fu & Zhu, 2020). There are many definitions of the smart city based on various perspectives. One of them is that smart city is using ICT for improving operational processes, sharing information and developing better services (TWI, n.d.). In other words, it is digitalization and automation of a city. Transformation applications of municipalities, interactive kiosks, sensors and smart lighting are some of the examples for smart cities (TWI, n.d.). The main goals of smart cities are increasing efficiency and increasing service quality. For example, traffic management is problem for many cities. In Los Angeles, because of integrated sensors, an application for traffic management is developed (Stefanini Group,

2020). The application collects data from the sensors, analyzes the situation, and regulates the traffic lights.

According to Hall et. al (2000), in the context of smart cities, most of the services will move to digital systems because of being environmentally and economically efficient (Hall et al., 2000). From another perspective, the smart cities try to find new ways to adopt technology for making people' lives more easier and expressing their ideas and thoughts (Partridge, 2004). Therefore, adaptation of ICT becomes an urban policy.

In Turkey, although smart city is a new term, ICT strategies of Turkey also relate to smart city strategies because they involve ICT usage in public services like transportation, traffic management, and personal safety etc. (Bilbil, 2016). Creating smart cities as a public policy was initiated by the EU framework, and accordingly Information Society Strategy and Action Plans in Turkey included smart city related plans (Bilbil, 2016). Today, there are several projects about smart cities in Turkey. One of the examples of smart city projects is the project of Turk Telekom and Innova in Karaman (Innova, 2015). Another example is the project of "Creating Three Smart Cities In Turkey By 2023" that aims to transform Sakarya, Kayseri, and Gaziantep to smart cities (Imtilak, 2017). On the other hand, in the smart city projects in Turkey, problems generally concentrate around the lack of coordination between institutions and planning (Bilbil, 2016).

The features of blockchain like anonymity, transparency, immutability and security can solve problems about the implementation of ICTs to various service areas and make their adaptation to the cities easier, because they answer the most basic needs of people. Blockchain technology also meets the basic needs of government agencies such as governance and securely sharing information. When the Turkish case is considered, coordination problem of institutions can be handled with private blockchain ecosystems. In other words, every institution

can reach the correct data and the coordination between them can be provided by smart contracts. Additionally, improvement of coordination between them and sharing information can solve planning problem of the institutions. As shown in the review of the country experiences with blockchain above, blockchain technology draws attention of governments for several public services such as transportation, which is one of the major areas of interest in creating a smart city (Fu & Zhu, 2020).

On the other hand, since blockchain is also a new technology, there are also some risks and disadvantages of it. First of all, interoperability could be a risk (Bhushan et al., 2020). The integration of blockchain to existing systems could bring compliance problems. There is the possibility of that some programs or existing documents may not be used in the blockchain system. Secondly, people are not educated about blockchain system. Both users and operators do not have enough and efficient knowledge about it. Thirdly, regulations about this area are so immature (Bhushan et al., 2020). Therefore, legally the question of what should be done is unanswerable in some areas. According to many scholars (Xie et al., 2019; Fu & Zhu, 2020; Bhushan et al., 2020), despite its challenges, blockchain technology gives promises about the development of smart cities, and new future studies can help to overcome the current problems.

For the smart cities, generally local governments take the big responsibility because they have autonomy on their territory and their area is limited. Therefore, they can go into an action faster than the centralized governments. When the local government implications are examined, it can be seen that some of the local governments have started to benefit from the blockchain technology (Gün et al., 2020) (Blockchain for Government Council - Cities Committee, 2020). Especially, in the areas like voting (Xie et al., 2019), data recording and data publishing (Blockchain for Government Council - Cities Committee, 2020; Young, 2019), local governments around the world has started to use blockchain,

and lessons from these experiences may also give a clear vision to central governments for large-scale national projects in Turkey.

4.3.4. Achieving Good Governance

Governance is an important concept for the systems in which there is more than one party. The importance of governance comes from the principle of "separation of powers". In other words, the underlying idea in the governance is weakening the power of the state. The rise of New Public Management (NPM) brought the new forms and debates of governance for developing new instruments of control (Peters & Pierre, 1998). Debates on governance in the literature lead to the emerging of concept of good governance. According to United Nations Human Rights (n.d.), if governance process is normative or can be evaluated, it can be defined as good governance. Therefore, the principles of transparency, accountability, and participation are essential for good governance. Good governance has been a hot topic for Turkey as well as for other countries. Because of EU process, international organizations and internal demands, Turkey makes progress about governance (Üstüner and Yavuz, 2017). However, there are existing deficiencies about governance in Turkey. OECD Economic Survey of Turkey (2021) indicates inefficiencies of governance institutions. According to Üstüner and Yavuz (2017), public policies and projects that support governance were created in Turkey, but the main problem in Turkey is about the implementation of these policies and projects. Centralization of the Turkish state and bureaucratic structure of the institutions make governance process difficult. Additionally, enthusiasm of the citizens about participation of governance is a question (Üstüner and Yavuz, 2017).

In addressing these problems of governance, blockchain technology is considered as promising (Wong et al., 2020). First of all, it is a decentralized system. Fundamentally, the purpose of existence of blockchain technology is to decrease centralization, and this purpose is in harmony with purpose of

governance. Decentralized immutable databases provide more security than the traditional databases. Therefore, using blockchain brings the advantage of that the possibility of modifying data is ruled out in a system (Veeramani & Jaganathan, 2020), and that reinforces the trust between the government and the citizen. Secondly, smart contract technology is another advantage for e-governance because code of smart contract provides the execution of defined conditions (Veeramani & Jaganathan, 2020). When certain requirements are not met, the code cannot be executed. This feature of smart contracts can be used for improving governance, and the implementation problems in the governance process can be solved. Thirdly, decentralized voting platforms can be created, and willingness of the citizens about participation in the governance process can be increased. Voting is an expensive and complex process everywhere in the world because it requires transparency, security and free will of participants. To ensure these, many precautions are taken, so it is lengthy for the citizens. According to Curran (2018), blockchain technology can provide certain criteria like public verifiability, individual verifiability, security, auditability, anonymity, transparency, and these criteria have to be met for a secure blockchain voting system (Bulut et al., 2019) (Curran, 2018; Hjalmarsson et al., 2018).

When the case studies are examined, it can be seen that the number of e-voting projects and implementations such as IIT Bandung, Ethereum Blockchain Trustless Voting increased. According to Şat (2019), blockchain transformation in the public administration will bring the citizens to a more active position. As a specific example, the city of Zug in Switzerland is using blockchain based e-voting system. In 2018, the City of Zug became a partner with Luxoft and Lucerne University for a blockchain based voting project (Luxoft, 2018). In the first place, Luxoft prepared the blockchain based voting project for a corporate group in United Arab Emirates, but project didn’t fit the requirements of the group. Then, city of Zug was interested in project for local elections. For voting, citizens create a digital identity and get a digital key. Then, with their keys, they access the system and vote. According to surveys which are conducted by city of

Zug, %79 of the citizens support the e-voting and %52 of them think that e-voting is easy, effective and fast (Maccabe, 2018). As in city of Zug, especially local governments can use blockchain based e-voting for the purpose of increasing governance between citizens and government. Thus, it creates a safe environment for e-governance.

To conclude, considering the features and capacities of the blockchain technology, evidence from countries' experiences, as well as the context of public administration in Turkey, big data, smart cities, transparency, and governance are proposed to be the main areas that Turkey may particularly benefit from this technology in public administration. There are also specific areas of use for blockchain implementation as reviewed in the next section.

4.4. Potential Disadvantages of and Challenges to Blockchain Use for Public Administration in Turkey

While the emergence of Industry 4.0 technologies brings many benefits, it also opens a door to new challenges. As an Industry 4.0 technology, blockchain technology sparks off new disputes, debates and questions. Many of these challenges that are related with the immaturity of blockchain and Industry 4.0 technologies will also be applicable to Turkey case, as a developing country.

4.4.1. Interoperability

Interoperability is key concept of Industry 4.0 for wide usage in computational systems. Though the definition of interoperability includes much more things with Industry 4.0, in the first place it is defined as cooperation ability and capacity between two or more software regardless of their differences in coding language, interface (Wegner, 1996). The use of computer technologies become widespread thanks to the increase in interoperability with the developing technology. The development of Industry 4.0 added people, organizations and

internet services (Hermann et al., 2015) because interaction among these parties increased with Industry 4.0. Integration in different levels; vertical, horizontal, end to end is behind the successfully establishing an interoperable system (Xu et al., 2018).

The interoperability of blockchain is a serious challenge for adaptation in Turkey. In Turkey, there are current digital systems almost in every public institution. Renovating the whole computational systems will bring a serious cost. Blockchain technology offers many benefits, but if interoperability between types of blockchain, smart contracts and different applications of it cannot be provided, it will render all the benefits of blockchain useless (World Bank Group, 2021). In other words, when a blockchain based system is established, system's interoperability in the same chain, with different blockchains and with the systems which are not based on blockchain is essential.

4.4.2. Scalability

Scalability of blockchain systems is a major challenge for Turkey as well as for the other countries. The concept of scalability states the capacity of a system to handle or manage accumulative data and expanding volume (Bondi, 2000). In a distributed ledger, many new blocks are added to the ledger, and every node on the system stores all of the ledger (Zheng et al., 2017). As an example, in Bitcoin, as the number of transactions increased in the chain, the speed of validation decreased. The speed of Bitcoin cannot compete with the speeds of traditional systems like Visa (Berryhill et al., 2018). Therefore, scalability has a direct effect on efficiency of the blockchain. Scalability problem is generally solved in two ways; increasing block size or changing the design of blockchain (Zheng et al., 2017). In a national project, the process of designing a blockchain should be carefully planned.

4.4.3. Immaturity and Lack of Experts

Blockchain is an immature technology when it is compared with other ICTs (Kouhizadeh et al., 2021). The unknown points about the blockchain still exist, and as a result of that, unexpected consequences can be met. Immaturity of a technology is directly proportionate to the lack of experts who would understand, apply, design and manage it, and the lack of adequate technological devices. In comparison with public services, scope of the firms in the private sector is limited, so the number of persons that the firms have to give education about blockchain technology is reasonable. However, in public services, the amount of civil servants who need to be educated is too many, and blockchain is a complicated technology (Cagigas et al., 2021).

Additionally, the government institutions work with citizens' personal data. A technical problem in a governmental institution can cost data breaches. Therefore, if emerging problems cannot be solved effectively and the right decisions may not be taken, more complicated problems can be created for Turkey. Nevertheless, the literature about blockchain continues to develop and the case studies, pilot projects and proof of concepts are conducted for benefitting from the advantages of blockchain.

4.4.4. Lack of Regulation

The regulation area of blockchain is another shortcoming point. The blockchain technology has been created with the aim of decentralization in financial area. In the long run, potential of it for other areas has been discovered, and besides cryptocurrencies, private companies have been established. As a result, this situation sparks off the debates on law and regulations in this area. The digital world is tried to be regulated and managed through laws and computer codes. Laws are naturally applied externally. In other words, when there is a violation, the results of violation can be compensated or can be brought into compliance

(Yeoh, 2017). On the other hand, computer codes are naturally applied internally. If there is a violation, computer codes cannot be used for compensation or compliance (Yeoh, 2017). Despite the unexpected results or consequences, computer codes execute what the code says strictly. Therefore, the regulations to be made in this area become more of an issue in terms of protecting people.

In the jurisdiction area of blockchain, the governments choose to follow one of the three strategies. The first one is wait and see strategy (Finck, 2018). Generally, in technological advances, legislators observes how the technology works and decides the current position towards it (Finck, 2018)(Ellul et al., 2020). The second one is implementing current laws to the blockchain technology (Finck, 2018). The governments can give guidance to the people and the users about how blockchain technology is subject to legal jurisdiction (Ellul et al., 2020). The third one is banning (Ellul et al., 2020). Legislators directly can ban or restrict all the activities about blockchain. However, banning pushes the stakeholders that carry their activities to another country.

It can be said that Turkey implemented a wait and see strategy for a long time. However, in the cryptocurrency area as a consequence of unexpected events like Thodex scandal (Independent Türkçe, 2021), Turkey banned cryptocurrencies (Ödemelerde Kripto Varlıkların Kullanılması, 2021). This action of Turkey did not cause to close down Turkish cryptocurrency market. Many of the markets like Paribu, Biance TR continue to their transactions. Additionally, this prohibition of cryptocurrencies prohibit the taxation in Turkey. On the other hand, blockchain companies which work in other areas different than finance cannot find a legal framework for themselves in Turkey. It can be said that Turkey maintains a wait and see strategy for these companies.

Though the governments implement different strategies to regulate the jurisdictional area of blockchain technology, the regulatory area of it is still so

immature, and the governments are faced with real challenges about how they adopt the blockchain to the current jurisdictional area.

4.4.5. Quality of Data

In this digitalization period, massive amount of data are gathered, and policies, actions plans, and strategic decisions are based on the data. In other words, data driven decision-making is so critical for creating effective policies. Another shortcoming about the blockchain technology is how quality of data can be ensured (Berryhill et al., 2018). Data quality means accuracy, consistency, reliability of data, and is generally also a problem of big data and ITs.

As it is the case in many countries, there is a data quality problem in Turkey. According to Onder and Brower (2013), the data problem in Turkey poses an obstacle for the researches in general. In addition, data driven decision-making is scarce in Turkey (Okuyucu, 2018), and the studies on data quality area are low (Güzel and Kurşunel, 2015).

The features of blockchain technology like immutability, privacy, transparency provides a proper ground for data quality. Immutableness and security of the records make it easier to find the origin of the record, and to reach the data. However, if the first records are not accurate, incorrect records are kept in the system. For example, an accountant may forge a document, and may record it. Blockchain does not recommend a solution for that. The origin of data is a problem like in the traditional systems (Berryhill et al., 2018). Therefore, this is another challenge about implementation of blockchain for Turkey.

4.4.6. Standardization

Standardization is a key element for common usage, interoperability, and integration. One of the reasons why blockchain technology is not widely used is

lack of certain standardizations. Though standardization is a concept of mass production, it is required for large-scale integration of a technology. The reason of that is that in a large scale project, a system which is designed below adequate standards creates security and privacy risks for all the system (König et al., 2020). Additionally, creating a certain standard in blockchain technology will make it more secure and increase trust to it (Deshpande et al., 2017). Therefore, when there is a possibility of blockchain implementation at a nationwide level in Turkey, many questions like "Which system should be used?", "What are the basic standards of blockchain implementation?", "Will our systems be compatible with other countries?" will arise. International standardization organizations like ISO, IEEE, ITU and W3C carry on studies for standardization of blockchain and distributed ledgers (König et al., 2020).

4.4.7. Immutability and Privacy

The feature of immutability means the ability of inalterability. In comparison with the traditional databases, after a data is written and validated on a chain, it cannot be changed or deleted. In other words, it makes the records permanent, and confidential, and it is considerably seen as a great advantage of blockchain technology. However, as argued in the British parliamentary debates, there is a risk that the usage of blockchain technologies in public services may violate the privacy of citizens. Right to be forgotten is one of the EU principles (Berryhill et al., 2018) and it is included in EU General Data Protection Regulation (GDPR) (GDPR, n.d.). It expresses that a person in certain situations can demand the deletion of his/her data (GDPR, n.d.). For example, if a citizen requests a deletion of certain information, blockchain based technology does not allow performing this request, because any change in the chain destroys the integrity of the records.

Like in the EU, there are also legal frameworks that provide the extinguishment of certain records from personal history in Turkey (KVKK, 2016). Therefore,

privacy and immutability issues are also blockchain related challenges for Turkey. Consequently, these issues bring questions on the privacy issue and implementation of blockchain technology to public services.

4.4.8. Organizational Structure of Public Institutions and Job Loss

Governmental institutions are centralized entities. Organizational structure of them for governing large scale institutions are based on bureaucracy, and duties of civil servants are pre-defined. Therefore, there is a rooted centralization culture in the governmental institutions in Turkey (Sözen, 2005). On the other hand, naturally, blockchain and distributed ledger technology are decentralized systems, and the distribution of centralized power is one of the reasons for the emergence of blockchain technology. Therefore, government institutions may not be in harmony with the blockchain technology. Civil servants may not want more responsibility, and executives may not want to give up their power. Additionally, blockchain can cause some of the civil servants' job loss because of automation of some processes. To put it simply, there can be a conflict between organizational culture in public institutions and the decentralized nature of blockchain technology (Cagigas et al., 2021). Thus, having a centralized bureaucratic structure can be a challenge for Turkey in blockchain implementation.

4.5. Possible Areas of Blockchain Use for Public Administration in Turkey

Even if the essence of public services remains the same, the embodiment of public services is constantly changing because of the transformation in the society. The dynamism in the society also brings dynamism to the different aspects of life such as education, health. Public services have a wide range, and as societies become more heterogeneous, satisfying the needs and handling the problems get harder. Therefore, applying or trying new ways for solving problems in the society is an important issue in term of addressing the societal

needs. In this perspective, blockchain technology offers new opportunities for the provision of public services.

Although Turkey is in the very beginning of the road in blockchain implementation, it is possible that this technology may also assist public administration in Turkey in relation to public services and administrative processes. This section presents a discussion on how blockchain can be used in public administration in Turkey, based on a review of the related literature and applications in other countries.

4.5.1. Land Registry

One of the areas where the blockchain technology is used in public administration is land registry. In liberal theory, property rights and ownership are associated with the concept of freedom (Gaus, 2010), and they are seen as a key for economic development in a country. Therefore, processes about property and ownership are highly carried out carefully in many counties, and the possibility of corruption and fraud is tried to be reduced as much as possible. Like in many other services, land registries have been digitalized gradually, and in this digitalization process, blockchain based systems are developed and applied in some countries like Georgia (Georgia, 2016), Ghana (Ameyaw & de Vries, 2020) because of increasing transparency. When the general process of land registry is examined, as it is shown in the Figure 5, it can be realized that there are open points for corruption and bribery.

According to Transparency International (2011), one out of every ten people are paying bribes to officials for services about land.

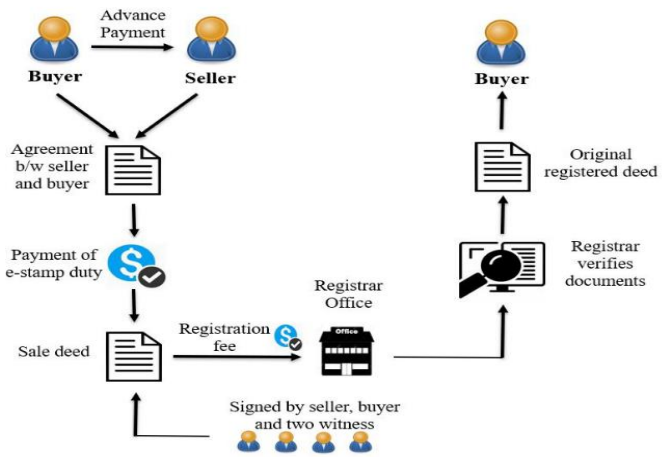

Figure 5. The current process in Land Registration

Source: Veeramani, K., & Jaganathan, S. (2020). Land registration: Use-case of e-Governance using blockchain technology. KSII Transactions on Internet and Information Systems, 14(9), p.3698.

In comparison with the traditional process, usage of blockchain-based technology provides more transparency. As it is shown in Figure 6, blockchain provides more digitalization and automation. In other words, it does not leave open doors to officials for bribery. As it can be seen in the Ghana experience, the features such as immutability of records, transparent databases and smart contract based processes optimize the operations about land (Ameyaw & de Vries, 2020).

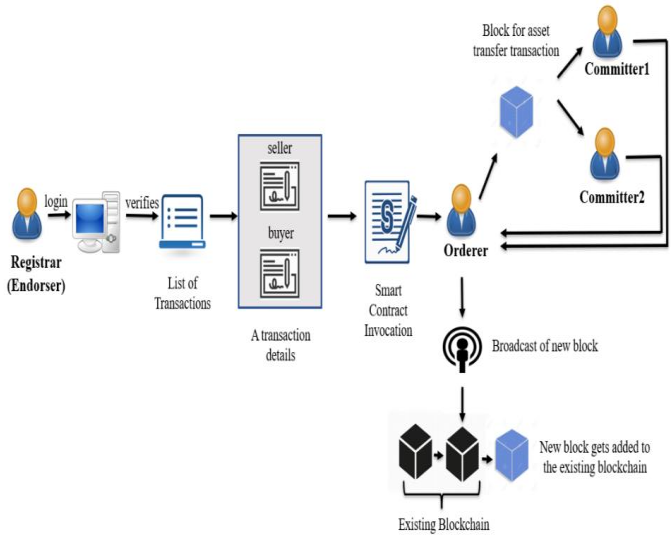

Figure 6. Land Registration using Blockchain technology
https://doi.org/10.3837/tiis.2020.09.007

Source:Veeramani, K., & Jaganathan, S. (2020). Land registration: Use-case of e-Governance using blockchain technology. KSII Transactions on Internet and Information Systems, 14(9), p.3699.

Blockchain can be advantageous for Turkey in improving the quality of land registry (Mendi et al., 2020; Mendi, 2021). The bureaucratic process of Turkish institutions about land registry can be accelerated. Additionally, immutability of land records can optimize the process.

4.5.2. Education

Most of the scholars highlighted that the great potential of blockchain technology for education is not discovered yet (Alammary et al., 2019), (Lizcano et al., 2020),(Chen et al., 2018). In the educational area, many different kinds of blockchain-based applications are developed. Certification (Han et al., 2018; Lizcano et al., 2020), creating e-learning platforms (Zhong et al., 2018), fees, scholarships and credit system (Turkanović et al., 2018) are the mostly used areas in education. The majority of applications used are in the certification area.

The main purpose of that is preventing forgery of officials documents and benefitting from trust and privacy of blockchain (Alammary et al., 2019). The University of Nicosia is the first university that used blockchain technology for certification (UNIC, n.d.). Additionally, Massachusetts Institute of Technology (MIT) is using blockchain for online learning (Chen et al., 2018).

In Turkey, especially COVID-19 obliged the online educational services. Even before that, Anadolu University planned to structure its open and distance learning processes over blockchain (Uğur et al., 2018). In addition, there is a forgery problem in diplomas in Turkey (NTV, 2021). For example, Ministry of National Education of Turkey expelled 45 teachers from their jobs because of forgery in diploma (Sputnik Türkiye, 2018). Therefore, blockchain has a critical importance for Turkey in education. It can also provide the originality of certificates.

4.5.3. Voting

Digitalization of the world has changed the dynamics and the structure of the society. In the near future, the adaptation of ICTs to broader public areas is expected and voting is one of them. Modern democracy and democratic governance are based on voting, so security, transparency and privacy are indispensable elements for voting. Even if a little deficiency in the procedure might affect the legitimacy of voting. Therefore, it is a challenging responsibility to create a secured system while using ICTs for the voting process.

In EU, there are serious studies about e-voting (Constitutional Affairs, 2016). When we look at the perspective of Turkey, e-voting is at the preliminary level. The closest examples to the e-voting application in Turkey are the online surveys conducted by the municipalities. For example, Ankara Metropolitan Municipality carried out a survey for deciding couch upholstery of buses (T.C. Ankara Büyükşehir Belediyesi, 2020). Another example is İstanbul Metropolitan

Municipality's survey about Taksim square (Sözcü, 2020). Recently, the most attention-grabbing application belongs to Hendek Municipality. Hendek Municipality that is a small municipality at Sakarya prepared an online voting application for the items of the agenda (T.C. Hendek Belediyesi, 2021). Although the application is still in the testing phase, the expectations are positive (T.C. Hendek Belediyesi, 2021). There are similar online initiatives about the participative budgeting in some municipalities.

In comparison with the traditional centralized technology, the blockchain technology is very promising. Firstly, digital identifications that has cryptographic algorithm required, and this guarantees that everybody only votes ones and only eligible users can vote (Khan et al., 2018). Secondly, privacy of voters can be provided (Curran, 2018). In other words, voters can authenticate their votes, but their identity are not connected with their votes (Curran, 2018). Thirdly, the blockchain provides transparency (Curran, 2018). The results of voting are open to public. For examining challenges and advantages of blockchain, many studies and cases are conducted in this area. As an example, a case study in Colombia aimed to find an efficient way to vote for Colombians who live abroad (*Blockchain Voting for Peace – Colombia*, 2017). At the end of the case study, importance of participation of different stakeholders for success of the project is seen, and as a challenge, it is realized that there are strong status quo and resistance in public institutions (*Blockchain Voting for Peace – Colombia*, 2017). As a different example, when the city of Zug in Switzerland with Luxoft started e-voting in 2018, results were shown that the adaptation of blockchain based e-voting is embraced by citizens and executors (Maccabe, 2018). Based on these examples, it may be stated that despite blockchain's advantages in the voting area, the successful implementation of it is related with politics of the country. Therefore, for successful implementation of blockchain to voting, pilot studies can be conducted in Turkey, and enthusiasm of the citizens to voting via blockchain can be increased.

4.5.4. Identity Management and Notary Services

With the rise in the digital platforms like Linkedin, Facebook, Twitter, digital identities have a place in people lives. Almost in every digital platform, a digital identity is created to use the platform. The development of E-government also brings a requirement of official digital identity for governmental platforms and the other platforms that are connected with governmental tasks. One of them is notary services. Especially, COVID-19 accelerated the process of digitalization in this area (Yıldız, in press). The main duties of notary services are validation of identities, checking willingness of the parties and witnessing the awareness of parties for some processes. Because of the nature of government, there are some problems in digital identity area and notary services. The first one is external security of identities and private information. In comparison with any other organization, the government has the most sensitive information about people and it has the power of collecting this information. Therefore, it always becomes a target for cyberattacks. The second problem is internal security. The possibility of public servants to use citizens' private information in the direction of their interests is a security threat. The third problem is data integrity. The communication of the governmental agencies and information sharing between them is a controversial issue because institutional structures of governmental agencies are separated by the principle of separation of powers in many countries. Therefore, information equals to power for the governmental agencies. These three issues are major problems for identity management. Additionally, in the world, there are some problems for refugees. The lack of an identity affects the refugees' proper access to governmental services for their basic needs.

As in other areas, some distinct features of blockchain technology draw the attention of governments for identity management and notary services, and there are some studies for blockchain-based implementations. For example, in South Korea, blockchain based driver licenses started to be used through an application (Mapperson, 2020). Driver licenses of citizens are cryptographically codified,

and officers who want to control validity of driver licenses just scan QR codes of the application. Thus, privacy of citizens are protected for external and internal threats. Another example is AID:Tech project for Syrian refuges in Lebanon (OECD & OPSI, 2018). AID:Tech which is a Singapore based technology company started a pilot project with partnership of the Irish Red Cross in 2015. In the project, 500 blockchain based digital identity were given to Syrian refugees, and identity cards included the records of aids. Thus, attempts of fraud were prevented (AID:Tech, n.d.).

When the implementation areas are analyzed and refugee crisis in Turkey is taken into consideration, blockchain based digital identities could be a strategic area for Turkey. Especially, refugees who work or are worked illegally can be taken under control, and social benefits for them could be tracked more effectively in Turkey. In addition, government databases can be more secure using blockchain.

4.5.5. Healthcare

Healthcare is one of the areas where blockchain technology implementation is visible. The reasons of visibility lie under the advantages that the blockchain technology brings. The first advantage is privacy, security and immutability. The distributed ledger technology and encryption of data with several mechanisms like merkle tree, digital signature, hashing is used in the blockchain technology. Therefore, blockchain provides more patient centric system for healthcare with these features (Agbo & Mahmoud, 2020). In other words, patients can manage and control their own data. Additionally, data about patients can be followed until first records. The second advantage is that blockchain increases auditability of healthcare industry (Kuo et al., 2017). The data on blockchain cannot be changed or deleted later like in the traditional centralized databases, so audit process will be more transparent. The third advantage is decentralization (Kuo et al., 2017). There are a lot of organizations and parties in

the healthcare industry, and systems are centralized, so interoperability and integrity between different organizations are inefficient. Therefore, for more decentralization, suitable applications can be developed with the blockchain technology. The fourth advantage can be seen as the sum of first three advantages. Because of the first three advantages, biomedical researches can gather speed. Accurate and cumulative data about illnesses and patients save time for medical researches.

Because of these advantages, countries and private companies have started to use blockchain technology in healthcare. Estonia is the first country that applies blockchain in healthcare at a national scale (Einaste, 2018), and many other blockchain companies like MedChain (MedChain, n.d.) run projects. In Turkey, there are digital applications in current health system like E-Nabız, HES, MHRS (Ministry of Health of Turkey, 2021). However, these applications are based on centralized systems, so transformation of these systems to blockchain can be studied (Takaoğlu, Özer, and Parlak, 2019). Blockchain technology can help to collect data under one application, and it can provide an infrastructure for future applications. More importantly, it can provide immutability and privacy of records. Considering the advantages like "transparency, accountability, decentralization, record accuracy, secure transactions, interoperability, lowering costs, collaboration and agility" (Gökalp et al. 2018, p. 179), blockchain technology can be suggested for implementation in the Turkish healthcare system. On the other hand, the identified challenges of blockchain use in the health care, including the need for standards and agreements, lack of legislation, sustainability, scalability, adoption and cost of operation (Gökalp et al., 2018) may also be valid for the Turkish case.

4.5.6. Supply Chain Management and Customs Services

Supply chain management is another area that blockchain technology is applied. The phrase of supply chain means connection between producers, intermediaries,

and suppliers for a product and supply chain management is management of this process. The process of supply chain management includes many different parties, resources, and actions like production, transportation, storage…etc., so supply chain management is critical for efficient usage of sources. The main problem in supply chain management is trust because it includes many parties in different stages and locations (Di Francesco Maesa & Mori, 2020). The fundamental features of blockchain technology can solve the trust problems to some extent. It can enhance transparency, data sharing, traceability and audibility (Di Francesco Maesa & Mori, 2020; Dutta et al., 2020). The records of the product are kept in the decentralized and immutable ledger, so the records cannot be changed and according the type of blockchain, people can see these records. Additionally, when management costs decrease, verification and effective management increase. Therefore, many industries in the private sector started to use blockchain technology in supply chain management. De Beers in diamond industry (DeBeers, 2018), Walmart and IBM in food supply (Aitken, 2017), Martine Jarlgaard in fashion industry (Martine Jarlgaard, n.d.), and OriginTrail and TagItSmart in wine industry (OriginTrail, 2018) use blockchain technology for supply chain management.

In this context, based on its applications in the private sector and in the customs services as in Korea case, the government can benefit from the blockchain technology in supply chain operations for increasing effectiveness and saving costs, especially in pharmaceutical industry, car industry, and food industry. In Turkey, a transition to blockchain in the supply chain operations can shorten the bureaucratic customs processes, and increase the efficiency. Also, the detection of contraband goods can get easier. In the private sector, blockchain use has already started. Therefore, blockchain usage in supply chain management has an importance for Turkey.

4.5.7. Energy

Energy sector is a tremendous market that affects all the other sectors. In the sector, adaptation of Industry 4.0 technologies is inevitable because energy sector's interaction with other markets is high, and centralization in the energy sector is an important challenge. Decentralized nature of the blockchain technology has drawn the attention of people who are in the energy sector as a possible solution to challenges in the sector. Energy market is a complex sector and there are many actors, so a trade between two companies is a slow process. Blockchain technology suppliers or producers and consumers can cut the middleman and automatize the process of trading with smart contracts (Andoni et al., 2019; Thukral, 2021). In addition to this, it can increase traceability. Smart devices like smart grids, micro grids are being used in the energy technologies and blockchain technology can be used for communication between these devices (Andoni et al., 2019). According to the data gathered, transparency, audibility and manageability of the sector increase.

As a case study, Germany introduced a research project that aims to adopt blockchain to power trading (Jardine, 2021). The name of the project is BEST, which is an abbreviation of blockchain-based decentralized energy market design and management structures in Deutsch (Ledger Insights, 2021). The main aim of the project is to increase sustainability of energy. In this scope, German government plans to prevent excess production by increasing automation and paves the way for easier peer to peer energy trading (Jardine, 2021). For Turkey, blockchain usage in the energy sector could be beneficial for efficiency and sustainability. Detection of power failures can become easy, and the quality of data from energy sector will increase. Therefore, future services that are based on electricity can be planned more efficiently. Additionally, digitalization of the energy sector can gather speed in Turkey.

4.5.8. Internet of Things (IoT)

The development of smart technologies has caused the emergence of the internet of things (IoT). IoT can be defined as connection and knowledge sharing between devices through the Internet (Clark, 2016). Internet of things has an extensive scope from wearable technology to smart homes and smart cities. In Turkey, after e-government applications started to develop starting with 1998 (Şakar, 2011), it paved the way for many other digital transformations, including the use of IoT. After 2015, IoT was directly included in several government policies such as 2015-2018 Information Society Strategy and Action Plan (Information Society Department, 2015), and the 11th Development Plan (T.C. Cumhurbaşkanlığı Strateji ve Bütçe Başkanlığı, 2019). Especially, in the 11th Development Plan (T.C. Cumhurbaşkanlığı Strateji ve Bütçe Başkanlığı, 2019), it is emphasized that required infrastructures will be improved for implementing technologies like IoT and artificial intelligence.

The blockchain technology can help with the adaptation of IoT technologies (Deloitte, n.d.). IoT technologies are weak for cyber-attacks and centralized storages increase the possibility of cyber-attacks. Blockchain based decentralized immutable ledgers and protection mechanisms of blockchain technology can create a secure environment for IoT technologies (Deloitte, n.d.; IBM, n.d.). Additionally, trust to the system will increase. The increase in the usage area of IoT technologies will also affect the characteristics of government services. Therefore, usage of the blockchain infrastructure in Turkey can solve security problems and increase the prevalence of IoT. With the aims of creating smart cities and enhancing the government services, Turkey can benefit from blockchain technology in implementing IoT technologies.

4.5.9. Public Finance Management

The emergence of blockchain technology is based on the need to find new ways for current financial systems. The founder of Bitcoin, Satoshi Nakamoto, wanted a currency that weakens the power of Central Banks. While Central Bank Digital Currency is a controversial issue for many governments because of the unexpected results, the blockchain technology is more useful for fiscal policies. In the scope of public finance, blockchain can be used as a regulatory tool or controller. As in the other countries reviewed above, taxation is a major income item for Turkey. In the taxation area, blockchain provides transparency, accuracy, control and simultaneous information (Akdemir Altunbaşak, 2018; Schofield et al., 2016), so efficiency in the system could increase. Additionally, it will provide more accurate data for budget allocation, so public expenditures and public revenues can be managed well. Tax experts in PWC pointed out that blockchain technology is proper for transactions and transactional taxes like The Value Added Tax, retention tax, revenue stamps and insurance taxes (Schofield et al., 2016). In other words, taxation of cryptocurrencies can be a new revenue for Turkey.

CHAPTER 5

CONLUSION

5.1. Summary of the Findings and Discussion

The aim of this study is to review the application areas of blockchain technology in the public sector around the world, examine the potential of it, and evaluate its implications for blockchain use in public administration in Turkey. The main research question is 'How blockchain technology could possibly be implemented in the field of public administration in the world and in Turkey?' With this purpose, blockchain and its characteristics are analyzed, and a literature review is done. For providing a comprehensive point of view, how blockchain is studied in the fields other than public administration is examined at first. Then, its position in the public administration literature and its position in digital era governance are studied. Thereafter, the current positions of Korea, Estonia, Australia, United Kingdom and Israel are analyzed. In this context, the attitudes of the countries, policies and the pilot studies that are in the public sector are reviewed. In the light of these findings, implications for Turkey are discussed. In addition to the current policies and implementation areas of Turkey, the advantages and opportunities that blockchain can provide and the disadvantages and limitations that it may cause in practice are presented.

Despite the fact that the blockchain technology emerged as a game changer at the finance area, its characteristics have opened a road to transformation in several areas. Distributed ledger technology provides security, immutability, authenticity, smart contracts and privacy as a suitable infrastructure for ICTs. Especially, while the digitalization of society keeps going as fast as lightening, the needs of society is changing with the same speed. Therefore, the

implementation of blockchain to the public services has become a major issue for public administration.

Studies that concern its implementation in public administration gather around the concepts like privacy, security, governance, transparency and accountability of the government. Several countries have started to shape their policies about the blockchain technology and research its applicability to the public services such as digital identity, records, digital currency, supply chain management, health, education…etc. The main goal of these case studies is to identify how the government can benefit from it. Undoubtedly, there are some disadvantages like immutability of sensitive information and privacy. It could be stated that the advantages of the blockchain technology are much more than the disadvantages. Therefore, some of the countries go beyond the pilot studies and actually apply the blockchain technology to public services, like Estonia and Korea. Table 1 shows the summary of the findings from the analysis of the country examples about the opportunities and challenges of blockchain.

Table 1. Summary of the Findings From the Country Analyses About The Opportunities and Challenges of Blockchain

	Opportunities	Challenges
Korea	-Ensuring Privacy -Security -Minimizing Human Interaction -Automation of Processes -Less Bureaucracy -Real time accessibility	-Immutability of records -Acceptance of usage by parties -Job loss for public servants
Estonia	-Increasing transparency -Making easier residency process -Authenticity -Security	-Immutability of records
Australia	-Increasing communication between agencies -Reducing costs -Transparency -Increasing citizen satisfaction	-Immaturity of blockchain technology -Privacy

Table 1. (continued)

UK	-Increasing transparency -Increasing coordination -Reducing costs	-Immutability of records -Functionality
Israel	-Improving sustainability -Authenticity -Contribution to the economy -Improving governance -Efficiency	-Ineffectiveness of digital currency rewards

In addition to these, the analyses on these exemplary countries indicate that having a national strategy, developing a national infrastructure, establishing a dedicated institution or human resource about blockchain technology, nationwide implementation, and having political stability are among the success factors about blockchain implementation.

In Turkey, some steps have been taken about blockchain. When the blockchain technology for public administration is considered, it has a great potential for breathing into issues like big data, transparency, smart cities, and governance. In the 11th Development Plan, it is highlighted that blockchain technologies will be implemented and infrastructure investments will be made. Furthermore, the blockchain technology takes place in the strategic plans of some public institutions.

The analysis of the features of blockchain technology highlights the advantages that it may offer for Turkish public administration. The first opportunity is about the concept of big data, which is developing. As a result of digitalization, big data is a public policy area for governments. In terms of the opportunities, blockchain offers security, privacy, decentralized database…etc., it brings solutions to most problems in this field in Turkey. The second opportunity is transparency. Security and immutability features of blockchain can remove the hesitations of institutions about sharing. The third one is about creating smart cities. The digitalization changed the way people need and access public

services, so the concept of smart city has emerged. The main problems in this area are privacy and security. Additionally, in Turkey, the stage of creating smart cities has coordination and planning problems. As a solution, blockchain offers decentralized secure database and ways for improving governance between institutions such as smart contracts. The final opportunity is in the area of governance. Automation of some processes, decentralized database, smart contracts can loosen the centralized bureaucratic structure of Turkish public administration. Thus, the concept of governance can improve.

Considering these potential advantages of blockchain for Turkish public administration and the examples from other countries, it may be suggested that blockchain can be implemented in the areas of land registry (Mendi, 2021), education, voting, identity management, healthcare, supply chain management, energy, IoT, and public finance management in Turkey. In addition, it may be applicable to certain e-government services, such as drivers' licence renewal or obtaining vaccine passports.

As in every technology, there are difficulties in the implementation of blockchain. Problems such as interoperability, scalability, standardization, immaturity, lack of experts, lack of regulation are generally encountered in new technologies like blockchain. On the other hand, the quality of data is a problem that is also related with the current technology. In addition to these problems, the features of immutability and privacy are seen as problems at some points because of the situations that require the deletion of data.

In comparison with the countries that are reviewed in Chapter 3, it can be said that Turkey moves slowly about the pilot studies and policy development. While the blockchain technology has been included in the national plans and policies, there is no research or pilot study about how it can be integrated into the Turkish public administration system. As a consequence, even when the limitations and

shortcoming are thought in the research process, the exploration and integration process will take much more time for Turkey.

5.2. Recommendations

One of the important findings is that Turkey has not conducted any pilot study or proof of concept about blockchain yet. Every country has different demographics, culture, societal background and political regime. These factors shape the dynamics of the state and society relations. Therefore, the structure of public institutions and the shape of public services are directly related to these factors, and when transformations, new methods and integration of technologies are made in public administration, circumstances and conjuncture have to be taken into account. Conducting pilot studies reveals the positive and negative effects of an innovation, thus predicting and measuring the outcomes of large scaled implementations become easier. Therefore, conducting proof of concept and pilot studies in Turkey has importance for the implementation of the blockchain and ICTs. Especially, about ICOs and digital money, there is a special need in the Turkey.

In the public administration area, smart cities, big data, governance and transparency have an increasing trend. With the digitalization, new concepts like smart cities and big data have emerged, and the existing concepts like governance and transparency have gained new meanings. The blockchain technology can enhance these concepts and prepare a suitable ground for them. Therefore, studies in public administration and public policies can further focus on these concepts.

The blockchain is a nascent technology and one of the requirements is high-level computational skill. Generally, the projects that are blockchain based are carried out in partnership with the private IT companies in the world. However, there is also a need for public servants who know the blockchain technology at the

expert level because of protecting the interest of public institutions. Therefore, public servants should be trained about blockchain.

There are serious concerns about privacy. Immutability of the ledgers can create disadvantages for citizens. The permanent and unalterable storage of sensitive citizen information can strengthen state authority and threaten privacy in different ways. Therefore, usage areas should be discussed in detail before implementation.

When blockchain is considered with regard to bureaucratic structure of Turkey, blockchain implementation could bring organizational challenges. Additionally, automation of the processes can cause public servants to lose their jobs. As a result, there may be resistance from institutions in blockchain adoption. Therefore, public policies should be prepared to include programs and trainings for preparing people to the profession of the future.

In addition to these, the review of the countries has indicated that the cooperation and partnerships among different actors facilitates blockchain implementations. Thus, it is recommended that the current studies be accelerated and the cooperation among public institutions, private sector and the academy be encouraged. For instance, Ministry of Industry and Technology of Turkey announced the National Blockchain Infrastructure in 2019 and there is a blockchain research lab within the body of TUBITAK. Ministry of Industry and Technology can work with TUBITAK Blockchain Research Lab, the private IT companies, and universities to actualize the National Blockchain Infrastructure.

This research indicates that Turkey does research and studies in the area of blockchain. However, it also shows that Turkey is in the preliminary stage for implementation of the blockchain technology. Country analyses indicate that pilot studies and proof of concepts are adopted as data based policy-making tools in blockchain implementation. Also, having a national strategy and developing a

special work force equipped for this technology appear to be the effective initiatives. In this respect, Turkey can also be among the leading countries with the appropriate analyses and by developing the right policies.

5.3. Limitations of the Study

One of the limitations of this study is that blockchain is a nascent technology. There are considerable amount of studies in the literature, but most of them belongs to computer science and engineering area. Although there are also publications in economy, finance, political science, public administration and sociology, computational science and engineering areas are quite dominant. In addition to this, the novelty of the blockchain technology makes it unpredictable to some extent. Therefore, the findings from the literature review are limited with the existing few studies in public administration area, which is developing.

Another limitation of this research is the lack of empirical analysis. Countries reviewed in this study carried out pilot studies and proof of concepts, but the reports of these studies generally do not provide any empirical data. Similarly, the current study does not use any empirical data to support the conclusions related to Turkish case. Turkey is at the beginning of the road about the blockchain technology. Although the blockchain and related actions are pointed out in the governmental documents like policies and strategies, Turkey does not conduct a proof of concept or trial about it. Therefore, currently, there is a lack of empirical data to be analyzed.

5.4. Future Research

In this research, a review of the blockchain use in the public administration around the world and an analysis about the implementation of this technology in Turkey are made. The study presents a general standpoint for the current position

of Turkey. Launching of the case studies and trails in Turkey can be developed based on this study.

For the future research, the blockchain technology can be discussed in detail in specific contexts. Governance, transparency, big data, smart city, cybersecurity, integration of the blockchain technology to the government and basis of the integration can be studied within the scope of specific projects and departments.

Another focus for future studies could be humanitarian side of integration of the blockchain technology. Current positions of public servant, attitudes and readiness of citizens, and the effects on organizational culture could be the hot topics for blockchain implementation in public administration in the future.

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APPENDICES

A. TURKISH SUMMARY / TÜRKÇE ÖZET

Dünyada meydana gelen teknolojik gelişmeler ekonomik, sosyolojik ve kültürel alanlarda insan ilişkilerinin temelini oluşturan birçok noktada dönüşümün önünü açmıştır. Tarihsel düzlemde bakıldığında teknoloji temelli ilk dönüşüm buhar gücünün keşfedilmesi ve insan kas gücüne duyulan ihtiyacın azalması ile 1700'lü yılların sonunda gerçekleşmiştir. Üretim için gerekli olan el emeği yerini mekanik üretime bırakmıştır. Bu dönüşümün bir diğer adı Birinci Sanayi Devrimi'dir. 19. Yüzyılın sonları ve 20. Yüzyılın başlarını kapsayan zaman diliminde ise İkinci Endüstri Devrimi gerçekleşmiştir. İkinci Endüstri Devrimi'nde elektrik enerjisi ile fabrikalarda seri üretime geçilmiştir. Tüketim mallarının seri üretimi dünyada el emeğine dayanan üretim şeklinin dönüşümüne ve buna bağlı olarak toplumlarda ekonomik, kültürel ve toplumsal ilişkilerin yeniden tanımlanıp şekil almasına yol açmıştır. İkinci Sanayi Devrimi sonrasında 1950'lerde bilgisayar teknolojilerin gelişmesi ile Üçüncü Sanayi Devrimi'nin temelleri atılmıştır. Bilgisayar teknolojilerinin gelişmesi üretimde dijitalleşmeyi başlatmış, üretimde verimlilik artmış ve bilginin ulaşılabilirliğini büyük ölçüde arttırmıştır. İnsanların yaptığı birçok iş bilgisayarlarla yapılmaya başlanmış ve bu nedenle bazı meslekler zamanla miladını doldurmuştur. Günümüzde ise Dördüncü Endüstri Devrimi'nin eşiğine gelmiş bulunmaktayız. Dördüncü Endüstri Devrimi kavramı ilk olarak 2011'de Almanya Hannover Fuarı'nda kullanılmıştır. Genel olarak Dördüncü Endüstri Devrimi siber fiziksel sistemlerin üretime dahil olmasıdır. Siber fiziksel sistemler, fiziksel dünya ile siber dünyanın bir araya gelmesini ve aralarındaki koordinasyonu nitelemektedir. Bir bakıma, kullanılan her şeyin yavaş yavaş dijitalleşmesi ve dijitalleşen nesnelerin birbiri ile iletişime geçebilmesi, fiziksel dünyayla etkili bir şekilde bağlantı kurabilmesi, bilgi aktarabilmesi siber fiziksel sistemlerin en önemli özelliğidir. Yapay zekâ,

nesnelerin interneti, akıllı şehirler, sensor teknolojileri siber fiziksel sistemlerin örneklerindendir.

Siber fiziksel sistemlerin gelişmesiyle ortaya çıkan Dördüncü Endüstri Devrimi dünyada birçok dönüşüme yol açmıştır. Artık insanların çoğu akıllı telefon kullanmakta ve birçok işlerini akıllı uygulamalar üzerinden yapmaktadırlar. Bu dönüşüm istemsiz olarak geleneksel organizasyonların da değişimine yol açmıştır. Başarılı bir şekilde Dördüncü Endüstri Devrimi teknolojilerinin uygulanabilmesi için geleneksel organizasyonların mimarileri ve organizasyonel entegrasyonlarının zaman içinde değişmesi gerekmektedir. Kamu kurumları ve özel sektör siber fiziksel sistem teknolojileri uygulayabilmek için bir dönüşüm geçirmeye başlamıştır.

Blok zinciri teknolojisi, siber fiziksel sistemlerden biridir. Temelde bloklardan oluşan bir dağınık defter teknolojisidir. Blok zinciri teknolojisini bir metafor ile açıklamak gerekirse, blok zincirinde yer alan blokların her biri bir defter sayfası olarak görülebilir. Blok zinciri teknolojisi bu defter sayfalarının kopartılamaz bir şekilde bir araya gelmesi ve her kullanıcıya bu defterin bir kopyası verilmesidir. Bu defter sayfasına ne yazılıp ne yazılmayacağı ne amaçla kullanılacağı ile ilişkilidir.

Bu çalışma, seçilen dijitalleşmiş ülkelerde blok zinciri kullanımına ilişkin akademik araştırmaları ve raporları inceleyip ve blok zincirinin Türkiye'de kamu yönetiminde nasıl kullanılabileceğine dair sonuçlar çıkarmak için akademik literatürün bir analizini yapmaktadır. Bunu yaparken de mevcut projelere ve kalkınma planlarına bakarak kamu sektöründe bilgi ve iletişim teknolojileri uygulamaları ve gelecekteki blok zinciri stratejileri ile ilgili Türkiye'deki gelişmeleri değerlendirmektedir.

Blok zinciri oluşturan bloklar, birbirlerine kriptografik mekanizmalarla zincir şeklinde bağlanmıştır ve her bir blokta istenilen bilgiler tutulmaktadır. Her bir

blok, üzerine yazılan bilgileri 32 karakterlik hash fonksiyonları olarak kodlar ve bu kodlar blokların birbirlerine bağlanmasını sağlar. Blokların herhangi birinde meydana gelecek olan bir değişiklik bloğun hash fonksiyonunu değiştirir ve bu da bloklar arasındaki bağlantıyı koparır. Bir diğer güvenlik mekanizması anahtarlardır. Her kullanıcının bir özel, bir de genel anahtarı bulunmaktadır. Genel anahtar bir e-mail adresi veya banka hesabı gibi düşünülebilir. Özel anahtar ise gizli bir kimlik gibi düşünülebilir. Genel anahtar verileri şifrelemek için, özel anahtar ise şifreleri çözmek için kullanılır. Bu sisteme asimetrik kriptografi denir. Diğer iki kriptografik metotlara ek olarak, sıfır bilgi ispatı yöntemi kullanılmaktadır. Sıfır bilgi ispatı yönteminde amaç karşı tarafın bir bilgiyi bilip bilmediğini bilgiyi vermeden kontrol etmektir. Örneğin kilitli bir kapının önünde duran iki kişiden biri kendinde anahtar olduğunu iddia ediyorsa ve anahtarı göstermeden bunu kanıtlamak istiyorsa kapıdan geçmesi onda anahtar olduğunun göstergesidir. Burada kapı karmaşık bir matematik problemi ve anahtar da bu problemin sonucu olarak düşünülebilir. Bilgisayar algoritması kullanıcıdan bir sayı alır ve bunu yüksek düzey bir matematik problemine dönüştürür. Karşı taraf eğer bu bilgiyi bildiğini ispat etmek istiyorsa bu sayıyı girmesi yeterlidir. Sıfır bilgi ispatı yöntemi kişilerin özel ve hassas bilgilerini paylaşmadan ispat edebilmesi için kullanılmaktadır.

Bir bloğun zincire eklenmesi için farklı doğrulama metotları vardır. Örneğin rastgele bir kullanıcı kodlar yardımıyla seçilip blok doğrulanabileceği gibi, Bloğun doğrulanması için karmaşık bir matematik problemi de çözmek gerekebilir. Bazı blok zincirlerinde özel seçilmiş üyeler blokları doğrulayıp eklemektedir. Doğrulandıktan sonra blok yayınlanır. Kullanıcıların her birinde birebir aynı bir dağınık defter bulunur ve blok onaylandıktan sonra her bir defter güncellenir. Böylece herkeste orijinal defterin bir kopyası bulunur ve bütün kopyalar birebir aynı olmak zorundadır. Bilgiler merkezi olmayan bir şekilde tutulur ve saklanır. Bir blok oluşturulduktan sonra içeriğindeki verileri silmek veya değiştirmek imkânsıza yakındır. Bu nedenle bir blok hakkındaki güncelleme başka bir blok eklenerek yapılır. Blok zincirin üç ayrı türü

mevcuttur. İlk blok zinciri türü açık blok zinciridir ve kendi içerisinde izinsiz ve izinli olmak üzere ikiye ayrılır. Açık izinsiz blok zinciri herkesin katılabileceği ve blok oluşturabileceği bir blok zinciri türüdür. Burada kullanıcılar anonimdir ve oluşturulan blokları görebilirler. Açık izinli blok zincirinde ise kamuya ait mallara benzetilebilir. Herkesin üzerinde söz hakkı olduğu kısıtlı kaynaklar olduğu için bir regülasyon gereklidir. Açık izinli blok zincirinde kullanıcılar blokları okuyabilir, görebilirler ancak sadece izin verilen kullanıcılar yazma ve doğrulama hakkına sahiptir. İkinci blok zinciri türü özel blok zinciridir. Yine kendi içerisinde izinli ve izinsiz olmak üzere ikiye ayrılır. Özel izinli blok zinciri türünde izin verilen kullanıcılar ağa katılabilirler. Bu kullanıcılar blok oluşturma, doğrulama ve okuma işlemlerini yapabilirler. Bir otorite tarafından zincirin kontrolü sağlanır. Daha çok özel sektörün verimlilik, daha iyi yönetişim ve hız için kullandığı bir türdür. Özel izinsiz blok zinciri teoride var olan ancak pratik anlamda bir anlam teşkil etmeyen bir türdür. Bu türde kullanıcılar blok oluşturma ve blok doğrulama yapabilirler ancak blokları okuyamazlar. Tartışmalı bir modeldir ve örneği mevcut değildir. Üçüncü tür ise konsorsiyum blok zinciridir. Konsorsiyum blok zinciri, özel blok zinciri türü ile çok benzer olup temeldeki farkı özel blok zincirinde bir tane kontrol eden otorite varken, konsorsiyum blok zincirinde, blok zinciri kontrol eden birden fazla otorite bulunmaktadır. Buradaki temel amaç özel blok zinciri türünü merkeziyetçilikten uzaklaştırmaktır. Blok zincirinde kullanılan bir başka teknoloji akıllı sözleşmelerdir. Akıllı sözleşmeler çalıştırılabilir bilgisayar kodlarıdır. Burada if-then döngüsü kullanılarak, sözleşmeler blok zinciri uygulamasına yüklenir ve if ile bahsedilen ilk kısım sağlandığında, then kısmının gerçekleşmesini sağlar. En basit örnek olarak A kullanıcısının 5 lirası olduğunda, B kullanıcısına 3 lira gönderecektir. Bu noktadan yola çıkılarak çok farklı şekillerde akıllı sözleşmeler hazırlanabilir.

İlk olarak Bitcoin ile finansal alanda uygulamaları görülen blok zinciri teknolojisi, zamanla barındırdığı uygulanabilirlik potansiyeli nedeniyle birçok alanda kullanılmaya başlanmıştır. . Blok zinciri teknolojisinin üç jenerasyonu

bulunmaktadır ve Bitcoin ilk jenerasyonu olan Blok Zinciri 1.0 olarak kabul edilir. Bitcoin kripto bir paradır ve yaratıcısı Satoshi Nakamoto'dur. Ortaya çıkışındaki amaç merkezi otoriteye olan ihtiyacı azaltmaktır. Satoshi Nakamoto'nun Bitcoin ile ilgili makalesi Blok Zinciri 1.0'nun kökeni olarak kabul edilmektedir (Nakamoto, 2008). Akıllı sözleşmelerin geliştirilmesi ve blok zincirine eklenmesi ise blok zincirinin ikinci jenerasyonu olan Blok Zinciri 2.0 olarak kabul edilmektedir. Ethereum'un kurucusu olan Vitalik Buterin 2013'de akıllı sözleşmelerin eklenmesi ile ilgili bir white paper (tanıtım dökümanı) yayınlamıştır. Akıllı sözleşmelerin blok zinciri teknolojisine eklenmesi geniş alanlarda kullanılabilirliğinin önünü açmıştır. Blok zinciri 3.0 ise blok zincirinin önceki jenerasyonlarında mevcut olan karşılıklı kullanılabilirlik, ölçeklenebilirlik, sürdürülebilirlik gibi problemlerin çözülmesi ve böylelikle endüstri ve sosyal hayata dahil edilebilmesiyle başladığı kabul edilir(Colomo-palacios et al., 2020).

Blok zinciri teknolojisindeki bu kademeli gelişme akademik literatüre de yansımıştır. Web of Science veri tabanı incelendiğinde ilk çalışmaların 2013 yılında başladığı görülebilir ancak 2013 ve 2016 yılları arasında yapılan akademik çalışmaların sayısı çok azdır. Akıllı sözleşmelerin blok zinciri teknolojisinde kullanılabilmesi literatürde bir yer edinmesini sağlamış ve yapılan çalışmaların sayısını arttırmıştır. Uygulama alanlarının artmasıyla özellikle literatürde akıllı şehirler, sağlık, eğitim, tedarik zinciri yönetimi, kamu sektörü, kimlik yönetimi ve oylama gibi alt başlıklarda çoğunlukla tartışılmıştır.

Kamu yönetimi alan olarak doğası gereği yeni teknolojilere ve bunların adaptasyonuna açıktır. Toplumsal, kültürel ve ekonomik hayatlardaki değişimler mecburen kamu hizmetlerinin değişimini ve dönüşümünü gerektirmektedir. 1980'lerde ortaya çıkan Yeni Kamu Yönetimi anlayışı ile organizasyonel problemlerin çözülmesi, kamuda verimliliğin artması ve kamu hizmetlerinin daha uygun maliyetlere karşılanabilmesi için yeni yöntemler ve metotlar aranmaya başlanmıştır. Bu yüzden bilgi ve iletişim teknolojilerinin kamuya

adapte edilmesi ve kullanımı, devletin verimliliğini, etkinliğini, şeffaflığını, hesap verebilirliğini ve devlet-vatandaş etkileşimini artırmak için hızla büyümüştür. 2000'li yıllara gelindiğinde ise teknolojinin gelişmesi, bilgi ve iletişim teknolojilerini kamu yönetimi reformlarının sadece bir ayağı olmaktan ileri taşımıştır. Kamu kurumlarında, kamu hizmetlerinde ve işleyişte teknoloji temelli değişimler meydana gelmiştir. Gerçekleşen bu değişim nedeniyle 2000'li yıllarda başlayan bu dönem, literatürde bazı teorisyenler tarafından Dijital Çağ Yönetimi olarak adlandırılmıştır (Dunleavy et al., 2006). Bu dönemde kamuda dijital teknolojilerin kullanılması ve adapte edilmesi kamu reformlarının temelini oluşturmuştur. Bu nedenle Dijital Çağ Yönetim anlayışı içerisinde siber fiziksel sistemlerden biri sayılan blok zinciri teknolojisinin kamuya adaptasyonu ve kullanımı kamu yönetimi için önem taşımaktadır.

Kamu yönetiminde blok zinciri ile ilgili literatür incelendiğinde, akademisyenlerin tartışmaları temel olarak üç kavram etrafında toplanmaktadır; organizasyon yapısı, yönetişim ve veri yönetimi(Gün et al., 2020; Lindman et al., 2020; Ølnes et al., 2017; Rodríguez Bolívar & Scholl, 2019; Reddick et al., 2019). Bu üç kavram altında güvenlik, güven, gizlilik, büyük veri, sürdürülebilirlik ve yönetişim gibi konularda sıkça tartışılmıştır. Bu konulardaki araştırmalar kamu yönetimi için uygulama alanında ise tapu kaydı, yönetişim, akıllı şehirler, eğitim uygulamaları, sağlık uygulamaları ve oy verme alanlarında yoğunlaşmış durumdadır. Diğer bir yandan kamu yönetimi literatürü, kamu yönetimi için avantaj ve dezavantajlarına sıkça odaklanmıştır. Bir diğer odak noktası olarak siyaset bilimi literatürü incelendiğinde ise liberalizm, sosyalizm, anarşizm gibi politik yaklaşımlar altında ele alınmıştır.

Kamu yönetiminde uygulama alanlarına bakıldığında ise birçok ülkenin deneme projeleri yaptığı ve bazılarının mevcut kamu sistemi içerisinde uyguladığı görülebilir. Tez kapsamında beş ülkedeki kamu yönetiminde blok zinciri uygulamaları ve politikaları incelenmiştir. Ülke seçimlerinde OECD Bilim Teknoloji Skor Tablosu ve Birleşmiş Milletler E-Devlet Gelişmişlik İndeksi

etkili olmuştur. Sırasıyla Kore Cumhuriyeti, Estonya, Avustralya, Birleşmiş Krallık ve İsrail incelenmiştir. OECD OECD Bilim Teknoloji Skor Tablosu'na göre bu beş ülkenin sanayi ve kalkınma için ar-ge Bütçeleri OECD toplamından daha yüksektir (OECD STI Scoreboard, 2021). Diğer bir yandan da Birleşmiş Milletler E-Devlet Gelişmişlik Endeksi'nde yüksek sıralamalara sahip olmaları etkili olmuştur. Bu ülkeler incelendiğinde blok zinciri teknolojisinin aslında henüz erken aşamalarında ve yeni gelişen bir teknoloji oluşu ülkeleri öngörülemez sonuçları tahmin edebilmek ve etkili kamu politikaları oluşturmak amacıyla pilot çalışmalar ve kavram kanıtı çalışmaları (proof of concept) yapmaya yönlendirmiştir. İlk olarak Kore Cumhuriyeti incelendiğinde, kişisel gizlilik, kamu veri tabanlarının ve uygulamalarının güvenliği, insan etkileşimini minimuma indirme, işlemleri otomatikleştirme, bürokrasiyi azaltma ve gerçek zamanlı erişilebilirlik sunması açısından avantajlar sunduğu görülebilir. Kayıtların değişmezliği bir avantaj olduğu kadar bir dezavantaj da olmaktadır. Hassas vatandaş bilgilerinin değişmez bir biçimde saklanmasının aslında bir mahremiyet ihlali oluşturabileceği görüşü de vardır. Bunun yanı sıra halk arasında kabulü ve yaygınlaşması, bazı kamu görevlilerinin otomasyon yüzünden işlerini kaybetmesi diğer dezavantajlar olarak Kore Cumhuriyeti örneğinden çıkarılabilir. İkinci incelenen ülke Estonya'da ise blok zinciri teknolojisinin pilot çalışmaların ötesine geçip ülke çapında uygulamaları görülebilir. Uygulamalar incelendiğinde şeffaflık artışı, kamu işlemlerinde kolaylık, belgelerin gerçekliğinin artması ve güvenlik gibi hususlarda avantajlar sağladığı görülmektedir. Kore Cumhuriyeti örneğinde olduğu gibi kayıtların değişmezliği ve silinememesi tartışmalı durum oluşturmaktadır. Üçüncü olarak Avustralya incelenmiştir. Avustralya örneğinde pilot çalışmaların sonuçlarından vatandaş memnuniyetini arttırması, şeffaflık, maliyetleri düşürmesi ve kurumlar arası iletişimi arttırması gibi kamu yönetimine avantajları çıkarılabilir. Ancak pilot çalışmaların sonuçları blok zinciri teknolojisinin henüz tam olgunlaşmamış bir teknoloji olduğuna ve kişisel mahremiyet alanına vurgu yapmaktadır. Dördüncü ülke olan Birleşmiş Krallık 'ta ise parlamentoda blok zinciri ile ilgili sıcak tartışmalar mevcuttur. Şeffaflığı ve kurumlar arası koordinasyonu

arttırması, diğer bir yandan da masrafları azaltması yapılan çalışmalardan sonuç olarak çıkarılabilir. Ancak parlamentoda önceki ülke örneklerinde olduğu gibi kayıtların değişmezliği önemli bir dezavantaj olarak görülmektedir. Bunun yanı sıra işlevselliği de tartışılmaktadır. Son olarak İsrail örneğinde sürdürülebilirliğin ve belgelerin gerçekliliğinin artması, ekonomiye katkıda bulunması, yönetişimi arttırması avantajlar olarak karşımıza çıkmaktadır. Dezavantaj olarak ise uygulanan bir pilot projede verilen dijital para ödülleri verimsizlik yaratmıştır. Genel olarak bakıldığında mahremiyet konusunda çok büyük endişeler olduğu görülebilir. Diğer bir yandansa ülkelerin blok zinciri teknolojisinin güvenlik, şeffaflık, yönetişim, belge kanıtlama gibi alanlarda sunduğu fırsatları kullanmak istemektedirler. Bu nedenle hükümetler akademi, özel sektör ve kamu arasındaki koordinasyonu arttırmaya çalışmaktadır ve pilot projeleri teşvik etmektedir.

Türkiye internet ile ilk olarak 1993 yılında tanışmıştır. 1993 yılından itibaren kademeli olarak internetin kullanım alanlarının artmasıyla ve Avrupa Birliği'ne giriş sürecinin gereklilikleri olarak 2003 yılından başlayarak e-devlet ile ilgili adımlar atılmıştır. Özellikle Avrupa Birliği'ne giriş e-devlet konusunda Türkiye'nin temel motivasyonu olmuştur (Üstüner and Yavuz, 2017). OECD verileri incelendiğinde hane halkının %90'ının internet erişimi olduğu görülmektedir. Günümüzde e-devlet üzerinden 814 kurum 5907 kamu hizmeti sunmakta ve bu hizmetlerin 56.030.215 kayıtlı kullanıcısı bulunmaktadır (Digital Transformation Office of Turkey, 2021). Diğer bir yandan 2020 Birleşmiş Milletler E-Devlet Gelişmişlik Endeksi incelendiğinde Türkiye'nin 53. sırada olduğu görülmektedir. Ek olarak 2020 Birleşmiş Milletler E-Devlet Katılım Endeksi'nde ise 23. sıradadır. Türkiye'nin e-devlet uygulamaları ile ilgili durumu incelendiğinde, eski sıralamalarına göre gelişim gösterdiği önceki Birleşmiş Milletler E-Devlet Gelişmişlik Endeksi sıralamaları incelendiğinde görülebilir. Ancak mevcut durumda kamu yönetiminde eksiklikler ve sorunlar vardır. İlk olarak Türkiye'nin vatandaşlık hakkı olarak dijital devlete ilişkin yasal bir çerçeveye sahip olmadığı ve yeni teknolojiler konusunda geleceğe yönelik stratejiler konusunda eksikliklerin olduğu görülmektedir (United Nations E-

Government Survey 2020, 2020). Diğer bir yandan bürokratik kültür, bir otoriteden onay alma ihtiyacı, kalifiye personel eksikliği ve entegrasyon zorlukları Türkiye'de e-devlet gelişimini etkileyen sorunlardan bazılarıdır (Arpacı, 2010). Türkiye'nin e-devlet yolculuğu değerlendirildiğinde, Türkiye'nin yeni teknolojilere ve yeniliklere açık olduğu görülmektedir. Ancak, genel olarak e-devlet ve teknoloji uygulamasındaki mevcut zorlukların üstesinden gelmek için, kamu politikalarının yukarıda belirtilen belirli sorunlara odaklanması gerekmektedir.

Türkiye'deki blok zinciri uygulamaları kamu yönetimi kapsamında değerlendirildiğinde bazı adımlar atıldığı görülmektedir. Blokchain Türkiye Platformu, TÜBİTAK'ın kurmuş olduğu blok zinciri araştırma laboratuvarı, Teknoloji ve Sanayi Bakanlığı'nın bünyesinde oluşturmuş olduğu blok zinciri birimi bunlardan bazılarıdır. Diğer bir yandan blok zinciri kullanımı destekleyecek politikalar ve stratejiler dikkat çekmektedir. Yayınlanan 11. Kalkınma Planı'nda gümrük ve ulaştırma hizmetlerinde kullanılması için gerekli altyapının hazırlanacağına ve blok zinciri tabanlı dijital merkez bankası parasının uygulamaya konulacağına yer verilmiştir. Aynı zamanda Ticaret Bakanlığı'nın yayınlamış olduğu 2023 Sanayi ve Teknoloji Stratejisi'nde ulusal bir blok zinciri ağı kurulması planlanmaktadır.

Blok zinciri teknolojisinin Türkiye'ye sağlayabileceği potansiyel avantajlar incelendiğinde karşımıza dört ana başlık çıkmaktadır; büyük veri kullanımını etkinleştirme, kamuda şeffaflığı arttırma, akıllı şehirler yaratma ve iyi yönetişimin elde edilmesi. İlk olarak büyük veri alanı incelendiğinde, bu alanın aslında bütün devletler için çok yeni olduğu görülmektedir. Dijital devrimden önce toplanan veriler sınırlıydı ve verilerin yönetim tarafı bu kadar karmaşık değildi. Büyük veri, geleneksel veri yönetimi teknikleri ile yönetilemeyen ve toplanan büyük miktarda dijital veri için geniş bir terimdir (Kim et al., 2014). Büyük veri ile ilgili verilerin güvenliği, mahremiyet, kurumlar arası iletişimin zayıflığı ve veri paylaşımının verimsizliği genel problemlerdir. Benzer şekilde

Okuyucu'ya (2018) göre Türkiye'deki kamu kurumları verilerini paylaşmaya istekli değildir ve veriye dayalı karar alma süreçleri düşük seviyelerdedir. Ayrıca, Türkiye'de nitelikli kamu görevlisi eksikliği, verilerin birlikte çalışabilirliği ve standardizasyonu, güvenliği ve büyük veri analiz sürecinin otomasyonu ile ilgili sorunlar bulunmaktadır (Okuyucu, 2018). Blok zinciri teknolojisi bu sorunlara çözümler vadetmektedir. Özellikle güvenlik, veri paylaşımını arttırma, gizliliği arttırma, bürokrasiyi azaltma ve merkezileşmeyi azaltma noktalarında potansiyel barındırmaktadır. İkinci olarak blok zinciri kamuda şeffaflığı ve hesap verilebilirliği arttırma potansiyeline sahiptir. Türkiye şeffaflığı destekleyen politikalar geliştirmekle birlikte bazı sorunlar da bulunmaktadır (Akpınar, 2011). Kayıtların değiştirilmesi, verilerin güvenliği ve değişmezliği gibi dünyadaki genel sorunlar Türkiye için de birer zorluktur. Öte yandan, Türkiye'de şeffaflıkla ilgili en büyük sorunlardan biri de kamu kurumlarında mahremiyet (veri paylaşımındaki isteksizlik) duygusudur (Akpınar, 2011). Blok zincirinin güvenlik, değişmezlik ve merkezi olmayan halka açık defter olması gibi özellikleri, Türkiye'deki kurumlarda mahremiyet ve güvenlik endişelerini ortadan kaldırarak şeffaflığı teşvik edebilir. Üçüncü olarak akıllı şehriler dijitalleşme ile hayatımıza giren kavramlardan biridir. Türkiye'deki akıllı şehir projelerinde sorunlar genellikle kurumlar ve planlama arasındaki koordinasyon eksikliği etrafında yoğunlaşmaktadır (Bilbil, 2016). Blok zincirinin anonimlik, şeffaflık, değişmezlik ve güvenlik gibi özellikleri, insanların en temel ihtiyaçlarına cevap verdiği için bilgi ve iletişim teknolojilerinin çeşitli hizmet alanlarına uygulanması ile ilgili sorunları çözebilmekte ve şehirlere adaptasyonunu kolaylaştırabilmektedir. Ek olarak blok zinciri devlet kurumlarının yönetişim ve güvenli bilgi paylaşımı gibi temel ihtiyaçlarını da karşılar. Türkiye örneğine bakıldığında kurumların koordinasyon sorunu özel blok zinciri ekosistemleri ile ele alınabilir. Son olarak iyi yönetişim, diğer ülkeler için olduğu gibi Türkiye için de sıcak bir konu olmuştur. Avrupa Birliği süreci, uluslararası kuruluşlar ve iç talepler nedeniyle Türkiye yönetişim konusunda ilerleme kaydetmektedir (Üstüner ve Yavuz, 2017). Ancak, Türkiye'de yönetişim konusunda mevcut eksiklikler bulunmaktadır. Üstüner ve

Yavuz'a (2017) göre Türkiye'de yönetişimi destekleyen kamu politikaları ve projeleri oluşturulmuştur, ancak Türkiye'de asıl sorun bu politika ve projelerin uygulanması ile ilgilidir. Türk devletinin merkezileşmesi ve kurumların bürokratik yapısı yönetişim sürecini zorlaştırmaktadır. Ayrıca vatandaşların yönetime katılım konusundaki hevesi de bir soru işaretidir (Üstüner ve Yavuz, 2017). Bu yönetişim sorunlarının ele alınmasında blok zinciri teknolojisinin merkezi olmayan bir sistem olması, yapısındaki akıllı sözleşme teknolojisi, oylama platformları oluşturulabilmesi gibi özellikleriyle iyi yönetişim umut verici olduğu düşünülmektedir. Bu noktada dünyada kamu yönetimi alanındaki uygulamaları incelendiğinde özellikle tapu kaydı, eğitim, oy verme, kimlik yönetimi, noter servisleri, sağlık, tedarik zinciri yönetimi, enerji, nesnelerin internetinin güvenliği ve kamu finansal yönetimi alanındaki uygulamalar öne çıkmaktadır.

Bir Dördüncü Endüstri Devrimi teknolojisi olarak blok zinciri teknolojisi, yeni anlaşmazlıkları, tartışmaları ve soruları da aynı zamanda tetiklemektedir. Blok zinciri ile ilgili zorlukların birçoğu yeni bir teknoloji olmasından kaynaklı teknik sorunlardır. Mevcut teknolojik sistemlerle beraber çalışabilirliği, ölçeklenebilirliği, standartlarının oturmamış olması, olgunlaşmamış olmaması, mahremiyet, yönetmelik eksikliği ve yeterli sayıda konu ile ilgili uzman eksikliği yeni bir teknoloji olmasından kaynaklı bütün dünyada çözülmeye çalışılan sorunlardır. Diğer bir yandan Türk Kamu Yönetimi'nin barındırdığı merkezileşme, katı bürokrasi, bilgi kalitesi ve kamu personelinin mevcut konumlarını kaybetmemek için oluşturacağı direnç Türkiye özelinde sorunlardır.

Blok zinciri teknolojisi ile ilgili bu çalışmanın sonucunda ortaya çıkan önemli bulgulardan biri Türkiye'nin henüz blockchain ile ilgili herhangi bir pilot çalışma veya kavram kanıtı yapmamış olmasıdır. Her ülkenin farklı demografik yapısı, kültürü, toplumsal geçmişi ve siyasi rejimi vardır. Bu faktörler devlet ve toplum ilişkilerinin dinamiklerini şekillendirir. Pilot çalışmalar yapmak, bir yeniliğin olumlu ve olumsuz etkilerini ortaya çıkarmakta, böylece büyük ölçekli

uygulamaların sonuçlarını tahmin etmek ve ölçmek kolaylaşmaktadır. Bu nedenle Türkiye'de kavram ispatı ve pilot çalışmaların yapılması blok zinciri ve bilgi ve iletişim teknolojileri uygulamaları için önem arz etmektedir. Bir diğer önemli nokta kamu yönetimi alanında akıllı şehirler, büyük veri, yönetişim ve şeffaflık giderek artan bir eğilim izlemektedir. Dijitalleşme ile birlikte akıllı şehirler ve büyük veri gibi yeni kavramlar ortaya çıkmış, yönetişim ve şeffaflık gibi mevcut kavramlar yeni anlamlar kazanmıştır. Blockchain teknolojisi bu kavramları geliştirebilir ve onlara uygun bir zemin hazırlayabilir. Bu nedenle Türkiye'deki kamu yönetimi ve kamu politikaları alanındaki çalışmalar bu kavramlara daha fazla odaklanabilir. Diğer bir yandan Türkiye'nin bürokratik yapısı açısından blockchain düşünüldüğünde, blockchain uygulaması organizasyonel zorlukları beraberinde getirebilir. Ayrıca süreçlerin otomasyonu kamu görevlilerinin işini kaybetmesine neden olabilir. Sonuç olarak, blok zinciri benimseme konusunda kurumlardan direnç gösterilebilir. Bu nedenle, insanları geleceğin mesleklerine hazırlamak için gerekli program ve eğitimleri içerecek şekilde kamu politikaları hazırlanmalıdır. Blok zinciri entegrasyonunun hız kazanması için gerekli uzman istihdamı sağlanmalıdır. Entegrasyon sürecinin verimli ilerlemesi için kamu, özel sektör ve akademi arasında iş birliği yapılması ayrıca önem arz etmektedir. Son olarak gizlilik konusunda ciddi endişeler vardır. Defterlerin değişmezliği vatandaşlar için dezavantajlar yaratabilir. Hassas vatandaş bilgilerinin kalıcı ve değiştirilemez şekilde saklanması, devlet otoritesini güçlendirebilir ve mahremiyeti farklı şekillerde tehdit edebilir. Bu nedenle uygulama öncesi kullanım alanları detaylı olarak tartışılmalıdır.

Türkiye'nin e-devlet alanındaki konumu, ileriye dönük politikaları ve diğer ülkelerin attığı adımlar düşünüldüğünde blok zinciri teknolojisinin Türk Kamu Yönetimi için önem arz ettiği aşikârdır. Bu açıdan Türkiye doğru analizler ve doğru politikalar geliştirerek öncü ülkeler arasında yer alabilir.

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