



# The Public Value of E-Government: A Blockchain-Based Approach

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## Abstract

**Purpose:** This paper is on a mission to elicit an understanding of how blockchain technology benefits for e-government services, can contribute to create the public value of e-government. In addition, to identify the blockchain benefits in the context of e-government services.

**Research Method:** To achieve the above-stated objectives, at the first section, the qualitative analysis has conducted using a literature review to identify the blockchain benefits for e-government services. Then, we have sought to identify which of the blockchain benefits are interconnected with the dimensions of the Twizeyimana and Andersson, (2019) s public value of e-government framework. Hence, we have positioned the suitable identified benefits into the each of the six dimensions of the public value of e-government. This leads to develop and present a comprehensive framework to create e-government public value through blockchain benefits.

**Originality/value :** Applying blockchain technology in the public value of e-government offers a new method for delivering and managing public services. This research is the first study in the area. Therefore, it creates a new value in this field. Furthermore, this paper provides a blueprint for government leaders in their endeavor of planning and investment to implement blockchain technology.

**Research implications:** This paper has implications for practitioners with illustrating the ways to modernise their services along digital lines. The blockchain-based solutions that identified in this study lead to innovative services, transform government processes and citizen services.

**Practical implications:** This paper exposes the blockchain based solutions for the e-government initiative . The paper serves as a beacon for further research and discussion on e-government and online public services. Considering the identified benefits, this paper provides insights into ways in which (BCT) might strengthen the public value of e- government.

**Findings:** Our study provides a guideline for public authorities to improve the e-government public value and creating more public value. In this regard the governments towards adapting (BCT) in their governance system and increase their ability to service delivery. The findings as well as contribute to the studies in this area of knowledge.

**Key words:** Blockchain Technology, Blockchain Benefits, E-Government Services, Public Value.

## Introduction

Contemporary governments face unprecedented challenges in governing their nations with citizens' rising aspirations, discontent with government, mistrust of government, and political apathy. The diverging gaps between citizens' expectations and the government's capacity have resulted in citizen discontent with government (Lee-Geiller and Lee, 2019). Furthermore, the issue of mistrust in government is striking numerous governments around the world, as less than 43% of citizens trust their governments in advanced countries. As a result, citizens have tended to become indifferent to public affairs, as reflected in low voter turnouts in societies with representative democracies (Berryhill, et al 2018). E-Government is the use of IT to enable and improve the efficiency with which government services are provided to citizens, employees, businesses and agencies (Bélanger and Carter, 2012). IT can be used to support service delivery to citizens (G2C), other Government organizations (G2G), employees (G2E) and businesses (G2B) (Iannacci, 2019).

Still with the huge benefits and synergies that e-government grants to governments and societies, it faces many obstacles and challenges (Al-Shboul et al, 2014). Rafique, (2017) categorized e-government challenges into: 1. IT Infrastructural weakness. 2. Lack of knowledge about the e-government program. 3. Lack of security and privacy of information. 4. Leaders and management support. 5. Lack of policy and regulation for e-usage. 6. Lack of partnership and collaboration. 7. Lack of strategic plans. 8. Resistance to change to e-systems. 9. Shortage of financial resources. 10. Poor alignment between government, citizens and businesses. 11. Corruption. According to Falco and Kleinhans, (2018), the main issues which present challenges for the implementation of an e-government include: 1. Technological challenges: Technological advancement challenges relate to the complexity and high speed of (global) technological change and the ability of government to keep up with the pace of innovation and new technologies. 2. Data challenges: The government agency needs to guarantee the objectivity of its own data, quality, integrity and openness (e.g. accessible formats, complete, reliable and updated data).

While relevant studies have described the needs and characteristics of new type of governance, little work on providing specific guidelines for realizing it has taken place, although it is crucial to develop the research on subjects that are useful for taking action in practice (Lee-Geillera and Lee, 2019).

A more recent development is to leverage information technology to support governments as a platform for public services (Treleaven et al, 2017). Previous research has highlighted that there is a lack of advanced technological solutions able to foster government-citizens collaboration (Falco and Kleinhans, 2018). The 2030 Agenda for Sustainable Development calls for transformation through enhanced creativity and innovation in the public service at all levels of governance and Public administration.

On the other side, governments around the world have invested in the development of e-government to advance key public values (Dai et al, 2019). As referred by Potts, (2019) government is an institutional technology to enable a group of citizens to create and exchange value under conditions of relative safety and security and the creation of public value should be the goal of public organizations because through public value, public organizations meet the needs and wishes of the public (Harrison et al. 2012).

The success of e-government systems depends on how citizens perceive the value realized from using those systems (Scott, 2016). Hence, studying the values embedded in the perceptions of e-government projects is a way of understanding their superordinate goals, and that coordinating stakeholders' basic values in the execution of e-government projects may be an important route to success (Jeremy et al, 2015). In spite of this, Twizeyimana and Andersson (2019) refer that regarding the current state of research on the public value there is a lack of research on the public value of e-government.

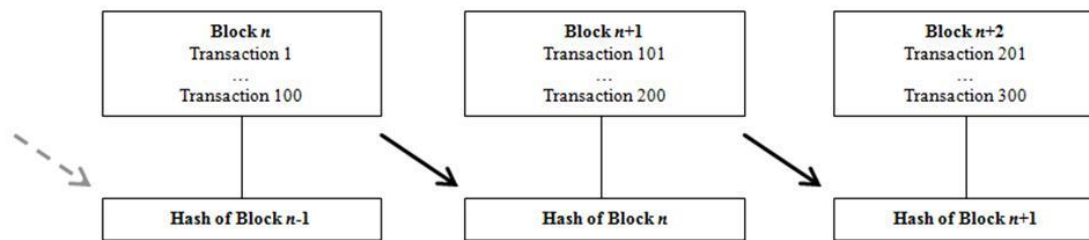
This paper moves towards the fulfilment of these gaps and is on a mission to identify the blockchain technology (BCT) potential benefits in the context of e-government services. In addition, aiming to elicit an understanding of how (BCT) benefits for e-government services, are interconnected to the public value of e-government dimensions. Hence, this paper will address two main research questions: (RQ1). What are the (BCT) benefits in the context of E-Government services?. (RQ2). How (BCT) benefits can contribute to create public value for e-government? To achieve the above-stated objectives, the qualitative data collection and analysis has conducted using a literature review to seeks to answer the first research question (RQ1), and in the second section, to seek the answer for the second research question and to reach an understand of how e-government public value dimensions are benefiting from the usage of (BCT) benefits, we have sought to identify which of the (BCT) benefits are interconnected with the dimensions of the public value of e- government (RQ2). Hence, we have positioned the suitable identified (BCT) benefits into the each of the six dimensions of the public value of e-government framework (Twizeyimana and Andersson, 2019). This leads to develop and present a comprehensive framework to create e-government public value through (BCT) benefits (Fig.4).

## **Theoretical Background**

### **Blockchain Technology (BCT)**

Blockchain a kind of distributed ledger technology has been described in the popular press as the next big thing. Put simply, a blockchain is a data structure that makes it possible to create a tamper-proof digital ledger of transactions and share them. This technology uses public-key cryptography to sign transactions among parties. The transactions are then stored on a distributed ledger. The ledger consists of cryptographically linked blocks of transactions, which form a blockchain . It is impossible or extremely difficult to change or remove blocks of data that are recorded on the block-chain ledger ( Kshetri, 2017). Blockchain technology is a form of distributed ledger technology that acts as an open and trusted record (i.e., a list) of transactions from one party to another (or multiple parties) that is not stored by a central authority. Instead, a copy is stored by each user running Blockchain software and connected to a Blockchain network also known as a node. Instead of a central authority maintaining a database, all nodes have a copy of the ledger and updates to a Blockchain ledger are propagated throughout the network in minutes or seconds (ACT- IAC 2017). Blockchain technology, as the name suggests, is merely a chain of “blocks”, each containing a unique set of transactions that each contain a cryptographic fingerprint called a “hash” . Each block is a set of validated transactions that are grouped together in such a way that the information remains accessible but cannot be tampered with. For blocks, the transactions in a block are hashed to create a unique hash code for the block. These hash codes are used to interconnect blocks together. Blocks are added one after the other in linear, chronological order, with each containing its own hash code and the code of the previous block. This links the blocks together to form a chain (see Figure 3).

**Figure 3. The interdependence of blocks**



*Fig: 1. Source: (Berryhill, et al 2018).*

Some Blockchain platforms allows for smart contracts, which are small computer programs that use a Blockchain for execution. Smart contracts are automated “if/then” software programs that self-execute when a specific trigger occurs (Marchionni, 2018). Smart contracts intend to provide a digital workflow process, whereby a series of necessary and binding steps must be taken before the outcome is reached, or the contract ends. They are “executed exactly as programmed without any possibility of downtime, censorship, fraud or third party interference” (Marchionni, 2018). Blockchain technology offers a promising mechanism for building a tamper-proof information system backed by strong cryptographic primitives (Liang et al, 2019).

### **E-Government Model (Ndou 2004)**

Ndou's e-government framework (2004) is detailed and extends other models of e-government. It was produced from a thorough analysis of principal definitions of e-government which were available in the literature (Twizeyimana and, 2019). In the domains of users, stakeholders and their interrelationships, Ndou (2004), argues that e-government encompasses the following four main groups of stakeholders: citizens, businesses, governments and employees. The electronic transactions and interactions between government and each group constitute the following e-government web of relationships: G2C, G2B, G2G, and G2E. (Fig. 2).

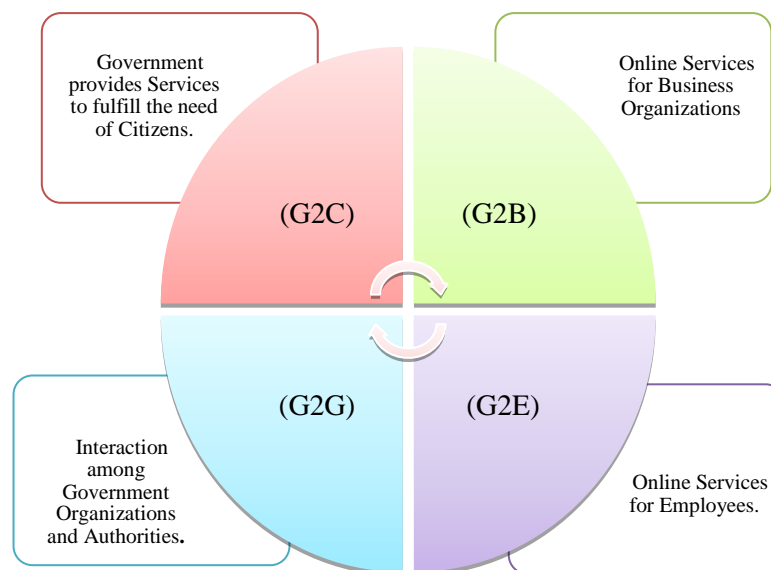




Fig. 2. E-Government users, stakeholders, and their interrelationships Model (Ndou 2004).

### Blockchain Technology Benefits for E- Government Services.

Bitcoin disrupted money, and blockchain trade platforms are disrupting global supply chains. But the biggest disruption that blockchain might bring is to disrupt government. (Potts, 2019). Blockchain provides an effective way of making government services more efficient (Hou, 2017). Although Blockchain technology developments have been most extensive in the financial services industry,<sup>11</sup> the discussion and application of Blockchains is also rapidly emerging in the public sector (Berryhill, et al 2018). Blockchain technology has the potential to catalyse a major shift in public service delivery and internal government strategies (Berryhill, et al 2018). In the context of the public sector, we can imagine smart contracts providing the ability to provide certainty and transparency in transactional processes. An example of a small process could be reimbursements for employee travel. A potential example of a more significant process could be to determine and govern times at which social aid would be granted, and conditions under which it must continue or stop. The logical steps that today apply to our relationship with government could be automated (Berryhill, et al 2018).

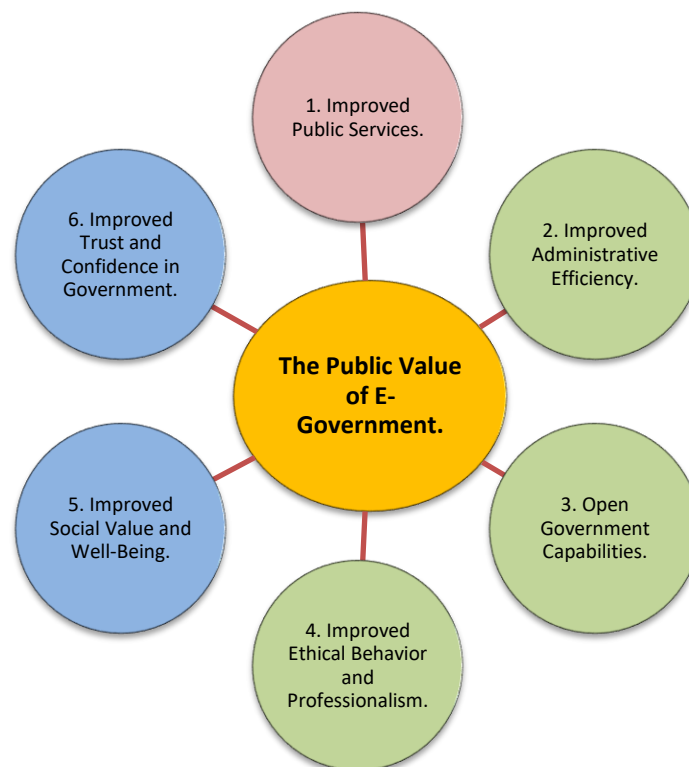
Blockchain has been used as a lever for enforcing accountability and responsiveness in different contemporary information and knowledge management environments. The core principle of blockchain is that it promotes the use of technology tools and platforms to achieve anonymous vetting of integrity for different types of information (Joseph, 2019). The majority of researchers and practitioners argues that many benefits could be derived from the use of this innovative technology with the most significant one being the improved sense of trust to BCT applications. At the same time governments pursue amplified trust from their citizens and BCT is gaining momentum since it addresses this of utmost importance problem based on its unique characteristics. More and more governments realize the advances of this technology and participate in pilot applications in different vertical governmental sectors (Alexopoulos et al, 2019). This technology is working in collaboration with major areas of research including governance, IoT, health, banking and education. It has anticipated revolutionary ways, which helps us to overcome the problems of governance such as human error, voting, privacy of data, security and food safety. In governance, there is a need to ameliorate the services and facilities with the assistance of blockchain technology (Razzaq et al, 2019). BC offers the key advantage of data integrity (immutability) based on decentralization, paired with consensus mechanisms and transparency. The following design options determine the concrete use in the public sector and concern the governance by BC: Decision rights. Accountability. Incentives (Allessie et al, 2019).

In less than ten years from its advent in 2008, the concept of distributed ledgers has entered into mainstream research and policy agendas. The analysis of a group of pioneering developments of public services shows that blockchain technology can reduce bureaucracy, increase the efficiency of administrative processes and increase the level of trust in public recordkeeping (Allessie et al, 2019). According to Ølnes and Jansen, (2017) we need to look beyond the currency applications and investigate the potential use of the blockchain technology in governmental tasks such as digital ID management and secure document handling. Government is a mechanism to enable a citizen to better trust their fellows, by providing rules and infrastructure to lower the cost of contracting and exchange by facilitating identification, monitoring, dispute resolution, verification and networking. Blockchain is also an institutional technology that can disrupt government by supplying new ways of supplying these

institutional and infrastructural functions (Potts, 2019). Blockchains have the potential to impact a large variety of topics and “create genuine opportunities for the government and other local and regional authorities” in reducing operation costs, increasing transparency and trust between governments and citizens, facilitating financial inclusion and boosting operational and financial capacities of small and medium-sized enterprises (Krawiec et al, 2016).

### The Public Value of E-Government

In this section when we discussing that what benefits (BCT) can bring to the public value of e-government, we need to discuss these benefits in relation to what the public value of e-government is. The public value of e-government is understood as citizens' expectations from e-government. Understanding the public value of e-government should facilitate successful implementations (Twizeyimana and Andersson, 2019). The three main dimensions of the public value of e-government and their corresponding six dimensions were identified from the content analysis of the 53 articles by Twizeyimana and Andersson, (2019). They have positioned the six dimensions of the public value of e-government in to the (Ndou, 2004) s e-government model in the perspective of users, stakeholders and their interrelationships and the result is presented in Fig.3.



*Fig.3. The Six Dimensions of the Public Value of E-Government in the perspective of users, stakeholders, and their interrelationships (Twizeyimana and Andersson, 2019).*

<i>E-Government in the perspective of users, stakeholders and their interrelationships (Ndou, 2004).</i>	<i>(G2C)</i>	<i>(G2B)</i>	<i>(G2G)</i>	<i>(G2E)</i>
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<i>Improved Public Services.</i>				
1. Improved Public Services.	✓	✓		✓
<i>Improved Administration.</i>				
2. Improved Administrative Efficiency.			✓	
3. Open Government (OG) Capabilities.	✓	✓	✓	✓
4. Improved Ethical Behavior and Professionalism.	✓	✓	✓	✓
<i>Improved Social Value.</i>				
5. Improved Social Value and Well-Being.	✓			
6. Improved Trust and Confidence in Government.	✓	✓		

## Research Methodology

This paper is on a mission to elicit an understanding of how blockchain technology (BCT) benefits can contribute to create the public value of e-government. when we discussing that what benefits (BCT) can bring to the public value of e-government, we need to discuss these benefits in relation to what the public value of e-government is. According to Twizeyimana and Andersson, (2019), the public value of e-government is understood as citizens' expectations from e-government. The three main dimensions of the public value of e-government and their corresponding six dimensions were identified from the content analysis of the 53 articles by them. In addition, they have positioned the six dimensions of the public value of e-government in to the (Ndou, 2004) s e-government model and the result is presented in Fig.3.

To reach an understanding of how the (BCT) benefits for e-government services, are interconnected to the public value of e-government dimensions, at the first section, a qualitative data collection and analysis has conducted using a literature review to identify the benefits that (BCT) can bring to e-government services (RQ1). To find primary studies, we searched the literature from leading journals and online resource databases such as Emerald Insight, SAGE Journals, LIBRIS, Science direct, Scopus, Springer Link and Google Scholar using key words: blockchain, public services, e-government services, benefits, uses cases. Then, we inspected the literature on the basis of the relevance of the abstracts we collected to the research question and finally, we proposed the identified (BCT) benefits for e-government services which this leads to the Table.1 in the section.1.

In the section. 2, to seek the answer for the second research question and to reach an understand of how the six dimensions of e- government public value are benefiting from the usage of (BCT) benefits, we have sought to identify which of the (BCT) benefits are interconnected with the each of the six

dimensions of the public value of e- government (RQ2). Hence, we have positioned the suitable identified (BCT) benefits into the each of the six dimensions of the public value of e-government framework (Twizeyimana and Andersson, 2019). This leads to develop and present a comprehensive framework to create e-government public value through (BCT) benefits (Fig.4).

## Section.1

### Identified Blockchain Technology Benefits for E- Government Services.

In this section, to seek the answer for the first research question, a qualitative data collection and analysis has conducted using a literature review to identify the benefits that blockchain can bring to e-government services. To find primary studies, we searched the literature from leading journals and online resource databases such as Emerald Insight, SAGE Journals, LIBRIS, Science direct, Scopus, Springer Link and Google Scholar using key words: blockchain, public services, e-government services, benefits, uses cases. Then, we inspected the literature on the basis of the relevance of the abstracts we collected to the research question and finally, we proposed the identified (BCT) benefits for e-government services which this leads to Table.1.

**Transparency:** Transactions and historical data of transactions are publicly visible on a chain and cannot be modified (Alexopoulos et al, 2019), (Wachal, 2018). Transparency: Permissionless Blockchains allow for perfect transparency, where “decentralised architectures generally rely on the disclosure of everyone’s interactions. the blockchain enables a great potential for standardization and automation, as it is a transparent system, which relies on formal code and data. The blockchain provides a platform, in which interacting parties can transparently and precisely interact with each other, for example through the definition of coded contracts (Ethereum). De Filippi, 2017). Underwood (2016). Semeijn and Mahr, (2018). Pullen, (2018). Batubara et al, (2018). Fridgen et al, (2018). Berryhill, et al, (2018). Nordrum,( 2017). Atzori, (2015). Hou, (2017). (De Filippi, 2017). Democratizing access to data. History of transactions remains visible and every nodes has complete overview of transactions Atzori (2015); Underwood (2016) (Crowe, 2019).

**Mitigating and identifying Fraud:** Blockchain through verifications of things such as land ownership, other assets, and identities, can assist governments in mitigating the risk of fraud (Hyvärinen , 2017). One major example of this would be for assessing and collecting tax payments (Batubara et al, 2018).

**Avoiding fraud and manipulation:** Hacks or unauthorized changes are difficult to made without being unnoticed, as information is stored in multiple ledgers that are distributed (Cai and Zhu 2016); (Swan, 2015).

**Reducing corruption:** Storage in distributed ledgers allows for preventing corruption. For example by storing landownership in a BT and having clear rules for changing ownership which cannot be manipulated (Kshetri 2017) (Mire, 2018).

**E-Democracy and Voting:** Blockchain have the potential to enable new methods of voting by transforming what often remains a paper-based process in countries, or an electronic process with limited validation and auditability capacities. This can enhance the convenience and confidence for citizens. Blockchain is an effective solution to problems in the voting system . Many projects of blockchain-based



voting have been launched already, such as BitCongress, AgoraVoting and FollowMyVote . (Foroglou and Tsilidou, 2015). (Qi et al, 2017).

**Bureaucracy:** It is possible and moreover unavoidable to replace bureaucracy with blockchain systems. There are three close similarities between blockchain and bureaucracy. First, both of them are defined by the rules and execute predetermined rules. Second, both of them work as information processing machines for society. Third, both of them work as trust machines for society (Jun, 2018). Seebacher and Schüritz, (2017).

**Government Credibility:** BCT-based platforms can be used to give citizens access to reliable governmental information increasing citizens' trust to governments (Alexopoulos et al, 2019).

**The Conveyance of Funds:** A permissioned blockchain would enable the budget to be allocated, and funds to be tracked at every step of the process. An organization would record all transfers of funds whether intra-agency, inter-agency or external, so, would enable immediate obligation and expenditure of funds (Mark G.,2018).

**Benefits, entitlements, and Aid:** Government programs such as social security and pension payments, medical care benefits, and domestic and international aid could benefit tremendously from Blockchains. Smart contracts could be used to automate processes for eligibility verification and disbursement of funds. Blockchains could help to ensure that benefits reach their intended beneficiaries and are not diverted (UK Government Office for Science, 2016).

**Streamlining interagency and cross-sector processes:** Blockchains and smart contracts can automate some transactions and make interagency processes more efficient and effective by removing the need for third-parties and automating transaction handling (UK House of Lords, 2017). Agencies that are part of a Blockchain network can securely and seamlessly share information stored on a shared ledger which can help ensure agencies work with the same trustworthy information, lessening the chance of inconsistencies (ACT-IAC, 2017).

**The Approval Chain:** Smart contracts can help to streamline some of these processes. They relied upon to act as unbiased mediators in the conduct of some transactions (Mark G.,2018).

**Contract and vendor management:** Blockchains can make government contracting more efficient by eliminating a significant amount of overhead and automating processes that lend themselves to the logical "if/then" workflows of smart contracts. Things such as tracking and paying vendors, managing purchase commitments and transactions, and monitoring schedule performance could all be done in a way the is accessible to all relevant players, as well as the public, as appropriate.

**Social Innovation:** It can be said that the blockchain will be a great tool for social innovation not only for the enhancement of the effectiveness of government but for the innovation of society from the grassroot (Jun, 2018).

**Trust:** Blockchain could change our paradigm for trusting records; instead of turning to trusted third parties, such as government registries, for evidence, we could find ourselves turning to the blockchain (Greenspan,2016).



**Increased trust:** Trust is in process by increased control due to immutable recordkeeping and by verification of the data by multiple nodes (Palfreyman, 2015); Zyskind and Nathan (2015); Mainelli and Smith (2015); (Swan, 2015).

**Transparency and auditability:** Being able to track transaction history and create an audit trail. Also by having multiple ledger which can be accessed for consistency (Palfreyman, 2015); Tapscott and Tapscott (2016); Atzori (2015).

**Increase predictive capability:** As history information can be traced back, this availability of the historic information increased the predictive capability (Tapscott and Tapscott, 2016).

**Increased control:** Increased control by needing consensus to add transactions (Zyskind and Nathan (2015); Kraft (2016); Mainelli and Smith (2015)).

**Clear ownerships:** Governance need clearly defined and how information can be changed (Yermack 2017).

**Reduce Cost:** Transaction's costs can be reduced since by using BCT the need for third parties is being removed (Alexopoulos et al, 2019). The costs of conducting and validating a transaction can be reduced as no human involved is needed (Palfreyman, 2015) Tapscott and Tapscott (2016); Ølnes and Jansen, 2017).

**Reduced energy consumption:** Energy consumption of the network is reduced by increased efficiency and transaction mechanisms Tapscott and Tapscott (2016).

**Increased resilience to spam and DDOS attacks:** Higher levels of resilience and security reduces the costs of measure to prevent attacks (Gervais et al. 2016).

**Flexibility:** BCT can be used in several ways in order to improve public services (Alexopoulos et al, 2019).

**Data Storage:** Large amounts of data can be stored off of the Blockchain and linked to from within a block transaction (Yaga et al, 2018). If government team are looking for a way of maintaining a distributed and trustworthy record of transactions, Blockchain may be a viable solution. It is possible that a hybrid approach is needed, where both Blockchain and a data storage solution are both pursued (Berryhill, et al, 2018).

**Data integrity and higher data quality:** Information stored in a system corresponds to what is being represented in reality due to the need for consensus voting when transacting and distributed nature. This result in higher data quality (Tapscott and Tapscott, 2016). Blockchain technology can be used to address issues associated with information integrity in the present and near term, assuming proper security architecture and infrastructure management controls (Lemieux 2016). Berryhill, et al, (2018). Pullen, (2018).

**Reducing human errors:** Automatic transactions and controls reduces the making of errors by humans (Cai and Zhu, (2016); Tapscott and Tapscott (2016).



**Personal records:** Personal records may be managed with Blockchains. Within government, payroll systems could be built using Blockchain, where employees could input their time and be paid automatically through smart contracts (ACT-IAC, 2017).

**The Public Records:** This use of blockchain is underway in some other nations, but is certainly a practical application of the technology for government entities within the United States (Mark G.,2018). Lemieux, (2016).

**Land title registry:** Land titles and other records related to ownership could be chronologically recorded on a Blockchain ledger, along with any details relevant to a sale of property. This could minimise the need for expensive and time-consuming third-party involvement for transactions (ACT-IAC, 2017).

**Access to information:** Information is stored at multiple place which can enhance the easy the access and speed of access (Palfreyman (2015); (Swan, 2015).

**Information Sharing:** Stored data in a chain can be easily shared among all participants (organizations, citizens etc.) (Alexopoulos et al, 2019).

**Privacy:** User's or information's anonymity can be accomplished by the usage of private keys. User can be anonymous by providing encryption keys or access can be ensured to avoid others to view the information (Alexopoulos et al, 2019). Tapscott and Tapscott (2016); Zyskind and Nathan (2015).

**Reliability:** Data is stored at multiple places. Consensus mechanisms ensures that only information is changed when all relevant parties agrees (Tapscott and Tapscott ,2016); (Swan, 2015).

**Copyrights:** Blockchains are excellent tools to keep a 'vigilant' eye out for anyone violating their copyright, create a permanent record of their work and issue their clients a time-stamped copyright certificate (Willms, 2016).

**Resilience:** Resilient to malicious behavior (Tapscott and Tapscott 2016); (Swan, 2015).

**Real IDs:** Blockchain-based identities can provide a means for people to safely and securely share and verify their identity to engage in any transaction that requires identity (Williams and Murat, 2019). Blockchains could be used to establish digital identities for citizens, residents, businesses, and other government affiliates (UK House of Lords, 2017). Multiple aspects of the identity could be managed using Blockchain. (birth certificates, marriage licenses, passport and visa information, and death records) (ACT-IAC, 2017).

**Persistency and irreversibility (immutable):** Once data has been written to a BC it is hard to change or delete it without noticing. Furthermore the same data is stored in multiple ledgers (Atzori, 2015); Underwood (2016); (Swan, 2015).

**Openness:Accessible:** Information stored in a chain is open and accessible by anyone (Alexopoulos et al, 2019).

**Standardization:** The lack of a common blockchain platform and application standard is one of the most important reasons why the initial investment of time and money to develop an e-government blockchain platform is so high. Clarifying the basic concepts, processes, and standards in the application



of blockchain technology in e-government can help to improve the awareness of blockchain technology, unify the basic develop platform and application programming interface, promote the interoperability of multiple blockchain systems and perfect the business processes required (Hou, 2017). According to (Alexopoulos et al, 2019) there are eight ISO standards under development for BCT.

**Automation:** By using smart contract, devices become self-serving and thus more intelligent. For governments, routine work can also be processed automatically, thus enable governments to provide services more efficiently. Less human intervention in the entire process also lowers the cost (Qi et al, 2017).

**Foster Automation:** Through smart contracts (Berryhill, et al, 2018).

**Processes Simplification:** BCT boosts government's processes by speeding up necessary subprocesses since information's access is easiest and quickest (Alexopoulos et al, 2019).

**Quality and Quantity:** BCT can empower public services by improving their interoperability, the speed of service and Increasing their predictive capability (Alexopoulos et al, 2019).Blockchain-based identities could help protect against identity theft, which is Europe's most significant enabler of crime (UK House of Lords, 2017). Many projects of blockchain-based voting have been launched already, such as BitCongress, AgoraVoting and FollowMyVote (Qi et al, 2017).

**Data Safety:** Consensus mechanism is being used by BCT and ensures the integrity of the chain (data) (Alexopoulos et al, 2019).

**Security:** Every action on blockchain is recorded and transparent to every user. Under such mass surveillance, conducting malicious behaviors without being detected is not possible. Blockchain technology can be used assuming proper security architecture. As data is stored in multiple databases using encryption n manipulation is more difficult. Hacking them all at the same time is less likely (Qi et al, 2017). Lemieux 2016). Gervais et al. (2016); Tapscott and Tapscott (2016); Underwood (2016); (Ølnes and Jansen, 2017).; Mainelli and Smith (2015).

**Healthcare:** The use of Blockchain will enable government entities to better provide health care services through keeping the health records of patients that can be shared with other service providers. Another advantage of this use case is the transparency over the health care services and the associated cost (Alketbi et al, 2018).

**Collaboration:** Prior to establishing blockchain platforms, governance institutions, technology organizations, archives and other involved institutions should participate in discussions about both start-up and maintenance, with each applying their professional knowledge of different areas to make the system and management procedure useful and reliable (Hou, 2017).

**Management System:** Although technology can improve the quality of government services, the management system remains critical in successful implementation. The government is ultimately responsible for the governance of the blockchain platform for public services. Since this system includes multiple organizations, it is necessary to clarify the responsibilities of each participating organization, the end-to-end processes, and the overarching framework in which they will all work (Hou, 2017).

**Developing the Individual Credit System:** Using blockchain technology to establish an individual credit system means that all these personal records can be preserved in the same system so that every individual will have a comprehensive digital identity, including all of their personal records, which contains reliable, authoritative personal information and cannot be changed arbitrarily. The long-term vision is that citizens will then value their individual credit, which will play an important role and not be able to be changed at random, and try their best to maintain good credit. This will also benefit the government's governance and social harmony (Hou, 2017).

**Strengthening the Government's Credibility:** An open government that relies on unchangeable information in a blockchain system brings more than just convenience to the public. Transparency breeds trust, and when individuals can trace the provenance of any particular information that impacts their life. Thus, by endorsing blockchain technology, the government can strengthen their authority and credibility with the public, and thereby govern more effectively (Hou, 2017).

**Promoting the Integration of Resources:** Blockchain technology can help to unify the basic develop platform and application programming interface, promote the interoperability of multiple blockchain systems and perfect the business processes required. This will reduce costs and improve customer satisfaction (Hou, 2017).

## Section. 2

### Positioning the Identified (BCT) Benefits into the Six Dimensions of the Public Value of E-Government.

In this section as a final step towards a comprehensive framework to understanding that how the identified (BCT) benefits can contribute to create e-government public value, we discuss how the identified (BCT) benefits are interconnected to each of the public value of e-government. we review the six dimensions of the public value of e-government from the perspective of (BCT) benefits. Actually, this study have sought to identify which dimensions of the public value of e-government are benefiting from the usage of (BCT) benefits. In this regards, in Tables 2 to 7, we specified the dimensions of the public value of e- government are benefiting from the usage of (BCT) benefits.

#### Dimension.1. Improved Public Services

Improved Public Services refers to different service improvements offered by e-government. For example, the adoption of digital platforms for the purpose of improved public services propositions and deliverables, improved access, and delivery of public services (Twizeyimana and Andersson, 2019).

1. Improved Public Services and associated Key Performance Indicators.		<i>BCT Benefits Number.</i>
1	Provision of services to citizens.	(49) (113) (3) (5) (13)(14) (16) (18)(23) (24) (25) (33) (35) (36) (38) (39) (37) (42) (43) (60) (63)(64) (65) (66) (67)(68) (69) (70) (73)(75)(77) (78)(83)(92)(112) (115).
2	Increased quantity of public information and services.	(100)
3	Increased quality of public information and services.	(52) (53) (100)
4	Provision of more inclusive public services.	(12) (13) (14) (117)

5	Provision of public (citizen)-centered services.	(113)
6	Provision of personalized services (e.g., special provision for disability, language support for minorities, online advice, etc.)	(23) (24) (25)
7	Provision of services directed towards the public good.	(36) (37)
8	Improved delivery of public services.	(13)
9	Enabled transparency, participation, and collaboration in the delivery of public services.	(1) (2) (3) (40)
10	Provision of more responsive, efficient, and cost-effective public services.	(19) (44) (45)
11	Improved access to government information and services.	(14) (69)

*Table.2. BCT Benefits interconnected with Improved Public Services.*

## **Dimension.2. Improved administrative efficiency**

The dimension improved administrative efficiency includes purposes of efficiency, effectiveness, increasing quality, and lower cost for administrative processes, systems, and services. It also concerns keeping government operations systematic, sustainable, flexible, robust, lean and agile, better management of public resources and economy (Twizeyimana and Andersson, 2019).

2. Improved Administrative Efficiency and associated Key Performance Indicators.		<i>BCT Benefits Number.</i>
1	Better management of public resources and economy.	(55) (62) (84) (30)
2	Cost-reduction.	(44) (45)
3	Reduced administration burden.	(13) (21)
4	Reduced bottleneck and queues in the delivery of services to citizens.	(13)
5	A robust government (e.g., operations are systematic, efficient, effective, sustainable, flexible, lean, and agile).	(19) (20) (49)
6	More responsive government operations.	(114)
7	Increase efficiency, effectiveness and the achievement of desired outcomes.	(19) (20)
8	Increased quality of processes, systems, and services to citizens.	(52) (53) (100)
9	Better collaboration, cooperation, and better communication.	(115).
10	Increased transparency, participation, and inclusiveness.	(1) (3)
11	Enabled public empowerment and capacity building.	(99) (100)
12	Enabled durable and competent institutional capacity and impartially serving citizens.	(99)
13	Maintained accurate and durable records.	(60) (61) (62) (63)
14	Enabled government to taking decisions by law and authorized policy.	(110) (63)
15	Reduced or eliminate the risk of corruption and abuse of the law by public servants.	(11) (15)

16	Enabled greater fairness, honesty, equality.	(35)
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*Table.3. BCT Benefits interconnected with Improved administrative efficiency.*

### Dimension.3. Open Government Capabilities

OG enables citizens to derive substantive financial, social, political or strategic values and also intrinsic values related to the government itself. Also, in today's dynamic environment, OG would then support government or public organizations to collaborate, or be in partnership with, other public organizations or with private-sector businesses to deliver quality public services (Twizeyimana and Andersson, 2019).

3. Open Government (OG) capabilities and associated Key Performance Indicators.		BCT Benefits Number.
		(90)
1	More open government or public sector operations.	
2	Increased transparency of public sector operations.	(1) (2) (3) (40)
3	Increased public/citizens participation in government actions and policy making.	(38) (1) (77)
4	Improved public engagement and well-informedness.	(69) (70) (72)
5	Improved communication and collaborative actions in the public sector.	(38) (1) (39)
6	Improved partnerships (within government or in the form of public private partnerships.	(12) (14)
7	Improved public control and influence on government actions and policies.	(42)
8	Improved political possibilities and innovations.	(32)
9	Improved capacity building and empowerment.	(99)
10	Increased frequency and intensity of direct involvement in decision making.	(110)

*Table.4. BCT Benefits interconnected with Open Government Capabilities.*

### Dimension.4. Improved ethical behavior and professionalism

The dimension improved ethical behavior and professionalism is related to foundational values by Rose, et al (2015). These values are at the backbone of government operations and policies. Also, through e-government humans can be removed from the decision-making chain by embedding rules in the software, thus, reducing or eliminating the risk of corruption and abuse of the law by public servants and deliver (to some extent) greater fairness, honesty, and equality (Twizeyimana and Andersson, 2019).

4. Improved Ethical Behavior and Professionalism and associated Key Performance Indicators.		BCT Benefits Number.
		(114)
1	Maintenance of fundamental beliefs and constitutional principles (e.g., responsibility to the citizen/politician).	
2	Proper and efficient use of public funds.	(23)
3	Facilitation of democratic will.	(16) (17) (18)
4	Compliance with the law.	(63)
5	Make decisions by law and authorized policy.	(63)
6	Demand for good information for decisions.	(69) (70) (72)

7	Reduction or elimination of the risk of corruption and abuse of the law by public servants.	(11) (15)
8	Maintenance of accurate durable records.	(60) (61) (62) (63)
9	Increased integrity, honesty, fairness, equality, accountability, responsibility, economy/parsimony, rectitude.	(54) (57)
10	Achievement or increased robustness, reliability, security, efficiency and effectiveness of government.	(74) (77) (78) (19) (20)
11	Increased citizens' access to government information and services.	(69) (14)
12	Provision of quality services to citizens.	(52) (53) (100)
13	Increased collaboration and participation.	(116)
14	Creation of durable and competent institutional capacity.	(99)

*Table.5. BCT Benefits interconnected with Improved ethical behavior and professionalism.*

### **Dimension.5. Improved social value and well-being**

E-government can impact social value and well-being in many ways. For example, social media platforms (twitter, blogs, etc.), could increase citizens' levels of social contact, hence, increase citizens' social health. Well-Being is also supported by e-government through facilitating a better management of public resources by means of online applications and transactions, by improving the quantity and quality of services to citizens, etc (Rose, et al., 2015).

5. Improved Trust and Confidence in Government and associated Key Performance Indicators.		<i>BCT Benefits Number.</i>
1	Better security of public information and privacy of citizens.	(77) (78)
2	Better management of public organizations, manage economy, public resources.	(117)
3	Better delivery of public services.	
4	Increased transparency (i.e., government (or public sector) is more transparent).	(1) (2) (3) (40)
5	Increased citizen participation.	
6	Citizens have more control of actions and decisions of their government.	(42)
7	Citizens have better access to government information and services.	(69) (14)
8	Increased flexibility, reliability, agility, and security.	(49) (74) (77) (78)
9	Increased quality of public services.	(52) (53) (100)
10	Increased quantity of public services.	(100)
11	Improved citizens' experience of service provision and service outcomes.	(3) (35)
12	Improved interaction at the local level (e.g., visiting a local government website increase citizens' trust in local governments).	(38) (39)
13	Protection of foundational values of trustworthiness, openness, robustness, reliability, accountability and security.	(38) (39) (90) (74) (77) (78)
14	Increased citizens' well-informedness.	(69) (70) (72)

Table.6. BCT Benefits interconnected with Improved social value and well-being.

#### Dimension.6. Improved Trust and Confidence in Government

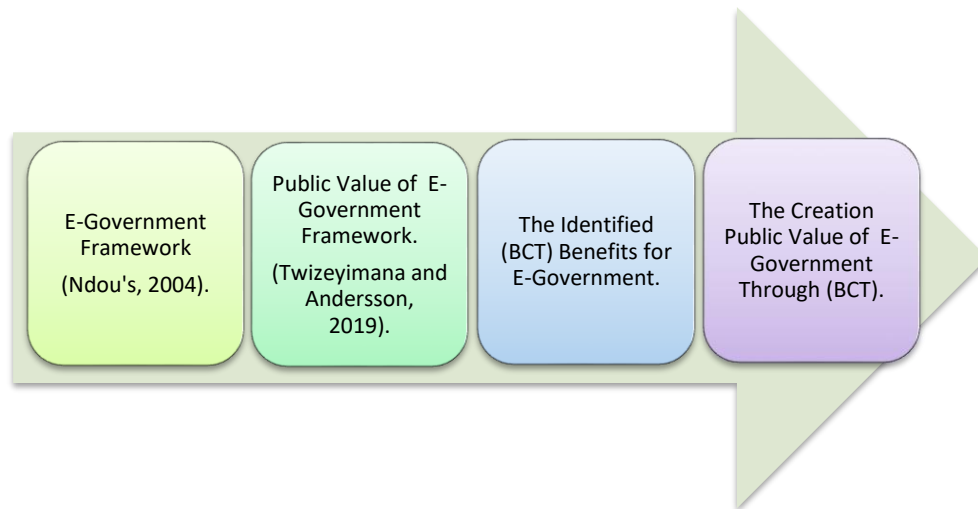
According to Twizeyimana and Andersson, (2019) trust via participation is created by public organizations by allowing and increasing citizens' participation in public discussions. E-government can improve public trust through increasing transparency, citizen participation, and by providing the public with more control of actions and decisions of their government (Castelnovo, 2013).

6. Improved Social Value and Well-Being and associated Key Performance Indicators.		BCT Benefits Number.
1	Improved social well-being.	(33)
2	Increased social status, relationships, and opportunities.	(33)
3	Improved capacity building and empowerment.	(99)
4	Creation of value(s) for families, community, and other relationships.	(33) (25) (113)
5	Increased safety.	(59)
6	Achievement of better outcomes in areas of peace, security, poverty reduction, public health, high employment, low crime rates, clean streets, improved environment and better educational achievements.	(77) (78) (66) (36)
7	Enabling freedom and equal rights.	(35)
8	Improved citizens' levels of social contact.	(33)
9	Improved citizens' social health.	(66)
10	Impact on individual and household health, security, and satisfaction.	(66) (77) (78)
11	Increased quantity and quality of services to citizens.	(100) (52) (53)
12	Improved economic well-being.	(23) (24) (25)
13	Impact citizen's income, assets, property, and wealth.	(108) (68)
14	Increase ease of doing business (i.e., create a value for citizens in terms of increased citizens' well-being and quality of life.	(92) (93)
15	Improved better management of public resources (e.g., by means of online applications and transactions).	(117)
16	A more flexible, pervasive, and cost-effective public sector (e.g., provision of online applications and transactions).	(49) (44) (45)

Table.7. BCT Benefits interconnected with Improved Trust and Confidence in Government.

#### Conclusions

In this study we have sought to identify which of the blockchain benefits for e-government services are interconnected with the dimensions of the Twizeyimana and Andersson, (2019) s public value of e-government framework. Hence, we have positioned the suitable identified benefits into the each of the six dimensions of the public value of e-government. This leads to develop and present a comprehensive framework to create e-government public value through blockchain benefits for e-government services (Fig.4).



*Fig.4. A comprehensive framework to create e-government public value through (BCT).*

However, applying blockchain in government sectors it's not an easy goal to achieve. The development of blockchain technology in government sectors is still a debatable topic this technology offers a new method for delivering and managing public services, and there remains a need to establish standards, deploy solid management systems and ensure adequate security to make sure the services and platform are reliable, authoritative and supportive of long-term preservation (Navadkar et al 2018). The only clear recommendation that can be made is that governments should invest in building its knowledge of this technology and explore, and even experiment with, its possible applications. It should also not do this alone, but identify and collaborate with partners from other parts of government, from other governments, and from other sectors (Berryhill, et al 2018). This paper serves as a beacon for further research and discussion on e-government and online public services. Considering the identified benefits, this paper provides insights into ways in which (BCT) might strengthen the public value of e- government. Applying blockchain technology in the public value of e-government offers a new method for delivering and managing public services. This research is the first study in the area. Therefore, it creates a new value in this field. Furthermore, this paper provides a blueprint for government leaders in their endeavor of planning and investment to implement blockchain technology.

Table.1. Classification of Identified Blockchain Technology Benefits for E- Government Services.

Blockchain Technology Benefits for E- Government Services.		
N	Benefits.	Literture.
1. Strategic.		

1	Transparency.	(Alexopoulos et al, 2019). (Wachal, 2018). (De Filippi, 2017). Underwood (2016). Semeijn and Mahr, (2018). Pullen, (2018). Batubara et al, (2018). Fridgen et al, (2018). Berryhill, et al, (2018). Nordrum, (2017). Atzori, (2015). Hou, (2017). (De Filippi, 2017). Atzori (2015); Underwood (2016). (Crowe, 2019).
2	Transparency with the lower cost.	(SMG Internal Presentation, 2017).
3	Transparency of transactions between government agencies and citizens.	UK Government Chief Scientific Adviser, (2015).
4	Transparent Budgeting.	(Mire, 2018).
5	Auditability.	Atzori, (2015).
6	Mitigating and identifying Fraud.	Hyvärinen, (2017). Batubara et al, (2018).
7	Prevent Fraud.	Batubara et al, (2018).
8	Reducing Fraud.	(UK Government Chief Scientific Adviser, 2015).
9	Overcoming Financial Fraud.	Hyvärinen, (2017).
10	Minimization of Fraud	101 Blockchains.com.
11	Reducing corruption.	Kshetri (2017).
12	Reduce friction between agencies.	(Pullen, 2018). Berryhill, et al, (2018).
13	Reduce bureaucratic barriers.	Berryhill, et al, (2018). (Pullen, 2018).
14	To reduce the barrier to access Government agencies.	(Ojo and Adebayo, 2017).
15	Combating corruption.	(Mire, 2018).
16	E-Democracy and Voting.	(Foroglou and Tsilidou, 2015). (Qi et al, 2017).
17	Voting ( Preventing Fraud, Increasing Access.	(Mire, 2018).
18	Transparent voting system.	101 Blockchains.com.
19	Efficiency.	(Crowe, 2019). (Allessie et al, 2019). (Hou, 2017).
20	Improve effectiveness.	Pullen, (2018). Berryhill, et al, (2018).
21	Bureaucracy.	(Jun, 2018). Seebacher and Schüritz, (2017). (Allessie et al, 2019).
22	Government Credibility.	(Alexopoulos et al, 2019).
23	The Conveyance of Funds.	(Mark G.,2018).
24	Benefits, entitlements, and Aid.	(UK Government Office for Science, 2016).
25	Welfare Distribution.	101 Blockchains.com.
26	Streamlining interagency and cross-sector processes.	(ACT-IAC, 2017). (UK House of Lords, 2017).
27	Legal Enforcements. Taxation.	101 Blockchains.com.
28	Replacing Paper-Based Systems.	(Mire, 2018)
29	The Approval Chain.	(Mark G.,2018).
30	Contract and vendor management.	
31	Financial Innovation.	(Wang, 2016).
32	Innovation.	(Wachal, 2018).
33	Social Innovation	(Jun, 2018).
34	Improving Shared Services Models.	(Mire, 2018)
35	Citizen Rights.	101 Blockchains.com.
36	Education.	101 Blockchains.com.
37	Traveling.	101 Blockchains.com.
2 .Organizational.		
38	Trust.	(Greenspan,2016). (Allessie et al, 2019).

39	Increased trust.	(Palfreyman, 2015); Zyskind and Nathan (2015); Mainelli and Smith (2015); Swan (2015).
40	Transparency and auditability.	Palfreyman (2015); Tapscott and Tapscott (2016); Atzori (2015).
41	Increase predictive capability.	(Tapscott and Tapscott, 2016).
42	Increased control.	(Zyskind and Nathan (2015); Kraft (2016); Mainelli and Smith (2015).
43	Clear ownerships.	(Yermack 2017).
<b>3. Economical.</b>		
44	Reduce Cost.	(Alexopoulos et al, 2019). (Palfreyman, 2015) Tapscott and Tapscott (2016); Ølne and Jansen, 2017).
45	Operations cost reduction.	UK Government Chief Scientific Adviser, 2015).
46	Reduced energy consumption.	Tapscott and Tapscott (2016).
47	Energy utilities.	Yaga, (2017).
48	Increased resilience to spam and DDOS attacks.	(Gervais et al. 2016).
49	Flexibility.	(Alexopoulos et al, 2019).
50	National Digital Currencies.	(Mire, 2018).
<b>4. Informational.</b>		
51	Data Storage.	(Yaga et al, 2018). (Berryhill, et al, 2018).
52	Data Quality.	Berryhill, et al, (2018).
53	Data integrity and higher data quality.	(Tapscott and Tapscott, 2016). (Lemieux 2016).
54	Integrity.	(Wachal, 2018).
55	Interagency Data Management.	(Mire, 2018).
56	Improved data integrity.	Pullen, (2018).
57	Process Integrity.	(Data Flair, 2018).
58	Reducing human errors.	(Cai and Zhu, (2016); Tapscott and Tapscott (2016).
59	Data Safety.	(Alexopoulos et al, 2019).
60	Personal records.	(ACT-IAC, 2017).
61	The Public Records.	(Mark G., 2018).
62	Records management.	Lemieux, (2016).
63	Legislation Records.	101 Blockchains.com.
64	Notary and registry services.	(Alexopoulos et al, 2019).
65	Inheritances.	101 Blockchains.com.
66	Healthcare.	(Alketbi et al, 2018).
67	Land title registry.	(ACT-IAC, 2017).
68	Property or land.	101 Blockchains.com.
69	Access to information.	(Palfreyman (2015); Swan (2015).
70	Information Sharing.	(Alexopoulos et al, 2019).
71	Better share knowledge.	Berryhill, et al, (2018).
72	Better share of knowledge and information.	Pullen, (2018).
73	Privacy.	(Alexopoulos et al, 2019). Tapscott and Tapscott (2016); Zyskind and Nathan (2015).
74	Reliability.	(Tapscott and Tapscott, 2016); Swan (2015).
75	Copyrights.	(Willms, 2016).

5. Technological.		
76	Resilience.	(Tapscott and Tapscott 2016); Swan (2015).
77	Security.	Qi et al, (2017). Lemieux (2016). Gervais et al. (2016); Tapscott and Tapscott (2016); Underwood (2016); (Ølnes and Jansen, 2017).Mainelli and Smith (2015).
78	Better Security.	(Data Flair, 2018).
79	Secure document handling.	(Ølnes and Jansen, 2017).
80	Secure and Immutable.	(Pullen, 2018).
81	Secure Data Entry.	(Mire, 2018).
82	Cyber-Protection.	101 Blockchains.com.
83	Real IDs.	(Williams and Murat, 2019). (UK House of Lords, 2017). (ACT-IAC, 2017).
84	Digital ID management.	(Ølnes and Jansen, 2017).
85	Persistency and irreversibility (immutable).	Atzori (2015); Underwood (2016); Swan (2015).
86	Immutability.	(Yaga et al, 2018). Nordrum,( 2017). (UK Government Chief Scientific Adviser, 2015). (Data Flair, 2018).
87	Cryptography.	(UK Government Chief Scientific Adviser, 2015).
88	Elimination of intermediaries.	(SMG Internal Presentation, 2017).
89	No Intermediary.	(Wachal, 2018).
90	Openness.	(Alexopoulos et al, 2019).
91	Standardization.	(Alexopoulos et al, 2019). Hou, (2017).
92	Ease of use.	
93	Ease in verification of transactions.	
94	Processes Simplification.	Qi et al, 2017).
95	Faster Processing.	(Data Flair, 2018).
96	Foster Automation.	(Berryhill, et al, 2018).
97	Legal Contracts.	101 Blockchains.com.
98	Automatically process.	Nordrum,( 2017).
99	Increased Capacity.	(Data Flair, 2018).
100	Quality and Quantity.	(Alexopoulos et al, 2019).
101	Confidentiality.	Berryhill, et al, (2018).
102	Traceability.	(Data Flair, 2018).
103	Decentralization.	UK Government Chief Scientific Adviser, (2015). Berryhill, et al, (2018). (SMG Internal Presentation, 2017).
104	Decentralized System.	(Data Flair, 2018).
105	Versatility.	UK Government Chief Scientific Adviser, (2015).
106	Faster Settlement.	(Data Flair, 2018).
107	Customs and Border Patrol.	(Mire, 2018).
108	Revenue.	(Crowe, 2019).
109	Accountability.	(Joseph, 2019).
110	Decision rights.	(Allessie et al, 2019).
111	Accountability.	(Allessie et al, 2019).
112	Incentives.	(Allessie et al, 2019).
113	Developing the Individual Credit System.	Hou, (2017).
114	Accountability and responsiveness.	(Joseph, 2019).
115	Collaboration.	Hou, (2017).
116	Strengthening the Government's Credibility.	Hou, (2017).
117	Promoting the Integration of Resources.	Hou, (2017).

118	Management System.	Hou, (2017).
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