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Blockchain technology in the area of e-Governance – Guidelines for implementation

Pascal Paintner

Dissertation presented as partial requirement for obtaining the Master's degree in Information Management

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BLOCKCHAIN TECHNOLOGY IN THE AREA OF E-GOVERNANCE – GUIDELINES FOR IMPLEMENTATION

by

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Dissertation presented as partial requirement for obtaining the Master's degree in Information Management, with a specialization in Information System and Technology Management.

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ABSTRACT

The perception of the public administration among society is widely associated with the area before the digital age and the information revolution: Less efficiency, less democratic, partially transparent, majorly bureaucratic, insufficient service quality, and slow responsiveness. Driven by information and communication technologies, there is an urgent need for disrupting the public sector to improve government decisions, increase the trust of citizens and their participation possibilities as well as enhance government accountability and transparency. The blockchain as a novel and innovative technology with its underlaying technological concept provides a plausible solution to reinvent the public administration processes and transactions with other governments, businesses, or citizens.

This dissertation follows a design science research approach to apply multiple analytical methods and perspectives to create an artifact. The type of evidence within this methodology is a systematic literature review, with the goal to attain insights into the current state-of-the-art research of blockchain technology in the area of e-Governance. Additionally, proven best practices from the industry are examined in depth to further strengthen the credibility. Thereby, the systematic literature review shall be used to pinpoint, analyze, and comprehend the obtainable empirical studies and research questions. This methodology supports the main goal of this dissertation, to develop and propose evidence-based practice guidelines for the implementation of blockchain technology that can be followed by the public administration.

KEYWORDS

Blockchain; Blockchain technology; e-Governance; Public administration; Design science research

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LIST OF ABBREVIATIONS AND ACRONYMS

A	Assumption
BC	Blockchain
BCT	Blockchain technology
DSR	Design science research
GDPR	General Data Protection Regulation
i.e.	id est
ICT	Information and communication technology
SLR	Systematic literature review
TOE	Technology-Organization-Environment

1. INTRODUCTION

1.1. BACKGROUND

The blockchain (BC) as a novel and innovative technological concept receives increasing responsiveness from several different industries due to its comprehensive use for simple or more complex transactions (Ølnes, Ubacht & Janssen, 2017). For that reason it finds suitable application in a multitude of domains, varying from the business and financial sector to the social area, including healthcare, education, and public administration (Ølnes, Ubacht & Janssen, 2017; Petkova & Jekov, 2018). One domain that is in particular faced with complex challenges is the sector of public administration, whereby obsolete processes, as well as trust, autonomy, and intermediaries, illustrate only some major challenges (Garg et al., 2019).

In recent literature, the BC with its underlying complex structure is often associated as a promising solution of e-Governance development. The BC has the characteristic to store information decentralized at different nodes, whereby consensus of each node is compulsory (Ølnes, Ubacht & Janssen, 2017). In addition, all transactions will be stored in a protocol, hence previously executed transactions cannot be altered, transferred, or erased. Applicable rules are previously defined in so-called smart contracts to define the regulatory framework (Rieger et al., 2019). This concept eliminates the dependency on one central party, the risk of harming or manipulations, and allows data and transactions to be recorded, shared, and synchronized between a distributed network and its participants (Ølnes, Ubacht & Janssen, 2017). The described characteristics provide a plausible reason that the BC has emerged as a conceivable technology to revolutionize government processes and transactions with businesses or citizens by supporting fundamental principles such as trust, privacy, inclusion, and participation (Ølnes, Ubacht & Janssen, 2017; Petkova & Jekov, 2018).

There are several countries where different BC architectures and applications have already been implemented. While in Sweden and Brazil the BC implementation already serves for land and property registrations, in Dubai and India it serves the purpose of tracking real estate transactions (Petkova & Jekov, 2018). Another example is Estonia, where the technology is used to establish an e-Residency, e-Voting, and cybersecurity system (Sullivan & Burger, 2017).

1.2. MOTIVATION

While blockchain technology (BCT) highlights promising approaches on how it can be leveraged to not only digitalize but also transform the sector of public administration, several challenges occur when applying and implementing BCT to this specific sector. Thereby, dealing with a lack of acceptance in major legislations, high costs for adequate, sufficient, and necessary concepts and implementation guidelines, as well as the high vulnerability of cyber-attacks and corruption exemplify just some of the foremost issues the disruption of the governmental sector would be faced with (Markusheuski, Rabava & Kukharchyk, 2017). Hence, from a technological point of view, BC illustrates a noteworthy technology that can be leveraged to improve security, privacy, autonomy, and data integrity in the field of e-Governance (Yli-Huumo et al., 2016).

To guarantee a sufficient and reliable implementation of BC solutions and achieve widespread acceptance within the governmental sector and society, guidelines and best practices need to be established and provided. Most of the latest existing literature covers the characteristics of BCT, its tremendous technical potential, and the different conceivable fields of application, but tends to ignore the issues in between, i.e. political and legislative matters. Furthermore, the overall trust in government and technology shape an additional socio-political complexity, that lacks sufficient research in the latest literature. In addition, among the present literature, there can be found less research on participation models and platforms with a focus on key driver values such as citizen trust, e-service design, governmental readiness, and collaborative processes that include all respective stakeholders. Neither can be found any implementation strategies or frameworks that support the proactive engagement to revolutionize the processes between the public administration and the citizenry to comprehend and solve problems of welfare and deliver additional public value (Atzori, 2015 Batubara, Ubacht & Janssen, 2018; Criado & Gil-Garcia, 2019; Lopes, Macadar & Luciano, 2019; Benítez-Martínez, Hurtado-Torres & Romero-Frías, 2020).

1.3. OBJECTIVES

The goal of this dissertation is to propose guidelines for the implementation of BCT in the area of e-Governance that can be followed by the public administration. To reach this research goal, the following intermediate objectives will be defined:

- Identification of several types of existing BCT implementations that can be used in the field of governance.
- Identification and analysis of currently implemented best practices of BCT in the area of e-Governance.
- Description of the purpose and main use of BCT for governance by comparing the implemented blockchain solutions.
- Identification of bottlenecks and possible problems.
- Proposal of a framework and guidelines for BCT in the area of e-Governance.
- Validation of the suggested implementation guidelines by consulting and interviewing experts from different industries, however, having related knowhow to BCT.

2. LITERATURE REVIEW

To acquire a generic understanding, this chapter is divided into three subchapters and covers the holistic concept of BCT as well as the history and structure of the public administration's domain. The following part will be supplemented by bringing both termini together and establishing a common understanding for BCT in the area of e-Governance, which later provides the baseline for the initial development of respective implementation guidelines.

2.1. E-GOVERNANCE PUBLIC ADMINISTRATION

2.1.1. History and concept

The perception of the public administration among society is widely associated with the area before the digital age and the information revolution: Less efficient, less democratic, partially transparent, majorly bureaucratic, insufficient service quality, and slow responsiveness (Potnis, 2010). With the revolution of the new public management reforms of the 1990s, some novel initiatives were introduced by applying professional management practices and processes of private-sector organizations to the governmental body. This introduced citizens to the possibility to access information of the public administration bodies online. Nevertheless, most critics argue that a customer-driven approach and collaborative engagement with society have not yet been established (Torres, Pina & Royo, 2005).

Driven by information and communication technologies (ICT), countries experienced a new transition to a more information and knowledge-based culture. This movement towards new digitalization describes a new area, characterized by networking activities, globalization, new social opportunities, economic facilities, and political freedom in cities, regions, countries, but also on institutional bodies such as governments or public administrations (Gascó, 2003). The request to disrupt and reinvent administrative processes to improve government decisions, increase the trust of citizens and their participation possibilities, enhance government accountability and transparency, as well as the involvement of different stakeholders, can be described as e-Government (Torres, Pina & Royo, 2005).

Although there is no uniform definition of the terminus of e-Governance, the following various definitions describe the main concept. While The United Nations defines e-Governance as "utilizing the internet and the World Wide Web for delivering government information and services to citizens" (Hafeez & Sher, 2006), the World Bank defines it as the combination of new public

management and “the exercise of political power to manage a nations affairs” (Rhodes, 2000). Foses (2002) agrees and describes it as leveraging ICT to offer and manage government services. Jun (2018) further emphasizes involving community members to expand the interactions between the government and its citizens. Saxena (2005) perceives e-Governance after new public management as the second revolution in public management. Thereby, it is important to change the way public service is delivered internally and externally by exploiting projects that describe the different forms of governing, i.e. e-democracy, e-voting, e-justice, e-education, and e-healthcare (Gascó, 2003; Torres, Pina & Royo, 2005).

2.1.2. Central and local public administration

The way public administration is structured and subdivided has a significant influence on how new services and policies for citizens will be implemented. The distinctive domains of competence for central and local government as well as their divergent interests and political discretion challenge the interconnection between both entities.

The typical relationship between central and local government is described by picturing the local government as an agent of the central government, whereby the central government determines the budget, speed, and priority on how the local services should be developed and implemented (Rhodes, 2018). Moreover, the access of local government to central entities is limited and the decisions vary on the dependency of the size of the respective local government (Sole-Vilanova, 1989). Subsequently, the existing dependencies and interventions from the central to local government harm not only the efficiency of the local government to enact a new policy, but also interfere with each other’s goals. This dynamic might characterize the dominance of the central government, but rather outlines the non-existing capabilities of both to pass local and communal government services to local authorities and citizens (Rhodes, 2018).

The first attempt to assign local government more power was by increasing the bureaucratization, which led on one hand to an increase in own discretion, including regulations, controls, financial power, and additional capacity. On the other hand, it led to less engagement of politicians and gave citizens fewer opportunities to actively participate in the state of welfare (Sole-Vilanova, 1989). Hence, when introducing the area of new public management, one main objective was to restructure the relationship between central and local government. Making the local government more independent will allow the authorities to have a significantly higher political discretion in designing,

passing, and implementing their policies and services based on patterns and needs from respective citizens, governmental agencies, and private institutions (Elander & Montin, 1990; Rhodes, 2018).

2.1.3. e-Governance domains

The provision of a general public service delivery system, with its various forms of administration, addresses a wide range of different stakeholders. Depending on the type of interaction, the stakeholders can be grouped into three key stakeholders: governments, businesses, and citizens (Rose, Flak & Sæbø, 2018). The following figure illustrates the three different types of e-Governance models and their interrelationships.

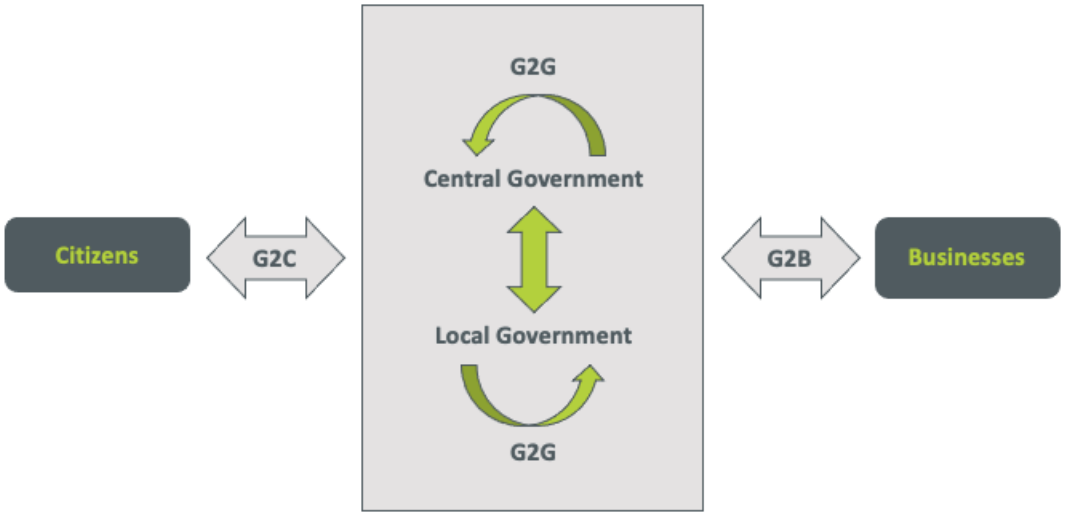

Figure 1: e-Governance models

Source: adapted from Pal, 2019

To get a better understanding of the in figure 1 described interrelationships, the three different types of e-Governance stakeholders will be outlined in detail:

Government-to-government (G2G): This relationship describes the communication process between the governments and its institutions and organizations; highlighted by the characteristics of non-commercial matters (Pal, 2019). Conceivable stakeholders in this group are institutions of central and local government. On the one hand, the focus of the local government is the efficient and fast exchange of relevant information of citizen services, inner-city services, urban development and building constructions, civil engineering, and education. On the other hand, the focus of the central government is the domain of

legislative, executive, and judicative, including the roles of finance, commerce, national defense, general foreign affairs, and general law.

Government-to-business (G2B): This relationship describes the communication process between the government and businesses of all kinds; highlighted by the characteristics of commercial business matters (Pal, 2019). Conceivable stakeholders in this group are commercial businesses and NGOs. This interrelation might address tax returns, employee registration, compliance with labor rights and labor laws, mandatory group and annual account statements as well as multinational trades.

Government-to-citizen (G2C): This relationship describes the communication process between the government and its society; highlighted by the characteristics of socio-cultural matters (Pal, 2019). Conceivable stakeholders in this group are the citizens. This might address the antibureaucratic, convenient, democratic, sufficient, and transparent provision of online services like civil registrations, insurance, pension, real estate, voting, and many more.

These three described dimensions above encompass the most stated stakeholders among the latest publications within academia. However, Sabbagh (2019) proposes another dimension to expand this e-Government model, by adding employees as a fourth dimension. Thereby, this interrelation describes the administrative transactional processes between an enterprise's employees and government-related institutions. In particular, use cases such as the entire reimbursement process of employees' travel expenses or time- and payroll tracking are mentioned as just a few examples within academia.

2.2. BLOCKCHAIN TECHNOLOGY

2.2.1. History and concept

In October 2008, a white paper entitled "Bitcoin – A Peer-to-Peer Electronic Cash System" by an individual or possibly a group with the name of Satoshi Nakamoto was dispersed among experts in the field of cryptographers (Crosby, 2016). The system outlined in the paper, called Bitcoin, was released in January 2009 and would allow online payments to be sent from one object to another without consulting and involving a financial institution. In mid-2017, with an estimated value of about $60 billion, the system found great promise among researchers and tech specialists (Ølnes, Ubacht & Janssen, 2017). Thereby, the digital currency represented the baseline for structured data

storage and verification methods and is now being used for further BCT implementations outside the area of finance (Crosby, 2016).

Due to the recent emergence of the BCT and its continued rapid development, no uniform definition for the terminus of BC exists. However, the overall concept of BCT allows all participants (nodes) within the system to access the previously stored digital assets by using a peer-to-peer network, where the information of these transactions is aggregated and stored on blocks distributed throughout the network, i.e., as a distributed ledger (Ølnes, Ubacht & Janssen, 2017). For security reasons, a public key cryptographer and signatures are used to list and track all owners of these physical assets to ensure data transmission and access security (Ma et al., 2020). Additionally, for each created block an individual hash function will be generated to identify this information. This function includes not only the transaction data and the timestamp, but also the hash of the previous block. Resulting from this procedure, an encrypted string as a unique key is generated, which connects all previous and subsequent blocks. Supported by a consensus protocol all transactions are validated and stored to detect any changes (Ølnes, Ubacht & Janssen, 2017). In addition, applicable rules are previously defined in so-called smart contracts to ensure that all transactions cannot be altered, transferred, or erased. Subsequently, all blocks are linked to each other in a time sequence and include information of certifiable records for each transaction (Rieger et al., 2019; Crosby, 2016). Since all nodes have a copy of the BC, this concept can also be described as a continuous-growing data structure with an immutable catalog of records that assists to report modifications on the ledger immediately to all partaking nodes (Sullivan & Burger, 2017; Shen & Pena-Mora, 2018).

Regardless of the complexity of the BCT, the advantages and opportunities that come along with this concept are very promising. It eliminates the dependency on one central party and other third parties, hence it has the potential to create trust in an insecure environment. Further, it eliminates the risk of harming or manipulations and allows data and transactions to be recorded, shared, and synchronized between a distributed network and its respective participants. Subsequently, there will be no centralized point of vulnerability, higher security and accuracy, immutability of transactions, and security of information (Ølnes, Ubacht & Janssen, 2017; Sullivan & Burger, 2017). In this context, the concept of BCT can be leveraged to create a new digital economy that is not only scalable and open, but more importantly, that is democratic and designed in a centralized manner (Crosby, 2016).

2.2.2. Challenges and limitations

Like any other innovative technology with the potential of disrupting certain industries, issues occur and challenges develop while being examined by practitioners and academia. The arising challenges constrain the tremendous potential of BC and its wide usages within industries. Therefore, this section discusses the various limitation of technical and business nature.

Although the characteristics indicate that the technological concept of BC is very promising to establish extraordinary data security, numerous technical challenges need to be examined. Both the hash algorithms and the smart contracts enable outstanding security of the BC, but it is still likely to crack the cryptographic algorithm. Malik et al. (2019) have outlined several different cyber-attacks that eliminate the underlying security. One of the proven approaches among practitioners can be described as the denial of services. Thereby, the main goal is to trash the nodes to eliminate or restrict the availability of the networks, causing unstable communication and broadcasting issues among the different networks and nodes. Another is called rooting partition attack, whereby the transactions and the respective data will be intercepted and manipulated even before it shifts from the nodes to the addressed peers within the network. Lemieux (2016) counts time jacking to a third well-known cyber-attack, whereby the hacker tries to manipulate the timestamps of the BC before being saved to the protocol with the intention to introduce inauthentic records and fake BCs. The lack of privacy is one of the further challenges that need to be analyzed. On one hand, saving the entire information and history of transaction data on each node proofs to be beneficial from a security point of view, but questions the overall applicability of the technological concept for use cases where greater confidentiality is demanded. Additionally, the immutability of all transaction data illustrates another limitation this technology is faced with since some use cases in the industry require modifications to certain transactions (Hughes et al., 2019).

Considerable doubts arise in regards to the question of the sustainability of the BC protocol, in particular for BCs that are used for applications of public nature. The security procedures and the respective consensus mechanisms cause tremendous waste of energy resources of the mining grid (Casino, Dasaklis & Patsakis, 2019; Yli-Huumo, 2016). This can be exemplified by taking a closer look at the energy consumption of China, the country that leads BC mining. According to the bitcoin energy consumption index, China consumes a greater amount of electricity than 159 countries accumulated (Index, 2017).

Moreover, most data transaction systems within the financial industry have the ability to execute thousands of transactions per second because of fewer security checks during the execution within the network; implying a trade-off with other security characteristics. The BCT, on the other hand, has

due to its higher security mechanisms undoubtedly a lower transaction rate and faces, therefore, latency issues, including the size of bandwidth. By comparing the transaction rates of other enterprises such as VISA (2.000 transactions per second) or Twitter (5.000 transactions per second) it can be concluded that this throughput frequency limits not only the applicability to certain industries, but also addresses serious scalability issues for other potential business models (Casino, Dasaklis & Patsakis, 2019; Yli-Huumo, 2016). Of course, there are many more challenges in this context than the aforementioned examples.

There is little doubt within the practitioner's world that BC has the potential to disrupt and innovate the operational efficiency, security, and privacy of traditional centralized systems. However, there are some challenges and limitations from a business point of view that should be acknowledged too.

Along with the tremendous growth of BCT and its application for a myriad of use cases, a huge amount of heterogeneous BC architecture types are created. This prevents not only the effort to establish an industry-wide standard for certain areas of application, but also increases the complexity for providing corresponding application program interfaces, implying overall interoperability issues, less transparent compliance standards, and insufficient auditing tasks (Casino, Dasaklis & Patsakis, 2019). This overall complexity is the origin of a lack of acceptance, not only from a perspective of correct operation and handling of the technology by its users but also from a legal and regulatory point of view by authorities. Thereby, a shortfall in knowledge and trust in technology, the legality of the transaction, and respective general data protection represent the main drivers of the BCTs' wider acceptance (Hughes et al., 2019).

Before implementing the BCT into the organization’s existing information system architecture, the implementation plan needs to be critically assessed whether the BCT can contribute additional value in comparison to the conventional centralized information system. Organizations likely tend to overvalue the disruptive innovation behind the BCT rather than seek to focus on the underlying business value (Ølnes, Ubacht & Janssen, 2017; Hughes et al., 2019). Aspects that need to be considered are, among horrendous costs for the implementation and energy consumption, the associated risks of opening up the business model and infrastructure to other participating parties. Leveraging this technology to add additional business value and simultaneously assuring the integrity of the data will fully challenge the entire concept and respective implementation (Seebacher & Schüritz, 2017; Hughes et al., 2019).

2.3. BLOCKCHAIN TECHNOLOGY IN PUBLIC ADMINISTRATION

Both different domains, BCT and public administration have been outlined in detail. Beyond the challenges and limitations, almost every novel innovation is faced with, there is a tremendous likelihood that BCT and BC-based systems can be leveraged to enable multifaceted practices for numerous applications within the area of public administration.

By looking at the past, there has never been any interference between these two domains. Combining them allows creating new interdisciplinary solutions for citizens, businesses, and other governments. Likewise, to introduce and establish a new field, i.e. “e-gov”, which consists of a series of artifacts that are originated and built in accordance with the fundamental normative structures and executive ideas (Homburg, 2018; Casino, Dasaklis & Patsakis, 2019). Major developments in ICT and the proliferation of social media and web-based services have transformed the interaction between citizens and their governmental institutions and vice versa. Resulting from this, the emerge of online platforms and communities has changed the expectation on how politics and government should be run in the future. Thereby, major challenges such as “efficiency, privacy, human connections, security, participation, capacity building, transparency, and accountability” need to be overcome to justify the reason for being established in the first place (Homburg, 2018). From the perspective of the latest technology, the full potential has not yet been exhausted. The combination of the internet and BC enables the governmental institutions to leverage the full potential of such disruptive technology to align novel capacities to accomplish individual citizen goals and simultaneously create a society's shared value (Homburg, 2018; Khan, 2018). Some of these approaches are already implemented, although with a more simple concept. Hence, the type of service delivery needs to be evaluated based on the maturity of the delivery channel. Services that can be characterized with a higher level of maturity involve not only simple forms of office problems but also handle more advanced issues, involving several different departments and organizational bodies (Homburg, 2018).

The strategy of the upcoming literature review intends to combine both the approach of examining scientific publications and best practices from the industry. Hereby, the main objective is not only to describe what has already been discovered and implemented up today but also to enrich those findings with research outlooks and related future work.

2.3.1. Scientific publications

This paper follows a systematic literature review (SLR) approach to gain insights into the current state-of-the-art of BCT research in the field of e-governance. Thereby, the SLR, applying the PRISMA methodology, shall be used to pinpoint, analyze, and evaluate the obtainable empirical studies, research questions, or a phenomenon of interest. Thus, it allows not only to identify the gaps of knowledge but also to justify further potential research of other, not yet explored, concepts in academia (Ghapanchi & Aurum, 2011, Moher et al., 2009). Further, it aims to enhance the superiority of the overall review process and credibility of the research work and respective results.

This methodological approach follows the main steps suggested by Kitchenham et al.: (1) identify the resources; (2) study the selection; (3) extract the data; (4) conduct a data synthesis by discussing the results. The final step completes this SLR by summarizing the study as a report (Kitchenham et al., 2009). This systematic assessment follows the PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analysis) method and grants a systematic schema (Moher et al., 2009).

2.3.1.1 Resource identification

As performing the first step, several inclusion criteria will be determined to set an overall clarity for this analysis. Therefore, the following characteristics will be used to identify a preselection of relevant articles that help to pursue the main study objective. The time frame chosen includes all articles published in the last five years, i.e. between November 2015 and November 2020. This predetermined time frame allows to focus on the most recent scholar and avoids the use of less frequent or early findings that are outdated or less prominent.

In the focus are journal articles and conference papers where the following rule applies to their titles, abstracts, or highlighted search strings: (“e-Governance” OR “e-Government” OR “e-Gov”) AND (“Blockchain” OR “Blockchain Technology” OR “Distributed Ledger Technology”) plus the terms (“Public Administration” OR “Public Sector”) AND (Blockchain” OR “Blockchain Technology” OR “Distributed Ledger Technology”).

The search strings are based on the previously conducted literature review up to this section. For the resources, there is a distinction between primary and secondary resources. For the primary resources, the search is to be performed on generic research databases, i.e. Taylor & Francis Online, ScienceDirect, Springer Link, Researchgate, and Emerald insights. Additionally, the three information systems and technological databases IEEE Xplore, Association for Computing Machinery, and

Association for Information Systems have also been considered. Other resources like JSTOR, SSRN, and cross-references are to be considered for this research as a secondary resource. The literature search was conducted in November 2020.

2.3.1.2 Selection screening

By looking at the inclusion criteria, the main intent is to include all respective articles that contain evidence of explicit use in the context of blockchain as the conceptual underlying technology to reinvent and innovate the domain of public administration. This is particularly important "since these are considered to provide valid data and therefore have the most influence in the field" (Podsakoff et al., 2005). For the exclusion criteria, all articles not published in English, without an introduction abstract or access to the full section of the relevant text were not taken into account. In addition, any articles that do not match the particular time frame and focus of this study, as well as do not support the main objective of this dissertation, were to be excluded.

2.3.1.3 Data extraction

Beginning with the analysis of the records, the first step included the check for existing duplicates. Subsequently, the records were screened for meeting the inclusion criteria. For the remaining articles, the next step included the checking of the respective abstracts for eligibility. When the remaining articles still appear to be crucial for the contribution in regards to the overall dissertation objective, the main text of the articles was then read, analyzed, and summarized to incorporate a final selection into the study.

Figure 2 below illustrates the process flow of the systematic literature review in detail. Thereby, step 1 included the identification of the potential articles, separated into primary and secondary resources. In total, 652 articles got identified; whereas the articles can be subdivided as followed – Emerald insights: 64; Taylor & Francis: 55; Science Direct: 47; IEEE Xplore: 53; Association of Information Systems: 46; Springer Link: 60; ResearchGate: 67; Association for Computing Machinery: 73; JSTOR: 50; SSRN: 56; cross-references: 81 articles. Performing step 2 implied excluding 82 articles based on duplicate appearances of the articles between the different consulted resources. In step 3 the remaining 570 articles were screened within two phases considering the previously defined inclusion and exclusion criteria, resulting in the removal of additional 538 articles. With 32 articles remaining, the main focus of step 4 was to assess the main text for eligibility to include as further

resources to the study. The execution of these outlined process steps can be described as a filter-based function and led to a final number of 21 articles that meet the full set of inclusion criteria.

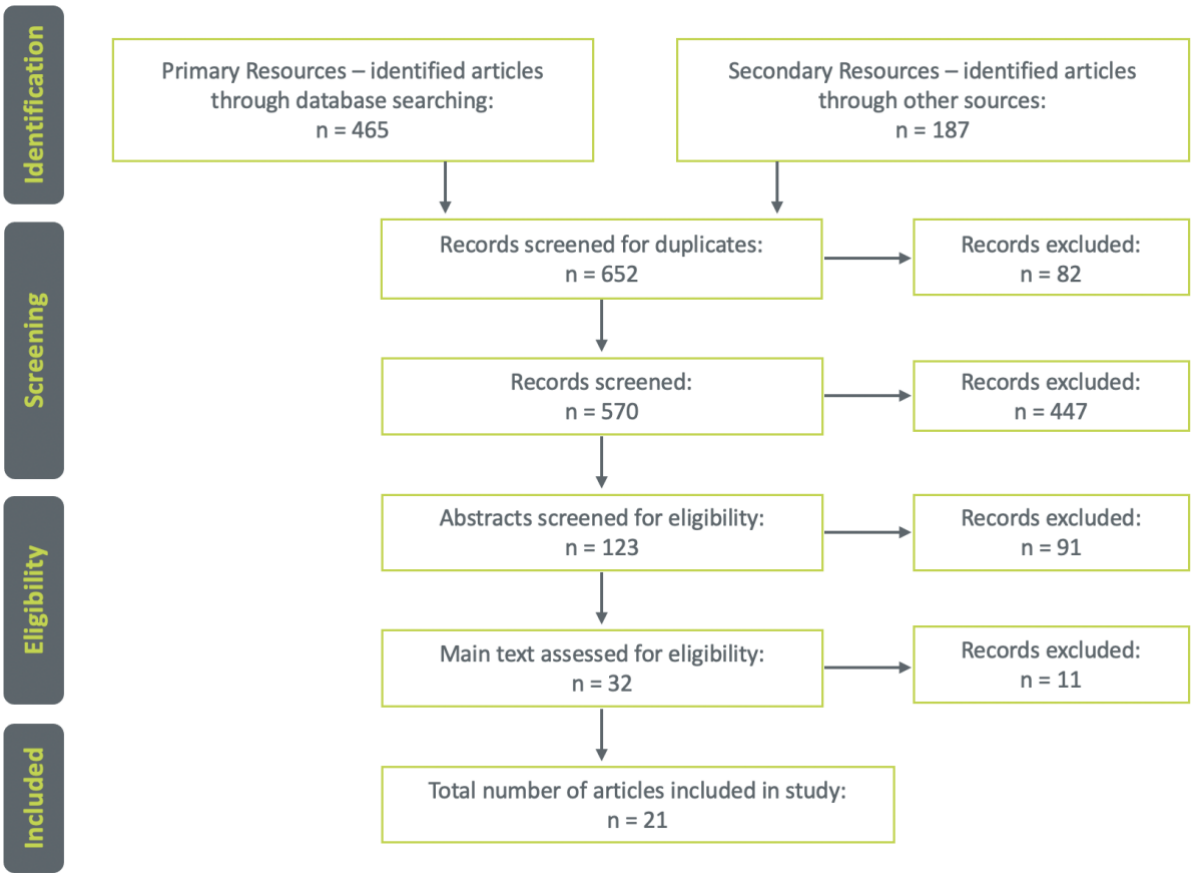

Figure 2: PRISMA flow chart

Source: adapted from Moher et al., 2009

2.3.1.4 Results and discussion

The 21 articles included in the final study collection were divided into two distinct categories: those used as a primary resource to build the main argument structure (14 articles), and those used as a secondary resource (seven articles) to support and reinforce the main rationale. Out of those 21 articles, 14 articles were published in scientific journals, whereas seven were published in conference proceedings. The full list of all articles can be found in the table below.

Authors	Ref. No.	Title	Publication Type
Alketbi, Nasir & Talib (2020)	[13]	Novel blockchain reference model for government services: Dubai government case study	Journal Article
Banerjee et al. (2020)	[8]	Decentralized Policy Feedback System for Privacy and Governance using Blockchain and Sentiment Analysis for Smart City Applications	Journal Article
Batubara, Ubacht & Janssen (2018)	[18]	Challenges of blockchain technology adoption for e-government: a systematic literature review	Journal Article
Benítez-Martínez, Hurtado-Torres & Romero-Frías (2020)	[6]	A neural blockchain for a tokenizable e-Participation model	Journal Article
Francisco et al. (2019)	[11]	A Systematic Literature Review of Blockchain Architectures Applied to Public Services	Conference Paper
Jun, M. (2018)	[21]	Blockchain government-a next form of infrastructure for the twenty-first century	Journal Article
Kassen (2020)	[3]	Politicization of e-voting rejection: reflections from Kazakhstan	Journal Article
Konashevych (2020)	[1]	Constraints and benefits of the blockchain use for real estate and property rights	Journal Article
Koster & Borgman (2020)	[16]	New Kid On The Block! Understanding Blockchain Adoption in the Public Sector	Conference Paper
Koulizakis & Loukis (2020)	[19]	A development framework for blockchain technologies in digital government	Journal Article
Lin, Li & Liang (2020)	[9]	Research on Strong Supervision Algorithm Model Based on Blockchain in E-government	Conference Paper
Linders, Liao & Wang (2018)	[7]	Proactive e-Governance: Flipping the service delivery model from pull to push in Taiwan	Journal Article
Lopes, Macadar & Luciano (2019)	[2]	Key drivers for public value creation enhancing the adoption of electronic public services by citizens	Journal Article
Mawela, Ochara & Twinomurinzi (2016)	[20]	E-Government Implementation: Lessons from South African Municipalities	Journal Article
Ølnes & Jansen (2018)	[17]	Blockchain technology as infrastructure in public sector: an analytical framework	Conference Paper
Pal & Singh (2019)	[14]	Blockchain Technology and Its Applications in E-Governance Services	Journal Article
Sabbagh (2019)	[15]	The Public Value of E-Government: A Blockchain-Based Approach	Conference Paper
Sullivan & Burger (2017)	[5]	E-residency and blockchain	Journal Article
Toapanta et al. (2020)	[12]	Hyperledger Technology in Public Organizations in Ecuador	Conference Paper
Yfantis, Veligou & Ntalianis (2020)	[4]	New development: Blockchain—a revolutionary tool for the public sector	Journal Article
Zhang et al. (2019)	[10]	Research on Government Information Sharing Model Using Blockchain Technology	Conference Paper

Table 1: Final articles PRISMA methodology

The articles [1], [3], [4], [15], [17], and [19] showcase best the latest challenges and obstacles BCT is facing when performing its initial implementation into the public sector; observing it from an analytical and critical perspective as well as considering the impact the articles have to contribute most to the present dissertation goal. Thereby, the following major issues are not only occurring from a data, technological, and business standpoint, but also from a political and legislative standpoint: immutability, infrastructure, anonymity, personal data, policy, regulation, trust in technology, trust in government, scalability, and price volatility.

The respective issue outlined above provides the baseline for further discussion. Hereby, the articles from the PRISMA methodology will help to analyze and examine the challenges to support the main dissertation objective, establishing and providing guidelines for sufficient BCT implementation into e-Governance. Multiple journal articles and conference papers address the immaturity of this technological concept, referring to its highly complex, yet non-transparent underlying processes and missing well-proven best practices. Additionally, the overall existing mistrust of society towards novel technology is not beneficial. Since trust in the government is a generally lengthy and difficult process to achieve, this interplay with technology makes it even more complex, well-knowing that a solution might be prejudiced for the sake of being provided by the public sector. Subsequently, gaining trust is the responsibility of both the public sector and society [3], [4]. Beforehand mentioned issues are strongly linked to the concern of personal data and anonymity, which tend to be erroneously regarded as less important. Since any distributed ledger technology is exposing published data as well as every public key of any transaction, the recently enacted General Data Protection Regulation from Mai 2018, covering the right to be forgotten and pseudonymity, is questioned within this technological concept after all. Hence, when implementing and deploying BCT within public administration, the overall method and concept should ensure privacy prevention [1], [17]. That the government is already aware of its responsibilities and appropriate governance of data, proves the article by Lin, Li & Liang (2020). Thereby, the authors point out the already existing data sharing concepts for the different types of government data resources, i.e. unconditional sharing data, conditional sharing, and non-sharing data [9]. Nevertheless, instead of having one central entity, a distributed ledger that stores and manages millions of data and transactions in a decentralized manner only further intensifies the central problem of trust [5]. Not to be unmentioned are the technological challenges that BC brings with it. Just to list a few: downtime, message packet loss, information delay, data safety and integrity, and platform security [10], [14], [17], [19]. Koulizakis & Loukis (2020) question the overall contractual validity. Since the requirements vary for each use case, e.g. voting, land registry, tax management, cross-border handling, and for every nation-state, the authors claim a lack of research and advocate to be more comprehensive in regards to that [19].

Franciscon et al. (2019) refer to the beforehand researched architectures that are intended to ensure BC control. Hereby, the authors point out the presence of private, public, or hybrid control forms that allow adequate consensus and respective integrity of the information [11]. Mawela, Ochara & Twinomurinzi (2016) highlight the growing concern among researchers towards the success rate of e-Government initiatives and emphasize the partially existing non-readiness of public sector employees in regards to personal capabilities, skills, and overall acceptance of the change. Further, the authors highlight the insufficient co-creation synergies concerning partnerships and collaborations among all participating stakeholders as well as the necessary infrastructure [20]. The authors Ølnes & Jansen (2018) also agree on the issue of the critical infrastructure and further draw attention to the problem of an unequal distribution between costs and benefits among institutional entities. While the e-Government initiatives and implementation processes are executed by each governmental sector, the related advantages for each respective entity are realized in other sub-sectors or even not at all [2], [17]. This enhances the forking issue not only on a technological level but also addresses it on an administrative level [1]. Additionally, Lopes, Macadar & Luciano (2019), as well as Batubara, Ubacht & Janssen (2018), argue that the realization and delivery of e-Government services and their benefits to society is essential to generate a satisfactory adoption rate, with which the public value will follow [18]. Sabbagh (2019) adds that the success of the adoption and implementation partially depends on the perceived public value among society and other respective stakeholders [15]. As a consequence, the authors refer back to the revolution of the new public management and argue that the ICT should be perceived as an enabler. Thereby, the offered e-Services should enhance the usage just-in-time and emphasize the exposure of stakeholders with the government [7]. Due to this highly socio-political complexity, the authors confirm the present research gap and therefore encourage further research; in particular on participation models and platforms with a focus on key driver values such as citizen trust, e-service design, governmental readiness as well as a collaborative process between all stakeholders [2], [18]. Benítez-Martínez, Hurtado-Torres & Romero-Fría (2020) underline this by pointing out the governance deficit, describing the demand from society for a renewed relationship with its public administration. Further, the authors emphasize the importance of developing a framework that supports the proactive engagement and participation of all stakeholders to facilitate long-term success [6].

To counteract this issue, Tornatzky and Fleischer (1990) developed the Technology-Organization-Environment (TOE) framework with the goal to provide guidance and support when implementing or adopting BCT concepts into the sector of public administration. For the technology context, recent hypes, “bandwagon effects” and “fear of missing out” pushed governments and businesses intrinsically to implement some sort of BCT within their environment, not even knowing whether the

adequate use cases or requirements even exist [16]. Within this framework the question of the technology to be used also arises. In most recent articles it is frequently referred to the possibility of using the BC network Ethereum or Hyperledger. Both distributed ledger technologies can be distinguished between permissionless and public versus permissioned and private [6], [12], [14]. While both concepts follow a novel approach of introducing a tokenizable e-participation model, an analysis of the respective technologies and their benefits is not the subject of this discussion. For the organizational context, the authors state that the involvement and proactive support of top management is indispensable for BC adoption. The environmental context intends to ensure that the implementation of the BC concept is provided by and executed in an appropriate industry, infrastructure, and regulations with suitable use cases [16]. Further, the authors argue that in particular, this dimension of context is critical, since the characteristics of trust and adoption are positively interconnected.

Batubara, Ubacht & Janssen (2018) also refer to the TOE framework in their article and emphasize its importance for a successful introduction and deployment of BC into the governmental sector [18]. Alketbi, Nasir & Talib (2020), Koulizakis & Loukis (2020), and Jun (2018) identify a significant research gap in the area of BCT architecture and respective principles. The authors agree on the importance of a certain skeleton and advocate the establishment of a holistic platform to not only support the identification of the application requirements but also to provide essential architectural and environmental guidance for governments [13], [19], [21]. In particular, Alketbi, Nasir & Talib (2020) propose a model that consists out of four steps, which are as follows: (i) formation of the BC network and its members; (ii) definition of the consortium and respective use case implementation; (iii) execution of the transaction; and (iv) continuous maintenance and upgrade [13]. Certain characteristics are in alignment with the suggested proof of concept the authors Banerjee et al. (2020) propose in their journal article as well [8]. Moreover, the suggested action plan endorses a more satisfactory user experience for stakeholders like businesses and employees to drive the adoption and implementation to an even further level.

2.3.2. Best practices in industries

While the BC is still in an early evolutionary process, an increasing amount of domains find its application as one of the most promising technological concepts to overcome business and technological barriers of all kinds. The domains vary from the business and financial sector to the social area, including healthcare, education, social welfare, and public administration. While some countries may have initiated a pilot phase of BC concepts for their respective business model, other

countries have already tested and established a reliable concept with proven best practices, which is already being used by the administration daily. The examination of relevant literature in this domain points Australia, Canada, Dubai, Estonia, Singapore, South Africa, South Korea, India, Israel, United Kingdome, New Zealand, Switzerland, Georgia, Japan, and China as countries where the concept of BCT is already most advanced and adopted to numerous applications within e-Governance.

The purpose of this section is to describe the most advanced BC initiatives that best contribute to the development of practical guidelines for implementation. The following table, therefore, lists only a select number of best practices where the concept has been tested and applied extensively.

Country	Field of implementation	Involved stakeholders	Objectives
Australia (Pettit et al., 2018)	Housing and land registration	Property owners, commercial intermediaries such as real estate agents, banks, Property Exchange Australia (PEXA), and the governmental bureaucracies	**Citizen perspective:** centralized storage of all housing-related documents to prevent security breaches, loss of respective data as well as enable efficient and convenient deals within the real estate business, among resolving any occurring disputes. **Government perspective:** centralized record-keeping of all housing and land registry process steps and documents to prevent forgery and manipulation, decrease the volatility and uncertainty of the housing market, increase in efficiency of bureaucratic housing-related processes. **3rd party perspective:** Online advertisement for real estate and mortgage coverage.
Canada (Global Government Forum, 2019; Wolfond, 2017; Verma & Dumka, 2021)	e-Employment	Citizens, businesses, and government-related job services	**Citizen perspective:** unique digital CV for every project-based employee to highlight previous experience, skills, and other qualifications. The purpose is to make the personal track record "permanent, self-owned, and secure". **Business perspective:** centrally created CV to prevent employment fraud, but also to increase efficiency and reduce costs within the hiring process. An individual can be their own lifelong "registrar". **Government perspective:** Prevention of forgery of documents, timestamps, and verifications that governmental administrations are faced with.
Dubai (Khan, Shael &	Business registry and licensing	Dubai Economic Department (DED), license authorities,	**Business perspective:** single point of contact to request trade licenses for a corporate registry. Increase in process transparency, efficiency, and

Majdalawieh, 2019)		and businesses	accountability for respective stakeholders. **Government perspective:** automated, streamlined, and fraud-protected information of all trade license requester with the authentication of all incoming and outgoing transactions.
Estonia (e-Estonia, 2021a; Eisermann, 2014; Schwede, 2016)	e-Cabinet	Estonian government	**Government perspective:** Automation, streamlining, and improvement of all government-related services and decision-making processes to be more transparent, efficient, and decisive towards transparency and traceability among the entire Estonian governmental body.
Estonia (e-Estonia, 2021b; Schwede, 2016)	e-Residency	Estonian government, businesses, and citizens	**Citizen perspective:** Creation of a digital identity that gives every citizen credibility and trust. It enables digital authentication, identification, encryption, and transmission of governmental documents of all kinds. **Government and business perspective:** The main objective is to enhance the service design in the public administrative sector where government and businesses have intersections with the Estonia citizens.
South Korea (Ojo & Adebayo, 2017; Participedia, n.d.; Agbesi & Asante, 2019)	e-Voting	Provincial government, community, and local residences	**Citizen perspective:** The goal is to enable local citizens to co-create, i.e. “citizens are mayors”, the development and future of their community by offering them to propose and vote for local community aid initiatives and policy proposals. **Government perspective:** centralized repository to trace, evaluate and store all votes and election results to ensure trust and transparency within the election process and democracy as well as immutability.

Table 2: Best practices of Blockchain implementations

As it can be concluded, when leveraging the already present knowledge of proven best practices and further analyzing the identified research gaps in academia, the possibilities for sufficient BC conceptualization and deployment within the domain of public administration are enormous.

3. METHODOLOGY

3.1. DESIGN SCIENCE RESEARCH METHODOLOGY

This dissertation follows a design science research (DSR) approach to apply multiple synthetic and analytical methods and perspectives to perform profound research in the area of information systems. By creating an artifact, this approach allows generating knowledge to improve "the current state of practice" as well as to solve existing research problems (Vaishnavi, Kuechler & Petter, 2019; Peffers et al., 2007). Thereby, the artifact can take various output forms, i.e. "design theories, constructs, methods, models, design principles, and technological rules" (Gregor & Hevner, 2013). The artifacts of this dissertation are a framework and guidelines for the implementation of blockchain technology in the area of e-Governance. To create relevant and widely accepted guidelines, the practical or functional knowledge needs to be examined and communicated to both practitioners and scholars (Vaishnavi & Kuechler, 2015; Hevner et al., 2004).

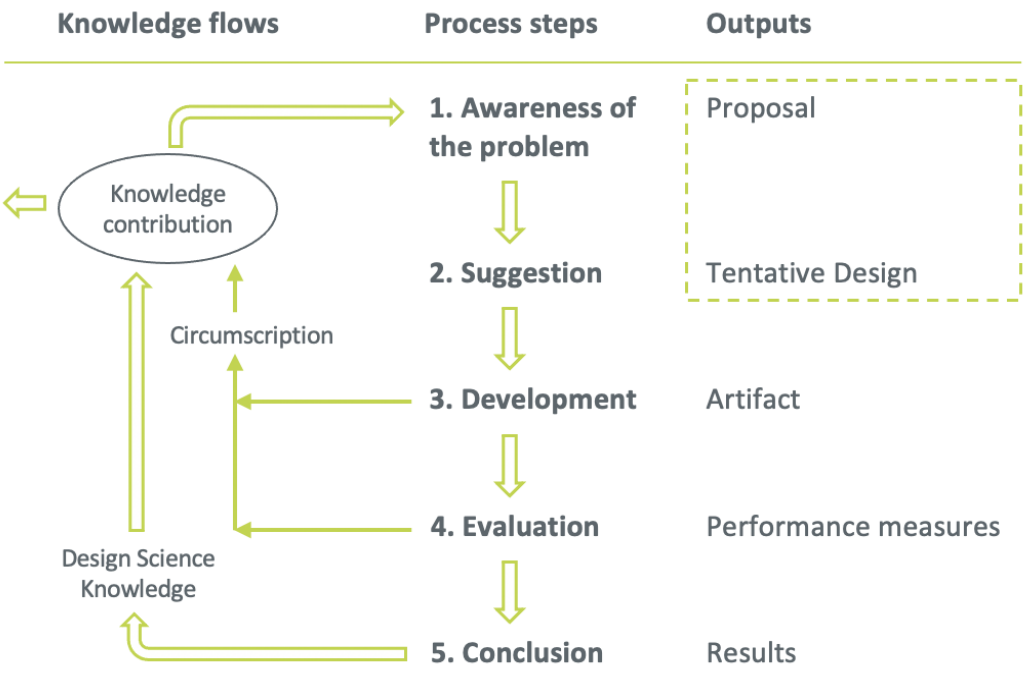

Figure 3: DSR process model

Source: adapted from Vaishnavi & Kuechler, 2004

Using this model allows for a more theoretical representation, has a much broader scope, and is universally applicable to various decision-makers in e-Government. The model consists out of five

process steps, which are outlined in detail below; guided by the recommendations of Vaishnavi & Kuechler (2004) and Hevner et al. (2004):

1. Awareness: The main focus of this phase is to conduct an extended literature review to particularly explain and address the main research problems. As a result of this phase, the existing theories, and findings in science help to develop new relevant research questions.

2. Suggestion: This step of the process involves developing a preliminary draft of a prototype that describes the author's ideas for solving the previously identified problems; allowing the author to pursue this goal more creatively.

3. Development: The main objective of this process step is to further improve and implement the previously proposed preliminary prototype design to create a specific artifact as a result of this process step. The approach in this phase may vary depending on the type of artifact to be created.

4. Evaluation: The main goal of this step of the process is to assess and evaluate the quality of the artifact by using the captured feedback for assistance. Hypothesizing helps determine the behavior of the solution, which entails critical acceptance of this analysis. Together with additional information, the feedback allows the previously proposed solution to be refined, improved, or possibly redesigned.

5. Communication: The main goal of the last step of the process is to communicate the result of the entire research work. The aim is to ensure that the behavior of the proposed research solution is accepted as sufficient and that the knowledge and facts created are repeatedly applied. Moreover, it is of great importance to achieve a high level of contribution.

3.2. RESEARCH STRATEGY

This section details how each process step of the DSR model was implemented and applied to the study context of BCT and the corresponding implementation for e-governance.

1. Awareness: The pursued literature review, composed of both an analytical review of the latest literature in a multitude of scholars and an examination of well-proven and implemented best practices in the industry pinpoints the latest problems, respective root causes, unanswered research questions, and state-of-the-art implementations of BC. This

explains the problem definition and is used as a baseline for the suggestion and development of the conceptual framework.

2. Suggestion: After studying the area of BCT and e-Governance from a scientific point of view and an industry point of view, it can be concluded that missing researches are covering the intersection between political and legislative issues. Moreover, another major finding is the lack of proactive engagement between the government and other stakeholders. Besides that, the already present frameworks and established best practices tend to ignore the essence of society's participation and overlook the focus on socio-political values. Therefore, it is necessary to propose sufficient guidelines that address the main issues and outline a framework for implementing BCT in the overall domain of public administration for e-Governance purposes. This framework illustrates the artifact.

3. Development: The profound guidelines are developed on the grounds of the respective learnings and key takeaways from the previously performed work, which will be described in detail in chapter 4.

4. Evaluation: Since the subject of BC and its underlying technological concept is no common matter, the validation of the artifacts will be performed qualitatively, by carrying out interviews with experts from relevant industries.

5. Communication: After the phase of developing and evaluating the proposed implementation framework and guidelines, the plan is to publish a scientific article in a relevant journal or subsection within a book chapter, whereas the fundamental learnings, limitations, and possible future work are of particular importance. Ultimately, the overall goal is to share those learnings with local administrations to provide possible contributions to innovate the public sector and close the gap between research, industry, and possibly public administration.

When applying the DSR process model, it is important to note that there is typically a continuous sequence between the steps of development and evaluation. Due to the limited time frame for this dissertation, there will be no opportunity to repeat this cycle more than once. For further consideration and possible improvements, this iteration could be carried out more than once to ensure an even more extensive development phase with respective critical evaluation.

4. DEVELOPMENT AND PROPOSAL OF EVIDENCE-BASED PRACTICE GUIDELINES

This chapter presents a framework to design and facilitate the implementation of BC applications in the domain of e-Governance. The first section leverages the knowledge from the previously conducted literature review to define preliminary assumptions on which the model will be based on. The second section proposes a implementation framework, supported by workflows and blueprints. The validation of the artifact is the subject of the third section. Thereby, the validation will be performed qualitatively, i.e. carrying out interviews with experts. In the last section, the proposed guidelines and respective validation will be critically assessed, discussed, and a revised model introduced.

4.1. ASSUMPTIONS

Based on the insights and evidence gained from the extensive literature review on the research gaps in academia, the different domains, and state-of-the-art applications that serve as best practices within the industry, the following assumptions (A) below serve as lessons learned and help to seek the full potential of the proposed implementation guidelines.

A1: The different entities within the domain of public administration foster the innovation process, rather than emphasizing and relying on the present adoption barriers of novel technologies. A2: The governmental entities evaluated their future business needs and can conclude, that BC with its characteristics can positively contribute to fulfilling their plans. A3: The involved stakeholders are aware that building a BC platform with interfaces to internal and external parties increases the exposure to other parties in regards to business strategy and overall processes. A4: Among others, one main objective is supposed to be the inclusion of governments, businesses, and society. In particular, establishing a platform or participation models where the required needs and functionalities for the provided services can be design jointly. A5: The involved stakeholders pursue the approach of co-creation, where the interaction between all stakeholders fosters the intention to create an additional public value. A6: To gain trust and support from society towards the implementation and usage of BC applications, the technological concepts needs to follow data and privacy protection laws strictly and coherently. A7: A predefined skeleton or framework of process steps fosters the engagement of all stakeholders and encourages the implementation of BCT in the sector of public administration.

4.2. FRAMEWORK FOR IMPLEMENTATION

The BC as an emerging technology can be described as very complex. Therefore, every type of BC application has a different set of requirements, also depending on the specific use case. As mentioned in subsection 2.3.1.4 in the discussion of the results of the scientific publication research, it is essential to examine the context and the application area as well as to design the technological concept without including all stakeholders involved. Therefore, the first process step offers the possibility of an initial screening and can at the same time be understood as a filter by setting the constraints for the second and third process steps. The second step of the process is to encourage the user and entities to define and describe the technical and non-technical requirements accordingly. The goal of this phase is to collaboratively develop by focusing on the project and implementation goals as well as user needs and regulatory issues; this implies that all requirements and settings are unique and may differ from the previous ones. The third process step is used to perform development, testing, and final implementation once all policies have been defined and aligned. The phases and processes just described can be summarized in a framework; the figure below shows the first proposal of this framework.

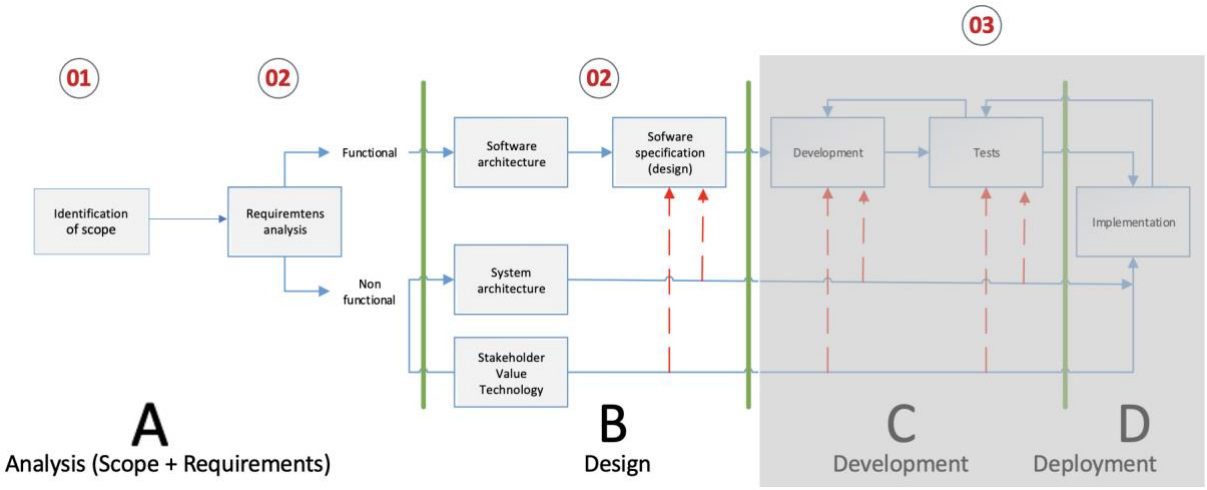

Figure 4: Implementation framework

Source: own illustration

The main goal of this framework is to outline a workflow that describes what steps need to be performed and in what order to successfully implement a BC project in the public administration domain; starting from design and ending with implementation. Before introducing some helpful methods and blueprints to facilitate the collection and structuring of information, it is helpful to

elaborate on the framework presented above. The three steps outlined can be divided into four phases, which can be described as follows:

Phase (A), the requirements analysis, by detailing the technical and non-technical requirements necessary for the deployment. In doing so, the previously collected information on the scope and stakeholders allows narrowing the perspective on e-government services; phase (B), the design by evaluating and identifying the software architecture and its specifications, the system architecture, as well as the intersections between all stakeholders and the necessary public value to be considered in the design of the application programming interface.

When facing the design, a decision about the BC architecture type has to be made. In general, there any numerous BC architectures to choose from, depending on the characteristics and key features of the use case. Overall, the variables that influence this selection can be categorized into the following two dimensions: first, the ownership of the data infrastructure, and second, the permissions granted for the participants. Further, variables like the degree of scalability, type of stakeholders, importance of security, and network openness influence that evaluation indirectly on a certain sublevel (Carson et al., 2018). However, further analysis on which BC architecture is most suitable and respective mapping between the requirements of the use case and key features is not within the scope of this work. Phase (C), development through the execution of the first implementation of the previously designed technological concept and continuous testing. And finally phase (D), deployment through the execution of the final implementation. However, these two last steps are not within the foremost scope of this analysis and therefore, are not outlined any further. As this process step represents a sequence, it is essential to adhere precisely to the order of these phases. The results and findings of each phase serve as the basis for those of the subsequent ones. Furthermore, it is evident from the figure above that there are certain dependencies on other process steps, marked as red arrows, especially in phases B, C, and D. These not only influence the results but are also indispensable to continue throughout the framework.

The below-proposed methodologies and frameworks are intended to serve as a blueprint with the goal to help the project owner, respective participants, and all other entities to collect and streamline all relevant requirements for a successful BC implementation.

4.2.1. Identification and validation of scope

Based on the current literature review and a comprehensive assessment of industry best practices, several BC applications provide tremendous value, assuming they are properly

implemented. Therefore, the main objective of this process step is to evaluate the context and scope for which the BCT will be implemented. It is necessary to define not only the use case itself but also the particular e-governance domain in which the BCT will be implemented. The following table serves as a blueprint to map both.

		e-Governance areas				
		Government-to-Citizen	Government-to-Business		Government-to-Government	
		All citizens	Commercial	NGO	Central	Local
Blockchain Applications	e-Voting	x			x	x
	e-Cabinet				x	
	e-Residency	x				
	e-Employment	x	x	x		
	e-Authentification	x	x	x	x	x
	e-Registery	x	x	x		
	e-Licensing	x	x			

Table 3: Blockchain applications and e-Governance areas

To identify the scope and validate the intended deployment scenario, all relevant stakeholders, including their synergies, need to be identified and the common data, process, and communication flows need to be streamlined. Additionally, for achieving a high acceptance rate and level of trust, General Data Protection Regulation (GDPR) rules need to be cross-checked and defined accordingly with all corresponding application programming interfaces. The following figure below illustrates the suggested workflow diagram.

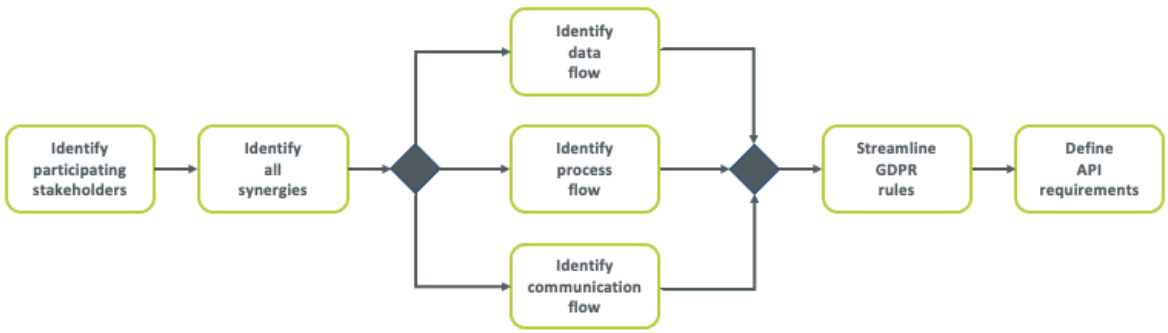

Figure 5: Workflow diagram 1

Source: own illustration

The first step is to identify all relevant stakeholders, including the public administration internally, but also externally. In addition, the respective synergies between the aforementioned stakeholders must be outlined to create a profound basis for the design of the technical and non-technical requirements. This also includes an analysis of the associated public value and the characteristics that the overall BC concept must have. By including the proposed table below, all stakeholders, specified by type, area, and concrete name, shall be listed to simplify the identification of synergies.

#	Type of stakeholder	Area of stakeholder	Name/ Description of stakeholder
1	Internal	G2G Local	Residential registration office for new citizens
2	External	Business	Tax and income reporting of employees
3	Internal	G2G Central	National tax authority
...			

Table 4: Identification participating stakeholders

For the further procedure, the listed stakeholders can then be referenced and assigned within the respective quantile of the matrix below, which describes whether the stakeholders have synergies in common or not. Likewise, this is the starting point for the following description of the process, data, compliance, and communication flow.

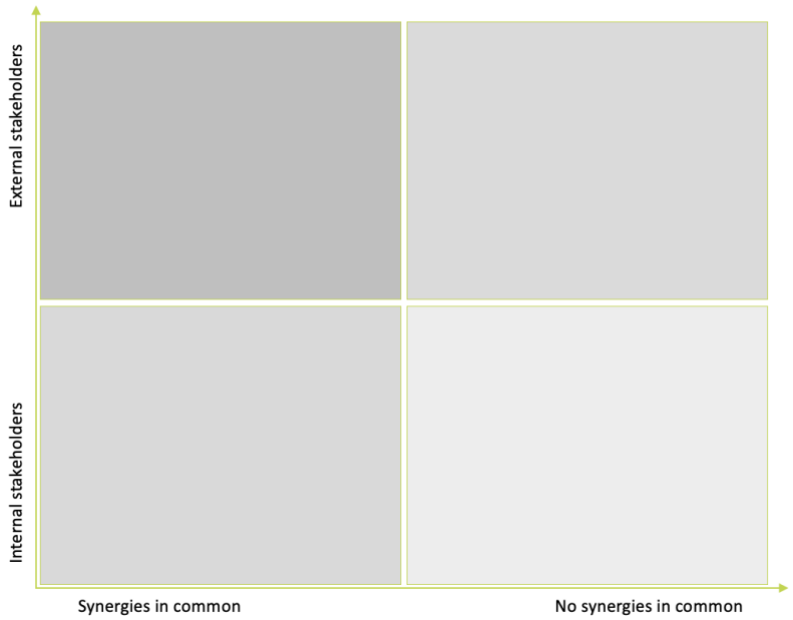

Figure 6: Identification of synergies for stakeholders

Source: own illustration

Having a myriad of stakeholders with various interfaces only makes the alignment with respective processes, data, compliance, and communication flows more complex. Therefore, being able to include all stakeholders and to achieve a holistic network effect, rather than just a linear one, across the whole BC project showcases a true disruption and additional value. Hence, this step is indispensable when defining the requirements for the pipelines. The figure below proposes a blueprint that intends to help to identify the different streams as well as their important requirements, common characteristics, and existing dependencies. Also, this is supposed to increase the awareness of the necessary GDPR and related privacy issues of the outlined flows.

Figure 7: Identification of workstreams

Source: own illustration

On this basis, the application programming interface needs to be further outlined, whereby the different needs and technical requirements from all stakeholders need to be not only coherent and compliant but also supportive for internal and external interactions.

4.2.2. Definition and description of requirements

The main goal of this process step is to identify and describe the technical requirements towards the BCT in the context of the selected e-Governance area and BC application. In addition, all the values and standards that the implementation aims to achieve should be enumerated. Specifically, values such as the right to co-design, user experience, degree of transparency, reliability,

security. Since not all requirements can usually be met with one technological concept and thus there is a trade-off between them, it is all the more important to be aware of this at an early stage. However, this also concerns the integration of the necessary skills and requirements of the employees who regularly work with the new technology. This is often not taken into account, which can result in a general resistance among employees accepting new technologies. On the one hand, this has an impact on the perception of inclusion, but on the other hand, it also affects employee motivation. The necessary steps outlined above can be derived from the analysis carried out in subchapter 2.3.1.4 and transferred to the following workflow diagram.

Figure 8: Workflow diagram 2

Source: own illustration

When implementing and introducing state-of-the-art and innovative technologies such as BC, it is imperative to unite the technology, in this case, the concept behind it, with the people. This not only creates transparency and thus trust, but also offers the opportunity to eliminate all prejudices of these technologies and possible concerns about ethical and data-fair handling the citizens but also other businesses and governmental entities have. The figure below combines this approach, contrasts the importance of these three aspects, and shows how the previously applied frameworks should be set deliberately in the right context.

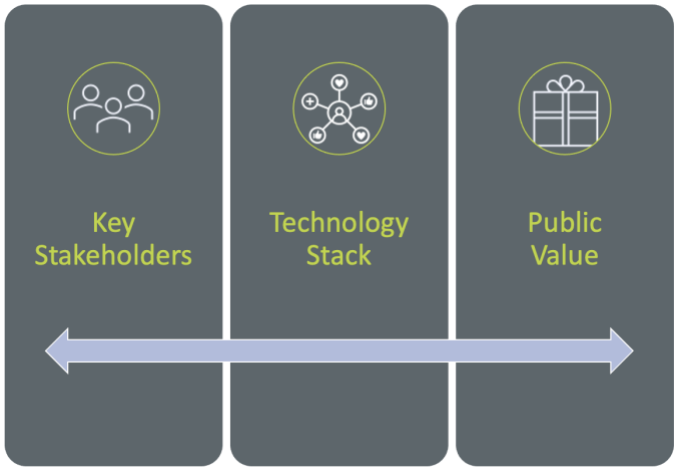

Figure 9: Stakeholder-Technology-Value relationship

Source: own illustration

The literature research conducted in chapter 2 focused on the scholars published, describing the BCT and its potential from a scientific point of view. Furthermore, this research also strongly addresses existing and established applications that already achieve noticeable scale and network effects. Therefore, the goal is to leverage this knowledge for designing an implementation concept. The following table lists the proven BC applications and their complexity, transaction speed, and the number of users in terms of potential usage.

Name of BC application	Complexity	Transaction speed	Amount of participants	Key features and characteristics
			Few Many	
e-Voting	●●○	Medium	■■□	
e-Cabinet	●○○	Low	■□□	
e-Residency	●●●	High	■■■	
e-Licensing	●●○	High	■■□	
e-Registry	●●●	High	■■■	
e-Employment	●○○	Low	■■□	
e-Authentication	●●●	High	■■■	

Table 5: Definition key characteristics of Blockchain application

For each of the BC applications listed, the complexity is indicated first. It is important to understand that this is the general complexity in terms of feasibility, the necessary speed of data transfer, data integrity, level of security, number of users on the platform in absolute or simultaneous terms. The possible speed of data transfer and the associated application and scaling options are also of enormous importance and influence other properties. Another aspect is the number of participants associated with the respective BC application. Whereas in the fewest cases there is a large sum of users participating simultaneously in the BC network, in others there are significantly more due to the economies of scale. However, before selecting the appropriate BCT, it is important to note the associated requirements for the planned use of the technology. For this purpose, the last column of

this blueprint above can be used. For instance, the following notes can be taken: Usage among governmental parties to foster efficiency, trust, and transparency as well as traceability within the decision-making processes. The BC is used within a predefined scope. Since the application of this BC is more specific than in wider use, the number of participants is very volatile, however, rather low.

4.3. VALIDATION

The interviews conducted with beforehand mentioned experts serve the purpose of validation of the earlier suggested implementation framework. This qualitative methodology is intended to fill the research gaps on this topic, which scientific research has not been able to address yet due to the topicality of the subject. Given the fact that the approaches are still in an early stage of development, there is some ambiguity in the literature regarding profound guidelines that can be applied for the implementation of BCT in the field of public administration; signaled by a paucity of publications to this point of writing.

Concerning the structure of a qualitative expert interview, an interview guide was developed that represents the central data collection tool for qualitative interviews. During the interview process, the interview guide is intended to provide structure and help to analytically evaluate the expert knowledge gained. Of particular importance are the interviewer's neutrality and openness to new insights, information, and evaluations. In this way, a limitation of the knowledge gained from expert interviews can be avoided. In terms of formulating the interview questions, different types of questions were used to generate diverse types and facets of information and to promote maximum knowledge gain (Kaiser, 2014). The earlier proposed model was intentionally designed on a rather holistic level, so the interviewees are not biased on their opinion. Additionally, it does not limit the interviewee's thoughts right from the beginning. The composition of experts is given by participants from the public, academic, and industry sectors. The experts draw their knowledge from their practical experience in the fields of blockchain, data mining, deep tech, digital transformation, and innovation. Furthermore, the interviewed experts are either working in corporates, start-ups, consultancies, or have a university professorship. The following table showcases the interviewed experts and a brief description of their area of expertise.

#	Field of employment	Are of expertise	Domain
E1	Doctoral Candidate & Research Associate in Blockchain	Professorship @ EBS Business School	Academics
E2	Startup, Deep-Tech	Expert @ IBM Blockchain Garage	Industry
E3	Assistant Professor of Information Systems with focus on Blockchain	Professorship @ IT University of Copenhagen	Academics
E4	Startup, Digital Corporate Enterprise	IT Consultant @ Diconium	Industry
E5	Invited Assistant & Researcher @ Nova IMS with focus on urban/ public projects	Advanced Software Engineer @ Diconium	Industry

Table 6: Participants expert interview

The interviews were conducted with each listed expert individually. All agreed on being recorded with the goal to list the transcription of each interview in the annex section. The interviews were conducted between March and April 2021.

4.4. Discussion

All experts, E1 to E5, believe that the proposed framework is useful when implementing BCT in the domain of e-Governance, pointing out that they have not discovered any existing framework focusing on business and public value yet. Also, all interviewed experts agree that this proposed framework is helpful and relevant for the implementation of blockchain projects.

Apart from the encouragement that this model has received, the interviewed experts have shared important suggestions for improvement that can additionally strengthen the framework in its current form. Likewise, thought processes were discussed that provide good input for the revision of the model.

Expert 1 emphasizes that it is more important than ever not to use BC for a given project simply for the purpose to use a novel technology (E1). Since the success of a project is evaluated by the benefits it creates, it only makes sense to evaluate the project, its specific use case, and requirements beforehand and decide afterward if BCT is the technology stack to use. This might be even more important in the sector of public administration, where the willingness and the motivation to change, along with its acceptance and money is cut short (E1, E3). Expert E2 agrees by outlining the necessity to first look at the business perspective, how the entire network of stakeholders is set up, how they engage with each other, and how the information and transaction flows are set up (E2). Regarding the design and sequence of the single steps within the proposed framework, E2 and E4 both agree on

the sequence and separation in functional and non-functional requirements, where the technical and business needs will be identified. Despite that the top-down approach is relevant for creating the additional public value, both suggested altering the sequence, by first performing an analysis of the non-functional requirements, which influence on a later stage the functional requirements for the suitable technological setup (E2, E4). E3 agrees on that and questions whether there should be a weighting between the functional or the non-functional requirements in order to avoid any disbalance, which is very crucial within the context of e-Government (E3). E5 expresses his opinion about the significance and the interplay between the stakeholders, the public values, and the system itself, as well as the technology with all necessary technological characteristics. Thereby, E5 challenges the current design of the holistic framework by expressing the missing specific elements from a governmental or blockchain point of view (E5). E4 supports this argument and emphasizes the essence of data regulation and trust, which cannot be altered or adapted at a later stage within the development cycle (E4).

When talking about areas for improvement towards the proposed framework, all participating experts suggest minor improvements that might enhance the framework to an even greater use of application. In particular, the experts E1 and E2 propose to focus even more on the regulations related to BC, covering data management, data privacy, data transaction, and ownership of the data. E2 underlines this argument by exemplifying the complexity and relevancy of regulatory frameworks (E1, E2). Since the data regulations vary from country to country and are essential for the success of a blockchain project or whether it simply stays as a demo version, they also decide on whether that technology and hence the government can be trusted (E2, E3, E4). Therefore, expert E4 proposes to introduce an adequate management technique right in the beginning, where regulatory concerns are constantly monitored and driven by a dedicated team that never leaves the project team as one possibility to lessen this concern. This includes a phase where constant prototyping is done, to constantly evaluate and re-engineer the design to reduce any additional development cycles. The fact that this has to be addressed right from the beginning of the project, showcases expert 4 by providing the simple example that every user has the right of erasure of its own data, according to the GDPR (E4).

Other challenging thoughts from the experts E1, E3, and E5 address the entire phase before initially starting a BCT project. They emphasize the question of whether a governmental institution fulfills the requirements to introduce BCT to their entities; i.e. IT infrastructure, technology stack, skills of employees (E1, E3, E5). Hereby, expert E3 also refers to entirely different motivations a public organization has. While private enterprises are revenue-driven and aiming to drive innovation, the mindset within the governmental sector is more about the stability and reliability of services that

citizens can use (E3). Likewise, the question arises whether not only the involved governmental entities fulfill the required state of digitization, but also the citizens themselves. Expert 4 addresses the need for a user-friendly experience. E4 argues that citizens should not be confronted with the additional burden of having to deal with the complexity and usefulness of their services offered by the local or public administration (E4).

While all experts find it useful that the framework follows a top-down rationality and is overall fairly generic, some of them suggest a higher granularity when speaking of the subprocesses. Both experts E3 and E5 argue that this is in particular important when discussing specific requirements with the business and tech teams or even with customers and partners (E3, E5). In addition, the experts E2 and E4 suggest implementing more iterations within each development phase to leverage even more the benefits from the combination of classical and agile IT project development models (E2, E4).

4.5. REVISED FRAMEWORK FOR IMPLEMENTATION

The foundation for the revised model is provided by the previously conducted expert interviews. Due to a heterogeneous composition of the interviewees and the rather generic first version of the model, a large number of diverse points of criticism could be obtained. Despite the differences in expertise, the constructive discussion above resulted in subsequent improvements being made within the originally proposed framework.

In the first step, the order of the previously presented functional and non-functional requirements was changed, along with the level of detail. The change responds to the criticism of the experts and addresses the importance of the business requirements and their influence on the technical settings and infrastructure. Furthermore, adjustments were made regarding the importance of the GDPR matter. A further sub-process was presented, which deals in particular with questions relating to data management, data ownership, a contingency plan for data breach for instance. Lastly, a further validation sequence was introduced to cope with increasing complexity and quality challenges.

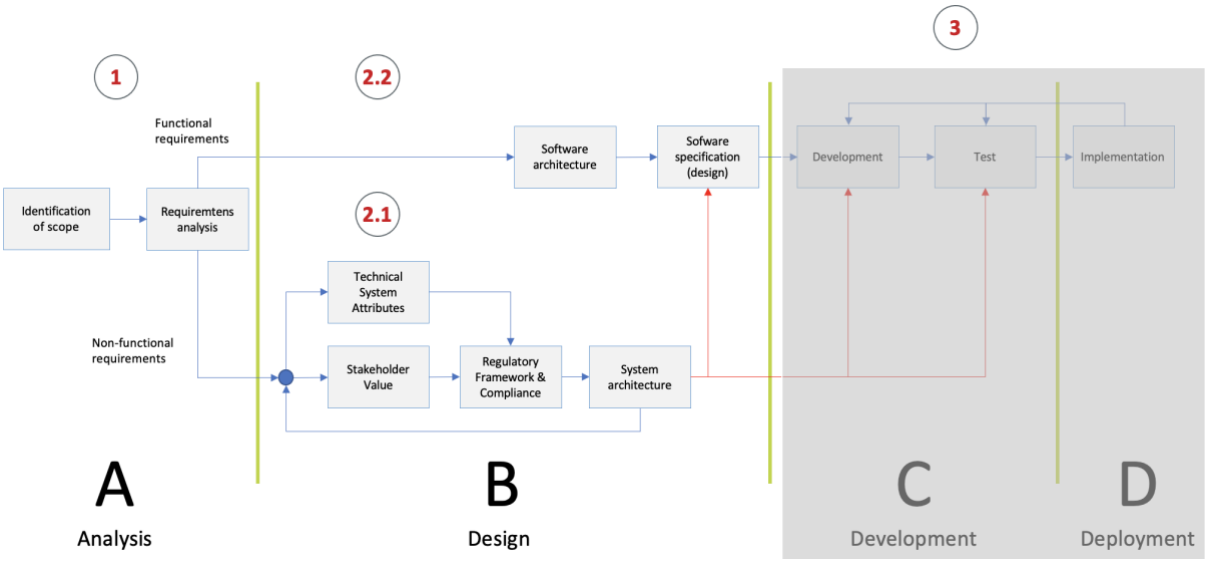

Figure 10: Revised implementation framework

Source: own illustration

The criticisms of addressing the fields of BC and e-Governance more in-depth were included in sections 4.2.1 and 4.2.2. Thereby, the proposed frameworks for additional guidance shall help to gather all relevant information from a business and technical point of view to reconcile its selected use case to the implementation framework.

5. CONCLUSION

After an extensive analysis of both existing literature and current best practices in the industry, the initial hypothesis that BC is an promising technology for the public sector was confirmed. The numerous best practices show that the concept is not too novel and innovative for the public sector. Although the underlying technical concept is rather complex and requires a lot of know-how from a technical, business, and data compliance perspective, countries such as Estonia, China, Switzerland, Dubai, and the USA have proven the additional benefits that e-government can add to society.

The findings of the SLR have shown that for the implementation of BCT in e-Governance a holistic framework is necessary that maps the scope of application, all requirements from a technical and non-technical perspective, all stakeholders as well as relevant compliance processes. Furthermore, the framework must represent a joint ecosystem for collaboration in order to ensure the participation of society and the associated additional public values.

The framework and associated blueprints developed based on the SLR have been well received by experts and considered to be useful. Through the validation of a quantitative approach, the framework was challenged, critical feedback was expressed, and marginal suggestions for improvements were given. Finally, a revised framework was created.

5.1. SYNTHESIS OF THE RESEARCH

The approach of this dissertation was structured and followed the subsequent procedure: In the first step, a literature review was conducted on the most recent scientific publications to show the relevance of blockchain technology and its use in the public sector. Based on these initial findings, a systematic literature review was conducted in the consecutive step. Not only relevant academic publications but also recent best practices from the industry were analyzed and evaluated. The resulting state of knowledge provides the basis for establishing the framework proposed for implementing BCT in the public sector. The validation of the model was carried out on a qualitative method by conducting expert interviews. The group was composed of heterogeneous experts from the industry, public sector, and academic backgrounds. Critical feedback and suggestions for improvements were used to improve and enhance the initial framework presented. By stringently following this method, the intermediate objectives defined at the beginning were achieved. The desired artifact of deriving a framework with guidelines for the implementation of BCT in the public sector has also been created.

5.2. RESEARCH LIMITATIONS

One limitation that this research faced was that there is little documentation and research, including papers, journals, conference proceedings, or sufficient best practices around the concepts for the implementation of BCT. Not only that there are few or no tangible guidelines to be found, but also no blueprints or potential methodological frameworks that can be applied to develop individual guidelines to provide guidance for the implementation. Another limitation in this research work is the reduced focus on the proposed implementation framework. Here, the focus is on the analysis of the scope and requirements as well as the design from a non-functional, i.e. business and functional, and technical point of view. Both the development (phase C) of the previously designed technological concept and testing (phase D) were thus not further addressed. The limited research to the topic of data privacy, data ownership, and security within this work represents a further limitation. Due to its topicality and importance, this topic has a noticeably high priority in all digital business models and technologies. Unfortunately, due to the complexity of this topic, it can only be dealt with to a limited extent. Another limitation is noticeable in the process of validation. Due to the time restriction, it is not possible to re-validate the revised model, which has been improved with additional feedback from expert interviews. Hence, the DSR approach was applied, but not fully exploited.

5.3. FUTURE WORK

In this context, future research in the domain of this dissertation can focus on a possible framework for the adequate application of compliance and GDPR concerning BCT. The necessary measurements, in turn, are closely linked to society's demands in terms of digitization, technology, and government: meeting and maintaining data security, which determines society's trust in its government. In addition, further research can analyze the extent to which a common platform or ecosystem can help to intensify the collaboration between the government, society, and businesses and contribute to an increase in trust and capabilities of the government. Not least, further research is needed on the extent to which the digital services offered by the government add value through the use of BCT and, at the same time, increase trust in the public sector.

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ANNEXES

Conducted expert interviews:

Interviewee: Expert 1, Date: 10.03.2021

Q1: Do you consider the proposed framework as useful and why? If not, why do you believe it is not?

I would say the framework is useful because in the area of public administration, the public sector, or the governmental sector, the blockchain use cases are rarely examined and the existing frameworks there are not that specific enough on the focus of business value or the actual process of implementation. Nevertheless, I would say that this might be helpful, especially the first section, section A with a large focus on the scope and the identification of value. And because what I've experienced in my practical research and the scientific research was that oftentimes, people try to enforce specific use cases and try to implement them onto other specific areas, even though they might not be that useful in that specific context. So, I would say, an important step is to examine the usability and the value creation, across blockchain use cases, because several steps might lead to public problems. For example, if you do not have a data pool, that is where the data is required for several entities, you might find it even difficult to defend the case in the first instance because what I've experienced is that in many cases, a simple relational database or even spreadsheets might be sufficient. So it might be helpful to look at the number of entities that are involved in the use case. And to look at specific data characteristics or things that are important for you, for instance, do you need immutability? Do you need data security? Do you need to change data after you're done with blockchain, and if you have problems in those areas, you might find it difficult to justify the costs and the value that is created for the blockchain and your use case? So to sum it up, I think the justification of the use cases is a very essential central step, especially in the public sector where usually money is short time is fraught, and let's say working motivation.

Q2: Do you have any criticism of the proposed framework? Please explain.

Well, I would point out the aspect of the legal requirements. This analysis is also important to look at the capability of the specific institution where you want to implement the production system. In many cases, I have experienced that for instance the readiness and order of the entire digitization. Implementing a blockchain would be the second step of the digitization process, whereas many companies still haven't completed the first step, which is the general digitization of data. Respectively ask yourself the question, how do you want to implement the blockchain if your work or

your data management system is even paper-based. Let me give you an example: Let’s have a look at the manufacturing or supply chain industry, where my team and I are currently trying to implement a blockchain solution. You can expect your institutions or companies to have specific blockchain knowledge and deal with it in a way that would be expected from traditional IT companies and their implementation of several systems.

So another legal thing that just came to my mind was the privacy issues with the data. Something which you almost always have to consider when you proceed with a blockchain project is that you always have the core part with the data management and data transaction management. And usually, in most cases, data ownership questions arise and due to the fact that this is still not well regulated. I am not sure how this is in particular handled in other countries, but for instance, in Germany, you have to contact a legal firm, they set up a contract where they define the data ownership, privacy regulations, and its handling. And then you can execute it on the blockchain. But by just designing a blockchain per se, you cannot define the data ownership and the data safety aspects.

Well, maybe regarding the design process, what we are currently doing and which is what's working quite well as kind of an iterative process, so that you do not only use your requirements to build up the design principles for the software architecture but that you initiate the first set of architecture design principles, present them to your stakeholders that then evaluate those and kind of like in an iterative structure, you take those the fit, you take the feedback and try to improve your design of the framework with this. And yeah, this of course, is not blockchain specific, but in general, designing of IT systems. But I think especially in a blockchain use case, this would be helpful to also enhance the knowledge with your stakeholders. Because they're often they either don't have a clue about blockchain or they're confused with Bitcoin and cryptocurrencies, which is one of the first things you have to get out of your head.

Q3: Would you consider implementing the proposed framework? Please clarify why/ why not.

Yes, sure! I think it's a helpful framework and I would use it, especially if I was a public institution. First of all, because it's top-down. It's very generic, I would say. it's applicable for different kinds of use cases. Maybe it would be helpful to kind of play it through two or three different specific use cases in order to see how it will actually work out. In general, with the additional comments that I've mentioned beforehand, I think it's a good framework.

Q4: Do you have any recommendations or suggestions for further improvements to the proposed framework?

One thing that just came to my mind was the legal aspect of blockchain. This is something that you actually almost always have to consider when you proceed with a blockchain project because in a blockchain use case the core part is always the data management of the data transaction management. And in most usually most cases data ownership questions arise and due to the fact that this still not regulators, I'm not sure how it is in the protocol but in Germany, it's not and what you have to do in Germany is that you have to contact a legal firm, they set up a contract where they define the data ownership, management. And then you can execute it on the blockchain but by designing up on a blockchain per se, you cannot define the data ownership and the data safety aspects as well. So, besides the technological roundtables inside the legal side, which is the Centre for the important pillar.

Apart from that, I cannot give any further ones except the basic stresses that I have suggested prior. And maybe it would be helpful to kind of discuss it with someone from a deeper regulation perspective because that's something that I have not done.

Interviewee: Expert 2, Date: 12.03.2021

Q1: Do you consider the proposed framework as useful and why? If not, why do you believe it is not?

Regarding the framework above, I do believe it's very useful. I really like the split between functional and non-functional requirements, as it splits the process into two parts because when you analyze how you implement blockchain, you always have to have a top-down approach. Especially in the second part, where you analyze what is the business network. So basically what are the participants, and what are the transactions between the participants. Where is the trust of the transaction relevant and who owns the information, who wants the assets, and how are assets and information transmitted to the network. And what are the trust relationships, and where, and not at least, there might be a single point of failures.

When you are implementing blockchain you always have to first look at the business perspective, and how the network is set up, how the participants will exchange information, and how the transactions are going to happen. And afterward, you can analyze the software architecture and the technical aspects, for instance, if you need a permissioned or a non-permissioned network, or if you need a by default tolerant algorithm for consensus, or proof of work algorithm for consensus, or any

other kind of ledger. So the first step is always the business perspective, and on the same path to always look how you can fulfill those business needs with the technical requirements. So to sum it up, I do believe the split between the functional and non-functional path, in the same way, is very important, and that it has an impact and the non-functional path has a high impact on the development process and iterations.

Q2: Do you have any criticism of the proposed framework? Please explain.

One minor criticism I could have on the framework is that the displayed process is a bit too general, so I would really break it down a bit more. For instance, the requirement analysis into the concrete requirements of the blockchain or blockchain network. So, for instance, you could separate it into participants' assets, information transactions, participants information, and transactions. So the assets as information are also information about assets.

Another minor improvement could be in the software development process. There you could also describe a concrete framework. So, if for instance, the participants know each other, you could describe a path for a permissioned ledger blockchain or if they don't know each other for a permissioned blockchain or public and private blockchain. And then you could have some kind of framework where you go through the critical paths. And in the end, you find the perfect solution for the business case.

Another point I would like to add is in the requirements analysis. So, first, you have the business requirements. And another thing, are the constraints of the technology and the constraints of the regulatory framework in this specific country. For instance, blockchain is always related to regulatory frameworks, and therefore also to technical constraints. The system also has, like, transaction throughput, or specific single points of failure, which are caused by bottlenecks, which are caused by the technical requirements of the system. So this is also an important aspect.

Q3: Would you consider implementing the proposed framework? Please clarify why/ why not.

I would definitely consider implementing the outlined proposed processes for the development of a blockchain solution for a specific business need. And I would extend it, as said, with the mentioned dimensions and additional aspects. One of the main showstoppers from my experience from previous projects is always the regulatory framework. Many blockchain projects remain only as use cases or demos, because of the regulatory framework in the respective country. Indications of

mistrust, or if the network has no proof of security, or something is going wrong in the transactions. Hereby comes the question: what are the regulatory acceptance of the information stored in the blockchain network.

The goal needs to be to have regulations and requirements implementation into the process so that at the end you have a solution, which is not only technically feasible but also accepted by the regulatory framework of the respective country.

Q4: Do you have any recommendations or suggestions for further improvements to the proposed framework?

Honestly, overall I really like the holistic model with the outlined subprocesses and issues with have discussed previously. I would definitely agree with the approach to split it into these two paths, and that the second path, the non-functional path has a very high impact on the development iterations of the technical system. Maybe something to keep in mind is the related transaction costs. So, the costs of the implementation of a blockchain network. Then you have to calculate them against the transaction costs that are occurring when there's a legal disagreement.

Just to add something, maybe you might know it already, but there is a good example of the notary services available here in Germany. You have to go there in person and you need to go to the notary and the lawyers, who have a special certification to tell you that the document is verified. This is something you theoretically could do exactly in a blockchain. You could write a document and you can start it in a ledger. And technically you have a unique document, which is probably signed by everyone and everyone agrees on that and the blockchain proves that everyone agrees on that. But the regulatory framework still says that you need the person who has testified, the lawyer itself, the notary with special certification the notary who testifies that this is a valid document. So, this is one example of the legal framework and shows that certain solutions, if they are very practical, are technically not feasible at the moment.

<u>Interviewee: Expert 3, Date: 19.03.2021</u>

Q1: Do you consider the proposed framework as useful and why? If not, why do you believe it is not?

Yes, it is. It seems to be quite useful. In general, what I'm asking myself is in particular about the functional and non-functional aspects. In regards to the successful implementation, do they have the

same weight, or is there a disbalance that either the functional or the non-functional elements might play a bigger role in the respective context of e-Government? Because usually, or it's like in general with any kind of implementation or adoption, the purpose or the success is determined by the benefits. So basically, what benefits can the organization, or the government actually, in the end, expect. For me, two interesting aspects within the governmental sector are: are the motivation itself, so what is the initial motivation to change the entire processes. And second, all the change-related aspects themselves. So let's just play this through: we want to implement this blockchain project. The first question would be why. Maybe to win some new stakeholders, we are willing to develop and implement it. To my knowledge, this is always driven by these non-functional aspects you have outlined and explained. So to come back to these questions: how can we implemented, how can we motivate such a project. And by answering those questions, especially in the EU government concepts, the non-functional aspects play a big role. Whereas, the technical aspects are just like options, and then later supporters for what kind of actual tasks we want to solve with the technology. It would be interesting to see, how these two dimensions, resulting in the implementation in the end.

So what could be added additionally, is maybe that some more iterations. I know you have explained it to me, but I would maybe add it here on the outlined framework as well.

Q2: Do you have any criticism of the proposed framework? Please explain.

No, I don't really have any criticism of your framework. But what I would intensively reflect on this the stakeholder question, because this is, especially in the government sector, a very relevant question so this is where the e-government sector is highly different from industries or private organizations. Because the motivation in the organization is different. The e-governmental sector is about stability, and it's not about revenue. This is the main difference. And this changes how the stakeholders in these organizations are motivated, open, or less open to change. So they're risk-averse because the risk is always destabilizing governmental institutions from the outside are measured by reliability and stability. And especially in implementation.

So another question here would be, if this framework is more about how to run a project that was already accepted, or is it like that, winning over stakeholders to agree for such a project so it's like right so this is, this is quite relevant, and then like how to frame it. I think because this is really what counts in their regard. The private companies are more interested in innovation and being like early adopters and to gain competitive advantage. But this is different from the governmental sector, so

maybe it’s worth stressing and emphasizing that stability and security aspect that will lead to higher willingness to think about those blockchain implementation projects.

Q3: Would you consider implementing the proposed framework? Please clarify why/ why not.

Yes, I definitely would use it, since it is very generic and describes the main process steps that are fundamental for implementing such a project. However, I would have loved to see a little more detailed processes, maybe the subprocesses or dimensions within the single phases along with the respective requirements for this e-governance industry. I think like in terms of discussing the framework with potential customers or partners, it's relevant to think about this framework and then have in addition a more detailed description as well. Because if it's a specialized framework for the government sector, then we should see it in the first sketch already. Maybe elements addressing security, trust, stability, decentralization aspects. Just think about it.

One question I would ask myself, is whether this framework works for any of those stakeholders or target groups? I think it's different if we're more like in a b2b procurement sector or inter-organizational world, or are we thinking about interaction with citizens. In one are more people to be integrated. Further, if we talk about citizens, it is always the question if they can access the technology and how far is the degree of digitization on the citizen's side. Especially for citizens, it is important to reduce the complexity of the technology so citizens should not be challenged with technical aspects at all. So the easier the better, whereas from b2b partners, or other organizations or institutions, there I can expect a little more involvement and engagement on them.

Q4: Do you have any recommendations or suggestions for further improvements to the proposed framework?

As I already said, I like the holistic idea of your framework and the different phases or streams you are addressing within those. However, being a little bit more precise and maybe more e-governance specific is something that I personally miss a little bit. Eventually in particular in the non-functional part. Pinpointing a little bit more the requirements for government and its relevant stakeholders, but also the employees. So to understand the non-functional part but then align and connect these. Because the aspects and actual use are the motivation for them. Maybe it might be even relevant, but this is just a quick thought of mine, to address the aspects of the technology support towards the

non-functional requirements. So how is it connected, where can blockchain technology, in general, support the required specific requirements in the governmental sector and the general structure.

Another thing here: it might be interesting to adjust the sequence actually a little bit and maybe start with the non-functional requirements, and maybe continue with the functional requirements afterward and then try to locate and map it.

Interviewee: Expert 4, Date: 22.03.2021

Q1: Do you consider the proposed framework as useful and why? If not, why do you believe it is not?

In general, I really like the framework. It's very similar to what we use in software projects to develop and implement software. It's kind of interesting to see that you tear down a traditional way of implementing software, and combining it with an agile approach. In the end, you have, the more agile and iterative way of the actual development in the C part. And within the part, you do have a more traditional way of making excellent requirements.

I like the idea of starting actually before step number one, before the iterative design. It is good that you holistically collect some requirements, because, especially for blockchain projects, the regulation is an important part. And you should consider that from the beginning and not figure it out later during development, where requirements regarding governance and regulation can be adopted and altered less easily.

Q2: Do you have any criticism of the proposed framework? Please explain.

As I already mentioned, I like the process. Maybe you should add someone iterations. Like, right now there is one forward direction from phase A to B to C to D, but maybe you have to reconsider adding some loops in between these phases as well. Since you are already kind of using an agile approach.

From previous experience, it makes sense to evaluate the selected stack of technology in an early stage. For one, to evaluate all possibilities and changes coming up when the business case changes as well, for instance leveraging the zero-knowledge proof.

Q3: Would you consider implementing the proposed framework? Please clarify why/ why not.

I would use this framework for the implementation. But I would also consider expanding it to some extent. When thinking about the implementation process itself, I am questioning myself, whether you have actually come up with some thoughts on which teams and staff members are going to implement respective blockchain projects. So for instance would it be one team working continuously on the project, or would there be a handover between different phases like A, B, C, and D from different teams. Like you have a requirements engineering team, and then you hand over to a software design team or software architect team and then you hand over to a development team. Or is this one big team, but where only one person talks to stakeholders for security, one person for architecture, etc.

My opinion is, that it would be great to have at least some key persons in the project who will always stay in a project. So for example, you need someone from the development team, which gives input to the requirements team because they might not know the specifics of the technology and especially within Blockchain, it can be very, very specific, and hard knowledge like cryptography and security, and distributed systems, how will the system scale, how many users will they have in the system, is there a separation between the back end and the blockchain itself. In addition, should there be someone who is there for the regulation aspect itself? So someone who is constantly in touch with the governance, because when it comes to regulations, all the small details matter a lot and have a huge impact on whether the project may fail or succeed.

There, I have worked on some use cases where the topic of regulation was kind of vivid. Here, I can give you an interesting insight into that. I always find it difficult to align blockchain with the GDPR. For example, let's take the rule with the right erasure of your data. To solve this on a blockchain is quite complex, which you need to ideally think about right in the beginning.

If you use validated products like the cloud, you have already some details outlined by the provider itself. For example, if you choose AWS or Azure or any other cloud provider, they give you a guarantee that they follow certain regulations like GDPR, military law, or others. On the blockchain, since it is very novel and very complex, you would be among the first ones to figure that out on your own, obviously depending on the use case and area of application.

Q4: Do you have any recommendations or suggestions for further improvements to the proposed framework?

One thing that comes to my mind would be to have a prototyping part in your framework included as well, which basically helps to do a broad assessment of all requirements you need. Then you can

start easily with a prototyping loop for validation purposes since the entire design process takes up some time. You can use the time to simultaneously gather information about the technical implementation of the project, frameworks, and everything else that comes with that. So when working on a prototype while others working on the requirements, it is much easier and more likely to be more successful in comparison to deal with missing requirements or regulations at a later stage.

Interviewee: Expert 5, Date: 22.04.2021

Q1: Do you consider the proposed framework as useful and why? If not, why do you believe it is not?

Since this question is very broad formulated, it feels a slightly difficult question to answer because I think the model you have there is important from a holistic and probably also from a strategic point of view to come up with a useful implementation of the technological concept.

Considering it from an overall perspective without having the detailed information about the sub-level processes in mind that you have talked me through, I would ask myself where this model differs in comparison to any other sophisticated IT software technology framework. So again, I guess it is definitely valid since it holds up when comparing to others. However, to make it even more useful and enhance its quality, you need to ask yourself where it can be more blockchain and use case-specific, in this case, its application in the governmental sector. When you adopt this aspect, then I guess it would be even more useful for its application, since this sector differs quite a lot from others.

I like the part in the, let's call it bucket, where you are addressing the importance and the interplay between the stakeholders, the values of theirs and the system itself, as well as the technology. In particular, in the public administration sector, it's more important than ever to cover those things because you want to provide a service which is accepted by the society, which is obviously way different than providing a service just to a business, which offers b2b solutions or something similar.

Q2: Do you have any criticism of the proposed framework? Please explain.

So the first point would be the issues I have slightly touched on within the first question. I would like to have a more specific point of view within the model covering the whole blockchain technology requirements as such. To my point of view, it is very good to be specific and still relevant, but here I miss a little bit the focus on the domain of governance and blockchain.

Another aspect would be that the model already begins with the analysis of the scope for the use case. But it is not clear to me, that we have previously decided that we want to tackle a project with certain requirements on a blockchain technology basis. I am saying that maybe, it is more helpful to have very carefully specified all these requirements beforehand and see if blockchain is the technology that's going to fit because of everything you already outlined. Big costs complex, you know, etc. There are very specific advantages to blockchain and there are specific disadvantages. So if we've already decided on the blockchain, you know, maybe it just makes this process easier, because we already have a good idea of these things. Since the usage of blockchain is very situational and not suitable for every use case, you need to ask yourself again and again, whether we really need to implement this use case using blockchain technology. Everyone wants to implement blockchain but rarely looks at the disadvantages and assumptions that have to be made beforehand.

So the background where this thought is coming from: I am currently working to implement a blockchain for basically tracking recycling products, and people charging people and rewarding people based upon their recycling and waste production. Additionally, tracking waste through the supply chain so you can kind of see what happens to things after they leave your house, how much gets recycled, etc. Something I constantly have to ask myself is what kinds of databases do I really need and are necessary to cover this business scenario. Does it really have to be a blockchain? The project I'm working on entirely just started with Blockchain, that's where, the money came from, but it's fundamentally not a great way to start a problem.

Q3: Would you consider implementing the proposed framework? Please clarify why/ why not.

This is a good question. The overall logic and procedure of this framework seem realistic and relevant to me to decide on whether I want to implement this proposed framework. And I guess it is helpful following your proposed framework since it provides structure and all relevant stakeholders.

However, there are two things I am uncertain about. One, how do I apply this framework. I'm not 100% sure about that. Second, does it provide guidance is on a more granular level?

Q4: Do you have any recommendations or suggestions for further improvements to the proposed framework?

I guess not any further apart from the ones I have previously mentioned. Just to sum it up, the first thing would be to kind of be a little more specific in terms of first doing like a beforehand analysis. And then secondly, being more precise within every step to just make it more tangible for the certain

projects, everyone wants to use or basically wants to leverage when thinking about blockchain technology. Also, maybe another idea is to come up with a specific technological framework and another one just business-related, so to say to different models. Maybe that helps to tie it to the topic of blockchain, which is a bit harder to do, I guess.