
BLOCKCHAIN AND BUSINESS VALUE CREATION

Kerley Silva

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Marketing and Strategy

Supervisors

Prof. Doutora Maria Catarina de Almeida Roseira

Prof. Doutor Pedro José Ramos Moreira de Campos

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ABSTRACT

The global information technology (IT) spending of the public sector (PS) reached approximately half a trillion USD in 2021. Although this significant amount is being directed to this segment of the economy, it seems that the research about the value of IT in the context of the PS has been ignored. This research aims to explore the impact of a specific emerging technology in the PS, which is blockchain, considering initiatives involving countries of South America.

Blockchain combines prior technologies, and its first case of adoption was bitcoin. Extant literature indicates that it is not clear why the PS adopts the technology, nor what is its value, and what are the resources and capabilities influencing value creation.

This research aims to fulfill these gaps and to understand: what are the motivations of the PS to adopt blockchain, what is the value of the technology, how value is created, and what are the resources and capabilities that influence the value creation of blockchain. A multiple case study methodology is adopted, considering six initiatives for data sharing or exchange related to foreign trade, the financial sector, civil aviation, public procurement, healthcare, and tax identification data. Interviews were performed with 14 individuals, including business and technical leaders, team members and final user.

The main results suggest that (i) the PS is using blockchain to increase security and decentralization, in situations that involve lower level of disruption and complexity, (ii) blockchain initiatives contribute to public value creation, especially to increase internal effectiveness and efficiency of public organizations, (iii) technical knowledge and dynamic capabilities are influencing the value creation of blockchain, and the PS deals with dynamic capabilities with different approaches and levels of maturity, and there seem to be more challenges in the execution of the sensing capability. The theoretical and practical contributions are discussed, addressing the gaps of the literature.

Keywords: Strategic Management, Dynamic Capabilities, Blockchain, Distributed Ledger Technology, Value Creation, IT Resources, Public Sector, Public Value

RESUMO

A despesa global do setor público (SP) com tecnologia da informação (TI) atingiu aproximadamente meio trilhão de dólares em 2021. Embora um montante tão significativo esteja sendo direcionado para este segmento da economia, aparentemente a investigação sobre o valor de TI no contexto do SP tem sido ignorada. Esta pesquisa visa explorar o impacto no SP de uma tecnologia emergente específica, que é blockchain, considerando iniciativas que envolvem países da América do Sul.

Blockchain combina tecnologias anteriores, e seu primeiro caso de adoção foi bitcoin. A literatura atual indica que não é claro porque é que o SP adota a tecnologia, nem qual é o seu valor, nem quais são os recursos e capacidades que influenciam a criação de valor. Esta pesquisa visa preencher estas lacunas e compreender quais são as motivações do SP para adotar blockchain, qual é o valor da tecnologia, como o valor é criado, e quais são os recursos e capacidades que influenciam a criação de valor de blockchain. A metodologia de estudo de casos múltiplos foi adotada, considerando seis iniciativas de troca ou compartilhamento de dados relacionados ao comércio exterior, setor financeiro, aviação civil, contratos públicos, saúde, e dados de identificação fiscal. Foram realizadas entrevistas com 14 indivíduos, incluindo líderes técnicos, de negócio, membros de equipe e usuário final.

Os principais resultados sugerem que (i) o SP está a utilizar blockchain para aumentar a segurança e a descentralização, em situações que envolvem menor nível de disrupção e complexidade, (ii) as iniciativas que utilizam blockchain contribuem para criação de valor público, especialmente para aumentar a eficácia e eficiência interna de organizações públicas, (iii) conhecimento técnico e capacidades dinâmicas estão a influenciar a criação de valor de blockchain, e o SP lida com capacidades dinâmicas com diferentes abordagens e níveis de maturidade, e parece haver mais desafios para execução da capacidade de detecção. As contribuições teóricas e práticas são discutidas no texto, endereçando as lacunas da literatura.

Palavras-chave: Gestão Estratégica, Capacidades Dinâmicas, Blockchain, Tecnologia de Registro Distribuído, Criação de Valor, Recursos de TI, Setor Público, Valor Público

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LIST OF ABBREVIATIONS

AA	Automation and analytics
CEM	Crypto economic models
DCV	Dynamic capability view
DDI	Decentralized data infrastructure
DLT	Distributed ledger technology
e-Gov	Electronic government
IoT	Internet of things
IT	Information technology
MM	Membership management
OECD	Organization for economic co-operation and development
RBV	Resource-based view
R&C	Resources and capabilities
RFID	Radio frequency identification
RQ	Research question
TA	Thematic analysis
TCA	Technical cooperation agreement
WOS	Web of Science

1 INTRODUCTION

The public sector investments in Information Technologies (IT) have grown significantly in the last decades and it seems that the research about the value or benefits of IT has ignored this important segment of the economy (Pang et al., 2014). IT is considered an important drive for innovation in the public sector (Luna-Reyes et al., 2020), but it is very defying to evaluate the outcomes of the use of new technologies (Srinivasan, 2008).

The shortage of research regarding the implications of IT in the public sector is hampering the interaction between researchers and public sector managers (Pang et al., 2014). Managers are facing the challenge to develop strategies to leverage the opportunities posed by emerging technologies and to handle the possible threats (Srinivasan, 2008). In this defying context, the public sector worldwide started considering the use of blockchain (Alketbi et al., 2018; Chen et al., 2018). Blockchain is an emerging IT (Beck & Muller-Bloch, 2017) that has been heralded as the next revolution that will transform organizations and business transactions (Janssen et al., 2020). Blockchain is a decentralized transaction and data management technology that allows validation and synchronization of transactions across multiple users, which does not require third party control of data and it does not require trust among the participants of a network (Ali et al., 2020).

The adoption of blockchain by the public sector may encounter some difficulties. According to Piening (2013), there is empirical evidence that the public sector organizations are struggling to implement initiatives with technological innovations, which frequently lose steam in the development phase or fail to realize the benefits. Blockchain has the potential to drive innovation and transformation in the context of the public sector and it has captivated its attention, but there is concern related to the relatively untested situation of the technology (Warkentin & Orgeron, 2020) and to its maturity level (Hughes et al., 2019; Olnes et al., 2017). There are few real-world applications using blockchain (Hughes et al., 2019) and there is an estimation of 200 planned or ongoing initiatives of blockchain adoption in the public sector, in approximately 40 countries (OECD, 2018; Warren and Treat, 2019). As it would be expected, there is a lack of re-

search about applied cases of blockchain in the public sector, which demonstrate the practical use of the technology (Tavares et al., 2019). Although on the one hand the number of blockchain initiatives is reduced (OECD, 2018; Warren and Treat, 2019), on the other hand, the technology is driving strategic and policy actions in several economies around the world (Ojo and Adebayo, 2017).

Previous research about blockchain focuses on bitcoin (Cagigas et al., 2021), other cryptocurrencies (Cagigas et al., 2021; Tavares et al., 2019; Zutshi et al., 2021) and technological issues (Adel, 2020; Zutshi et al., 2021), neglecting the possible value created with the use of the technology (Risius & Spohrer, 2017). Furthermore, there is a gap regarding how and where blockchain is effectively applicable and with which practical effects (Risius and Spohrer, 2017; Yli-Huumo et al., 2016). Previous literature has not addressed how organizations make decisions needed to deliver benefits with blockchain (Hughes et al., 2019). The benefits of the technology in the literature are often exaggerated (Olmes et al., 2017) and there is a lack of empirical studies about the benefits of blockchain in the context of the public sector (Batubara et al., 2018). Blockchain offers diverse and novel value propositions, hindering the analysis of its true value (Zutshi et al., 2021).

More research is necessary to better understand and evaluate the use of blockchain (Ali et al., 2021) and some questions remain open, related to why should blockchain be used in the public sector (Konashevych & Poblet, 2019) and about the value created by the technology (Toufaily et al., 2021), since there is a gap regarding the role of the technology in the context of the public sector (Zein & Twinomurinzi, 2019).

Previous research regarding the value of IT in the context of the public sector consider the influence of resources and capabilities (Goh & Arenas, 2020; Krishnan et al., 2010; Pang et al., 2014; Piening, 2013). However, this influence is not clear when using blockchain, and it may be related to a necessity identified by Sanchez (2019), which is the need to move from theoretical speculations to real world insights regarding the use of the technology. Based on these identified gaps, the research questions of this study are the following:

RQ1: Why does the public sector adopt blockchain?

RQ2: What is the value of blockchain in the context of the public sector and how is value created?

RQ3: What are the resources and capabilities that influence the value creation of blockchain in the context of the public sector and how does this influence occur?

To support and frame the research questions, this study builds on the literature of strategic management, information systems and digital government. The latter two encompasses the literature regarding blockchain, IT and its use in the public sector, which is considered as digital government (Koulizakis & Loukis, 2020) or e-government (Twizemana & Andersson, 2019). Regarding the former, the use of blockchain by the public sector has been possible through the efforts of different stakeholders (Berryhill et al., 2019). These efforts may require the use of resources and dynamic capabilities to integrate internal and external resources and competences (Krishnan et al., 2010; Piening, 2013; Teece et al., 1997) to deal with the technology in a rapidly changing environment (Waring et al., 2018). Previous studies about the value of IT in the public sector rely on the resource-based view (Picazo-Vela et al., 2018) and dynamic capability view (Chatfield and Reddick, 2018). In this research, these views underlie the development of a Theoretical Framework of blockchain value creation in the context of the public sector. This framework supported the data collection and analysis and contributed to clarify the value of the technology and the resources and capabilities that influence its value creation in the context of the public sector.

A multiple case study methodology is adopted to address the research goal. The cases are initiatives of blockchain adoption of public sector organizations in different areas of application. Since most of the previous research focus on cryptocurrencies (Tavares et al., 2019; Zutshi et al., 2021) this study will consider applications of the technology that are not restricted to this topic. This decision would contribute to clarify the value of the technology in different use cases, addressing this void in the literature.

To support the analysis of value, the study integrates cases that are in advanced stages of development or fully implemented. The cases encompass initiatives involving countries of South America, which contributes to fill a research gap related to the adoption of blockchain by developing countries, since there is limited research in this context (Zein and Twinomurinzi, 2019).

The theoretical contribution of this research is the clarification about the impact of an emerging technology in the public sector. This study explains why the public sector uses blockchain (Konashevych & Poblet, 2019), and it explores the alignment between the motivations to use the technology and the real value created by it. The research contributes to the advancement of knowledge by providing a concrete evaluation of the use of blockchain in the context of the public sector (Al-Megren et al., 2018). It fulfills the gaps related to the lack of applied cases (Tavares et al., 2020) and the shortage of empirical and rigorous analysis of the benefits of the technology (Cagigas et al., 2021; Ning et al., 2021).

The research provides theoretical contributions related to the strategic management literature, it deepens existing understanding about how resources and capabilities (Abdullah et al., 2020; Dahiya & Mathew, 2016; Goh & Arenas, 2020; Pang et al., 2014) influence value creation of IT in the public sector. The research adds and innovates by considering a specific emerging technology. Although RBV and DCV have already been used to analyze the impact of IT in the context of the public sector (Janssen & Joha, 2007), to the best of our knowledge this is the first study that evaluates this relation considering this specific technology.

Regarding the practical implications, this study addresses the lack of validation of the technology, which hampers its implementation and use in the public sector, since there was indication that blockchain has not been tested enough (Rana et al., 2021). It is expected that the results of this multiple case analysis would contribute to support professionals from the public sector in decisions regarding why to adopt the technology, in which conditions; how it can contribute to public value creation and what are the resources and capabilities that deserves more attention when dealing with blockchain initiatives.

The chapters of this research are organized as follows:

- Chapter 2 explores the literature review process, the main insights and gaps related to the use of blockchain and IT in the context of the public sector, the public value created by IT and the resources and capabilities that influence the value creation of IT in the context of the public sector.

- Chapter 3 proposes the research questions and the Theoretical Framework, related to the gaps addressed by this research. It explores how the framework guides the decisions about data collection and analysis.
- Chapter 4 explains the methodology adopted, which considers a qualitative and multiple case study research, with six cases. The research design components, process of data collection and analysis are discussed.
- Chapter 5 discusses the data collected from the six cases. The cases are related to foreign trade (A), data exchange among regulators of the financial sector (B), civil aviation (C), public procurement (D), healthcare, specifically regarding covid-19 vaccines and exams (E) and data sharing related to tax identification records (F).
- Chapter 6 encompasses a cross-cases analysis, discussing similarities and differences between the cases, with insights from the literature, providing a basis to answer the research questions.
- Chapter 7 summarizes the answers for the research questions and presents the major conclusions, the theoretical and practical contributions, the research limitations, the implications and suggestions for further research.

2 BLOCKCHAIN, IT AND THE PUBLIC SECTOR

This chapter presents the synthesis of the theoretical revision, and it is divided in the following five sections:

- The process of the literature review is explained in the first section (2.1).
- The second section (2.2) discusses relevant literature.
- The third section (2.3) exhibits a brief introduction regarding blockchain, to present some concepts and to facilitate the comprehension of the content of the research.
- The chapter also discusses some relevant issues regarding Blockchain and IT (2.4). Specifically, section 2.4 has three subsections, which encompasses the value propositions of blockchain, considering the motivations and benefits for each value proposition (subsection 2.4.1), addressing the RQ1 and RQ2. The second subsection focuses on value in the context of the public sector and the value of IT (subsection 2.4.2), which also addresses the RQ2. The last subsection presents the synthesis and the identified research gaps (subsection 2.4.3).
- The fifth section of this chapter (2.5) is related to the RQ3, and it presents the resources and capabilities influencing the value creation of IT in the context of the public sector. This section is divided in four subsections. It presents the following elements that influence the value creation of IT in the context of the public sector: dynamic capabilities (subsection 2.5.1), IT resources and capabilities (subsection 2.5.2), and other types of resources and capabilities (subsection 2.5.3). At the end of the section, it is presented the synthesis of the literature and the identified research gaps (subsection 2.5.4).

This chapter brings forward what has been researched in previous studies and what are the issues that need further investigation. It supports an understanding about the value propositions of blockchain, motivations to use and potential benefits involved, resources and capabilities that influence the value creation of IT in the context of the public sector, and that may influence the value creation of blockchain. The findings and research gaps of the literature represent the foundations to the development of the Theoretical Framework that supports data collection and analysis.

2.1 Literature review process

One of the challenges to scientific progress is the limited ability of researchers to retain, organize and synthesize earlier knowledge, to offer the appropriate foundation to the further development of a field in a reliable way (Templier and Paré, 2015).

The literature review process discussed in this chapter constitutes the theoretical background related to the empirical part of this research. It considered the phases of planning, carrying out and reporting (Templier and Paré, 2015). These phases are similar to the process of assembling, arranging, and assessing, defined by Paul et al. (2021).

In the phase of planning, the research questions presented in the previous chapter were considered to support the selection of the documents. The phase of carrying out involves the search, selection, and analysis of existing articles. The literature review considered a search at Scopus and Web of Science databases, using the terms presented in Table 1.

Table 1

Key words and search expressions

Research question	Key words and search expressions
RQ1 – Why does the public sector adopt blockchain?	Blockchain OR “distributed ledger*” AND government* OR “public sector” OR “public administration” OR “e-gov” AND motivat* OR driver AND adopt* OR use OR utiliz*
RQ3 – What are the resources and capabilities that influence the value creation of blockchain in the context of the public sector and how does this influence occur?	“information technology” OR “information system*” AND “value*” OR “value creation” OR “value-creation” OR “benefit*” OR “advantage*” AND resource OR “resource-based view” OR rbv OR capabilit* OR dev OR factor* AND government* OR “public sector” OR “public administration” OR “e-gov”
RQ2 – What is the value of blockchain in the context of the public sector and how is value created?	Blockchain OR “distributed ledger*” AND government* OR “public sector” OR “public administration” OR “e-gov” AND value* OR “value creation” OR “value-creation” OR benefit* OR advantage*

Articles or proceeding/conference papers written in Portuguese or English were selected. The search was not restricted by knowledge area, once the application of the technology in different areas would allow publications in a variety of journals and conferences. Publications in different knowledge areas may explore the motivations to use the technology and the potential benefits of it. The search was not restricted by year of publication, so it would be possible to find documents published anytime.

Regarding the key words, “digital government” (Koulizakis & Loukis, 2020), “electronic government” or “e-government” (Twizeyimana & Andersson, 2019) are used as synonyms, and they refer to the utilization of IT in the context of the public sector. Since the focus of the research is the value of blockchain, which is a type of distributed ledger (Ali et al., 2020), both words and expressions were used: “blockchain” and “distributed ledger”. Considering that the literature regarding the value of IT were used as a background to explore the value of blockchain, the key words “value” and “value creation” were included. As literature regarding value of IT encompasses the resource-based view and the dynamic capability view to support the analysis regarding how value is created, key words and search expressions regarding resources and capabilities were included.

The search considered articles and conference papers and it yielded 4281 documents. An analysis of duplicity was performed: 917 were duplicates documents and were excluded and 3364 remained. Then, it was performed the reading of title and abstracts of these 3364 documents, and it was excluded 3080 documents, and just 284 remained. The papers were selected when at least one of the following criteria were met:

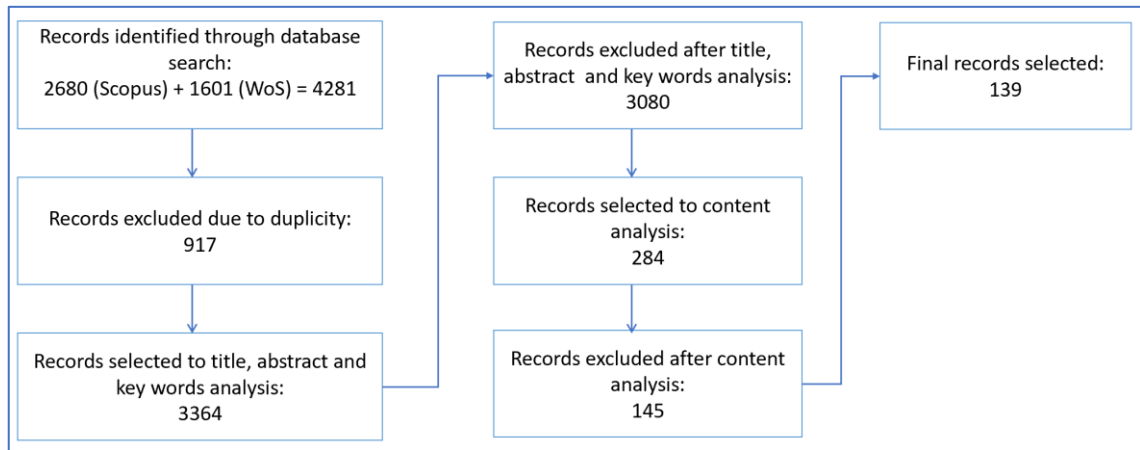
- They were related to the use of blockchain in the context of the public sector, but they were not restricted to cryptocurrency.
- They addressed the value or the public value of IT.
- They explored the resources or capabilities influencing the value creation of IT in the context of the public sector.

Then, the 284 articles were read and 145 of them were excluded. During the reading of the documents, it was excluded the papers in which the content did not mention or explore the key words and search expressions from Table 1. Then, it was excluded the articles that: (i) do not mention motivations to use the technology; (ii) that are not relat-

ed to the public sector; (iii) that do not mention the potential value, benefit or advantage of the technology; (iv) that do not mention the public value of IT and (v) that do not mention resources and capabilities influencing value creation of IT. As a result of this process, a total of 139 articles were selected for further review. The sequential procedure for the selection of documents is presented in Figure 1.

Figure 1

Sequential procedure for the selection of documents



In the phase of Reporting, a structure to the presentation of the topics was planned and discussed with two other researchers.

The final selection of papers related to each research question is presented in Table 2.

Table 2

Papers selected by research question

RQ	Authors
RQ1 and RQ2 (106 papers related to blockchain in the context of the public sector)	Al Barghuthi et al. (2019a), Al Barghuthi et al. (2019b), Al-abri et al. (2019), Alexopoulos et al. (2019), Ali et al. (2021), Alketbi et al. (2018), Al-Megren, et al. (2018), Alnafrah et al. (2021), Amelin et al. (2019), Aranda et al. (2019), Aristidou and Marcou (2019), Balasubramanian et al. (2021), Baranwal (2020), Britchenko and Cherniavska (2019), Cagigas et al. (2021), Cao et al. (2019), Casallas et al. (2020), Cisneros et al. (2021), Coffie et al. (2021), Collomosse et al. (2018), de Souza-Daw and Ross (2021), Demir et al. (2020), Denny et al. (2017), Dhagarra et al. (2019), Dhinakaran et al. (2021), Dubey et al. (2020), Elisa et al. (2019), Enwerem and Chukwudebe (2021), Ezzine and Benhlina (2020), Gao et al. (2021), Garcia-Font (2020), Geneiatakis et al. (2020),

	Gomez Rivera and Tosh (2019), Guo et al. (2021), Hang et al. (2019), Hao et al. (2019), Hardwick et al. (2018), Hassija et al. (2021), Iyer et al. (2019), Jaffer et al. (2020), Jamil et al. (2020), Jaoude and Saade (2019), Kadam et al. (2020), Kamaruzaman et al. (2018), Kaur et al. (2020), Khan et al. (2018), Khan et al. (2020), Konashevych (2020), Konashevych and Poblet (2019), Koster and Borgman (2020), Krogsboll et al. (2020), Kumar and Sharma (2019), Kundu (2019), Leite et al. (2020), Li et al. (2021a), Malik et al. (2019), Manoj et al (2020), Meijer and Ubacht (2018), Micheler and Whaley (2020), Mintah et al. (2020), Mishra and Maheshwari (2021), Moura and Gomes (2017), Mukhametov (2020), Mukherjee et al. (2020), Musoke et al. (2021), Natarén and Herran (2019), Ning et al. (2021), Norstrom and Lindman (2020), Olnes and Jansen (2018), Pandey (2018), Piao et al. (2021), Pradana et al. (2018), Prakash and Gunalan (2020), Pu and Lam (2021), Qian et al. (2020), Rukanova et al. (2021), Saho and Ezin (2021), Sánchez (2019), Satish Babu and Suresh Babu (2020), Scholl and Bolivar(2019), Semenets et al. (2018), Shen et al. (2021), Shih et al. (2018), Shuaib et al. (2020), Singh et al. (2020), Somayaji et al. (2020), Song et al. (2021), Sotoudehnia(2021), Tavares et al. (2021), Thosar et al. (2020), Toapanta et al. (2019), Toufaily et al. (2021), Tseng et al. (2018), Tshering and Gao (2020), Vanany et al. (2020), Wang and De Filippi (2020), Wang and Huang (2021), Warkentin and Orgeron (2020), Wattegama et al. (2021), Westerlund et al. (2021), Xu et al. (2019), Yadav and Kushwaha (2021), Zein and Twinomurizi (2019), Zhang et al. (2019a), Zhang et al. (2021), Zhang et al. (2019b).
RQ3 (33 papers related to IT, resources, capabilities, and public value)	Adnani (2014), Alshaher (2021), Andersen and Danziger (1995), Ashbaugh and Miranda (2002), Bondarouk and Ruel (2013), Brown and Brudney (1998), Chan et al. (2011), Chatfield and Reddick (2018), Chohan and Hu (2020), Cunningham et al. (2007), Dahiya and Mathew (2016), Dasuki and Abbott (2015), Goh and Arenas (2020), Janssen and Joha (2007), Kamau and Wausi (2015), Kanungo and Jain (2011), Luna-Reyes et al. (2020), Makasi et al. (2021), Martins et al. (2019), Abdullah et al. (2020), Pang et al. (2014), Patola et al. (2017), Pedersen (2017), Picazo-Vela, et al. (2018), Prakash (2016), Scott et al. (2016), Sorongan and Hidayati (2020), Thompson et al. (2005), Waring et al. (2018), Zhao and Fan (2018), Zhao and Fan (2021), Zheng et al. (2013), Ziemba and Oblak (2014).

This subsection discussed the procedure for the selection of publications, the numbers of documents involved in each step of the procedure, and the authors of the publications selected. The next subsection explores some preliminary insights regarding the third research question, about the value of blockchain in the context of the public sector.

2.2 Literature overview about the value of blockchain

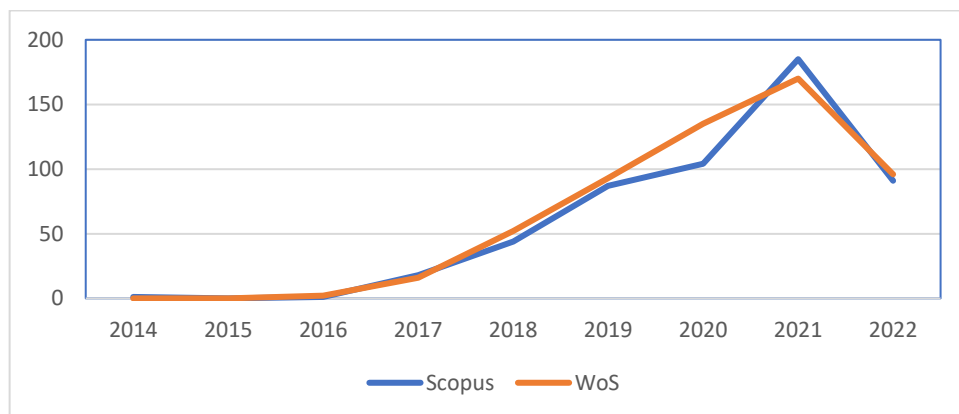
This section explores an overview of the literature regarding the value of blockchain in the context of the public sector found in Scopus and Web of Science (WoS). This part is specifically related to the third research question, and it represents the total quantity of papers found, before the procedures for the selection of some of them.

The following search parameters were used in Scopus: (TITLE-ABS-KEY (blockchain) OR TITLE-ABS-KEY ("distributed ledger") AND TITLE-ABS-KEY ("public sector") OR TITLE-ABS-KEY (government) OR TITLE-ABS-KEY ("public administration") OR TITLE-ABS-KEY (e-gov) AND TITLE-ABS-KEY (value) OR TITLE-ABS-KEY (benefit) OR TITLE-ABS-KEY (advantage)).

Regarding Web of Science (WOS), the following search parameters were used: ALL=(blockchain) OR ALL=("distributed ledger")) AND (ALL=("public sector") OR ALL=(government) OR ALL=("public administration") OR ALL=(e-gov)) AND (ALL=(value) OR ALL=(benefit) OR ALL=(advantage)). No other filter was defined in Scopus neither in WoS. The result was 531 and 564 documents, in Scopus and WOS respectively. Figure 2 presents the quantity of publications by year in Scopus and WoS.

Figure 2

Publications by year



Regarding the quantity of publications by year, it is possible to note the similarity between Scopus and WOS and the trend of a growing quantity of documents published over the years. The first publication, according to the defined criteria, is a book from 2014 and it aims to explore the economic and technological advances of the cryptocurrency bitcoin (Franco, 2014). The quantity of documents published by subject area in Scopus is presented in Figure 3.

Figure 3

Documents by subject area (Scopus)

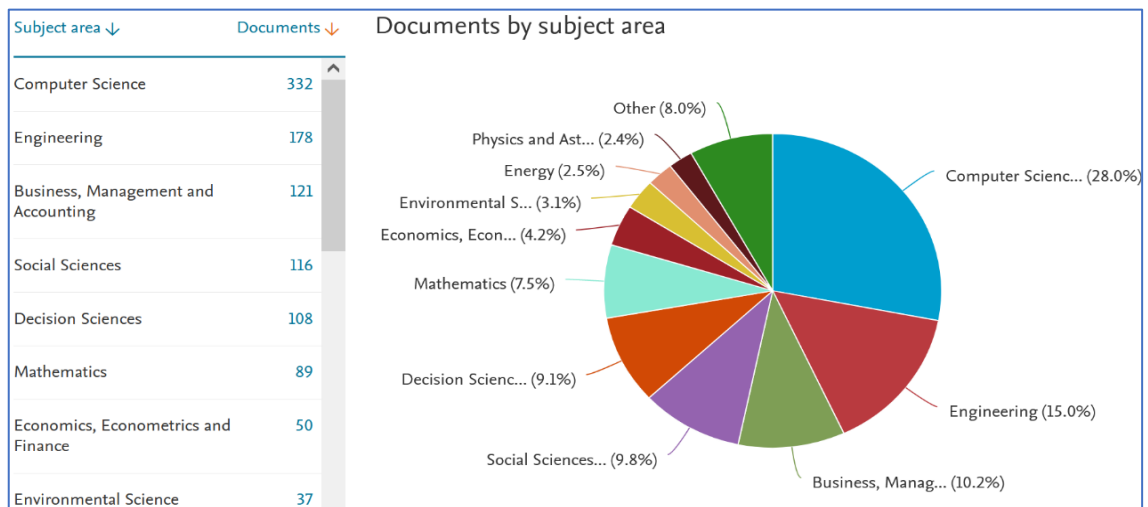
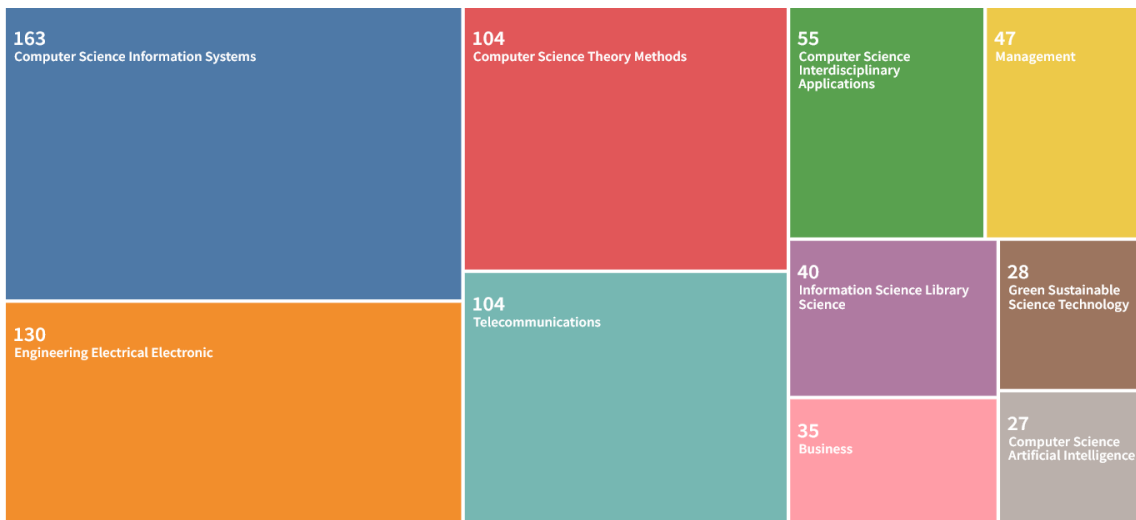


Figure 4 presents the quantity of documents published by subject area in WOS.

Figure 4

Quantity of documents by subject area (WOS)



It is possible to observe that the quantity of documents related to Business, Management and Accounting in Scopus is 121 (Figure 3), while in WoS the quantity of documents related to Management is 47 and related to Business is 35, reaching 82 in total (Figure 4). This difference may be explained by the fact that WoS has a subject area named Computer Science Interdisciplinary Applications that may consider some publications related to management, business, or accounting. Figure 5 presents the quantity and percentage of documents by type of publication, according to Scopus.

Figure 5

Documents by type (Scopus)

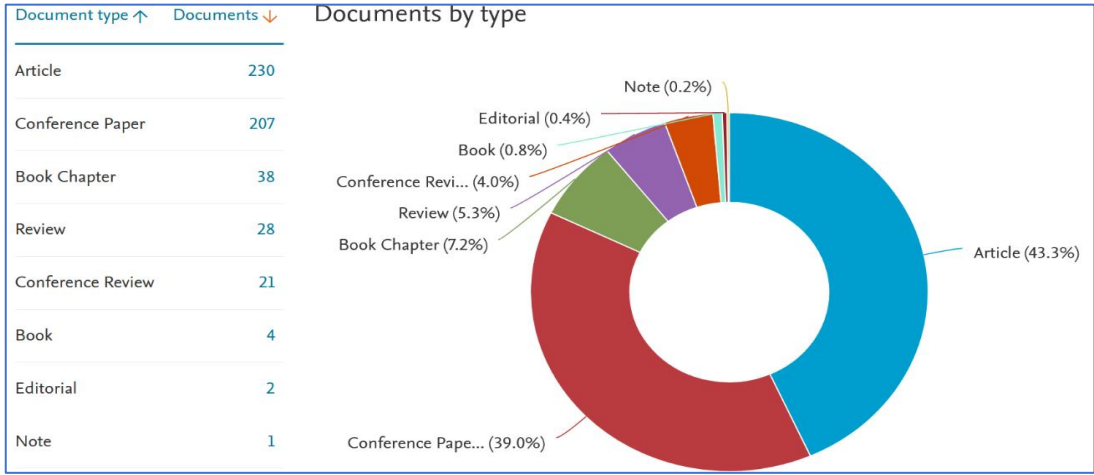
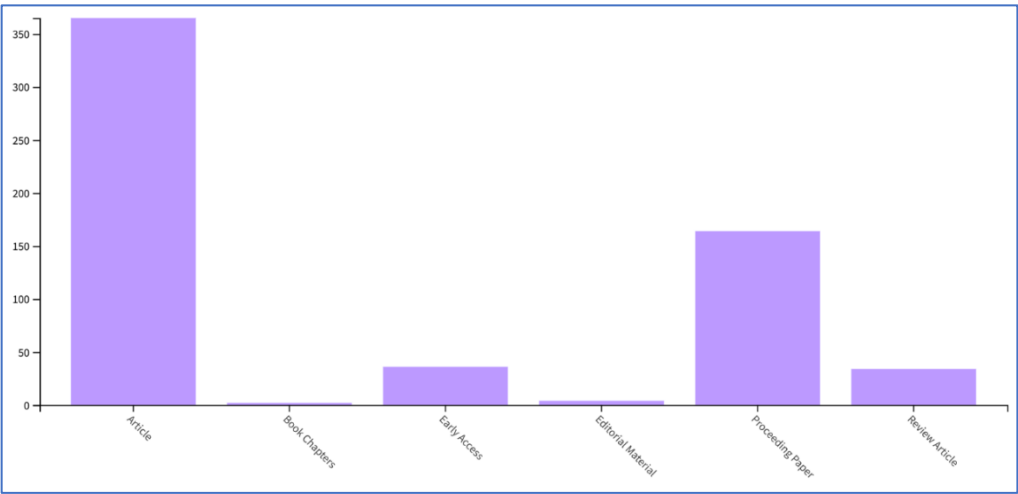


Figure 6 presents the quantity of publications by type, according to Web of Science (WoS).

Figure 6

Publications by type (WoS)



Considering Figure 5, the difference of the quantity of articles and conference papers is reduced and together it represents more than 80% of the documents published. In *Figure 6*, it is possible to note that the quantity of articles is more than the double of the quantity of proceeding papers.

Then, it is possible to conclude that the interest about the benefit of blockchain in the context of the public sector is growing over the years and the debate about this topic in the subject areas related to business and management is scant for now, in comparison to the areas of Computer Science and Engineering. This offers space for this study to contribute and advance knowledge in the fields of business and management.

This subsection discussed some insights from the literature and the next subsection describes a brief explanation about blockchain, to support the understanding of its basic characteristics, and to facilitate the assimilation of the other topics related to the research.

2.3 What is blockchain?

There are different definitions of blockchain and distinct ways to relate it to distributed ledgers technologies (DLT). According to Konashevych and Poblet (2019), blockchain is a distributed ledger technology, and DLT is often used as a general term to refer to a subset of technologies that use some elements of blockchain. For Montgomery (2022), blockchain is an append-only system of records or transaction logs and a distributed ledger is a distributed database with decentralized trust. He considers that most of the popular blockchains are distributed ledgers and most of the distributed ledgers are blockchains.

Blockchain enables interactions between parties within a peer-to-peer network, allowing an open record of transactions that are stored in blocks, which are interconnected using cryptographic hash functions, resulting in a chain of blocks, or ledger (Sanchez, 2019). Therefore, it has timestamps, with chronological saved transactions in a chain of blocks secured by cryptography (Konashevych, 2020).

The hash function used in blockchain, is a mathematical algorithm that generates an alphanumeric string with fixed size (a hash) from data of arbitrary size (Konashevych,

2020). Hash function is a one-way function which is considered unfeasible to invert. The ideal hash function should allow an ease calculation of the hash from any given data, it should be extremely difficult to calculate computationally the text that has given a hash and it should be extremely unlikely that different messages would have the same hash (Konashevych, 2020).

A copy of each transaction in a blockchain is distributed and stored by the nodes or computers running the software (Sanchez, 2019). The chain of blocks grows continuously, and it can only append new blocks.

The first use case of blockchain was bitcoin, a decentralized digital currency (Bitcoin, 2023), and nowadays there are different topologies of the technology and there is some debate about them (Olne and Jansen, 2018; Sotoudehnia, 2021). The original system used with bitcoin is public and permissionless and some authors consider that the use of the term “permissioned blockchain” is misleading. It would be more correct to refer to it as a DLT, since DLT can be architecturally centralized with a hierarchical system of nodes. According to Konashevych & Poblet (2019), the criteria for the qualification of a system as a blockchain is yet under discussion. Other authors consider private and permissioned networks as a blockchain (Rukanova et al., 2021).

According to Olne and Jansen (2018) and Sotoudehnia (2021), the different topologies of blockchain are related to different combinations of the properties of private/closed X public/open, and permissioned X permissionless systems, as presented in Table 3.

Table 3

Blockchain topologies

	Permissioned	Permissionless
Public/ Open	Anyone can read, authorized participants can write and a subset of them can commit. Therefore, only select users can participate in the validation of data published to the blockchain (e.g., Ripple).	Anyone can read, write, and commit transactions. There are no restrictions on access to data, transactions, or validation. Everyone can participate and are subject to the same rules (e.g., Bitcoin).
Private/ Close	Read can be defined to a set of participants, write and commit are defined by the network operator (e.g., Hyperledger Fabric).	Anyone can run a node, but there are restrictions surrounding access to data and network transactions.

Note. Adapted from Olne and Jansen (2018), Sotoudehnia (2021).

In the context of blockchain, read is the ability to read or consult information from the

blockchain, write is the ability to conduct transactions, and commit is the ability to append data on the blockchain (Olmes and Jansen, 2018).

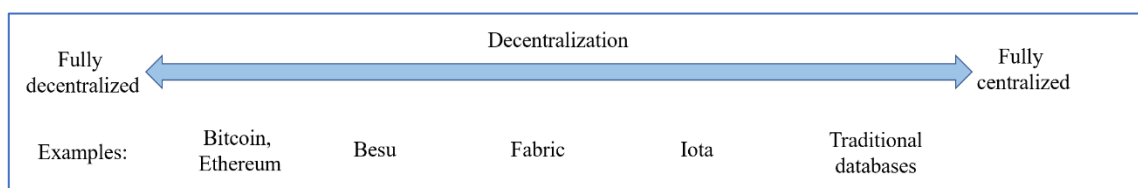
Besides the features of cryptography and consensus mechanism, some blockchains, such as Ethereum also uses smart contracts, which is a software program that integrates conditions that can be automatically executed when they are met. These conditions may be related to clauses from traditional business contracts. It has potential to enhance the transparency and tracking of transactions, to increase automation, generating efficiency and to reduce fraud. It is also related to immutability, because contracts cannot be modified after deployment (Gomez et al., 2021).

It is considered that immutability may be appropriate for public blockchain applications, but it might not be for enterprise applications, due to some rights in some legislations. Some authors evaluate the different types of blockchain platforms according to the level of decentralized trust (Montgomery, 2022).

Blockchain integrates digital signatures and distributed consensus mechanism, facilitating tamper-proof transactions (Zein & Twinomurinzi, 2019). Blockchain verifies each transaction using a consensus mechanism between the nodes, that may ensure that no single party has power to alter it (Cagigas et al., 2021). The distributed ledgers may have different consensus mechanisms, and its type is an impactful design choice on decentralization. Decentralization is considered as the degree to which a single entity or group of entities control something, and its measure can involve the proportion of control of a single entity or the number of entities that can complete control a system. When the decisions about the records are concentrated in one entity, it is a centralized system, and when many different entities are involved, it is more decentralized (Montgomery, 2022). The different levels of decentralization and some examples of blockchain and distributed ledgers are presented in Figure 7.

Figure 7

Decentralization



Note. Adapted from Montgomery (2022)

Considering that the basics regarding blockchain was presented, the following information is related to the motivations to use the technology and its potential value in the context of the public sector, representing the first and third research questions.

2.4 Blockchain and IT

This section is divided in three subsections. The first one (2.4.1) presents the value propositions of blockchain, the motivations to use the technology in the context of the public sector and its potential benefits. Since there is indication that the use of IT in the context of the public sector provides a set of specific values related to this context, it was included a section about this topic (2.4.2), which explores value in the public sector and the value of IT. This was necessary because the public sector has specific expectations regarding the use of IT. The last subsection (2.4.3) encompasses the synthesis and research gaps.

2.4.1 Value propositions, motivations, and benefits of blockchain

In the literature review process, it was identified 106 papers that discuss the motivations to use blockchain or its potential value in the context of the public sector, or both motivations and value. There are 58 papers with a design approach, which propose ideas or initiatives of adoption of the technology for specific purposes, exploring the motivations to use the technology and the benefits expected. These studies are based on design science research, encompassing problem explanation, the definition of requirements, the design of system architecture, the demonstration of its usefulness, and the evaluation of the concepts or technical specifications (Pandey, 2018). The organization of these studies according to the different stages of development of the ideas and initiatives is presented in Figure 8.

The ideas and initiatives that explore the use of blockchain are in the following stages of development:

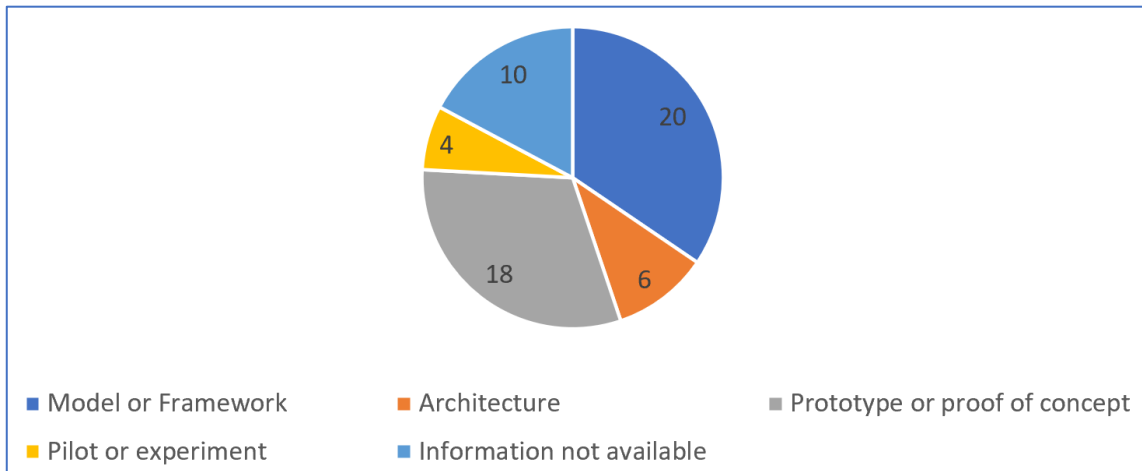
- Model or framework: it presents the main stakeholders involved in a solution and how they may interact within the system (Alnafrah & Mouselli, 2021).
- Architecture: it presents the technical layers of the system with more details than

in models or frameworks (Elisa et al., 2019).

- Prototype or proof of concept: a prototype considers an architecture built over one infrastructure for preliminary evaluation, that may use a test net (Collo-mosse et al., 2018). A proof of concept may be considered as synonym of proto-type (Cisneros et al., 2021).
- Pilot or experiment: a pilot is an experiment, in which the system may be in pro-duction with few functionalities for a restricted period (Zhang et al., 2021). An experiment might be used to collect some evidence about the applicability of the technology in real case scenarios (Leite et al., 2020).

Figure 8

Ideas or initiatives organized by stage of development



It is possible to observe that the ideas or initiatives are in their initial stages of develop-ment, which means that the value or benefit of the technology cited by the authors in these studies is just the potential value.

There are 16 case studies in the literature, which analyze the use of blockchain in the context of voting (Al Barghuthi et al., 2019), healthcare (Balasubramanian et al., 2021; Hang et al., 2019), construction (Khan, 2020), land and property registration (Pandey, 2020), poverty alleviation (Ning et al., 2021), municipal government (Krogsboll, 2020; Norstron & Lindman, 2020), sustainability (Tavares et al., 2020), supply chain (Ruka-nova et al., 2021; Westerlund et al., 2021), self-sovereign identity (Wang & De Filippi, 2020), regulation (Scholl & Bolivar, 2019), data sharing (Piao, 2021) and multiple cases in different areas of application (Koster 2020; Olnes & Jansen, 2018).

Among this set of papers related to case studies, six of them evaluate, among other things, the value, or potential benefits of blockchain. Olnes and Jansen (2018) analyze the potential benefits of blockchain of some cases in the pilot phase; Norström and Lindman (2020) consider the analysis of benefits of pilot cases that have not been run with real users; Westerlund et al. (2021) focus on cases in the pilot phase, analyzing only secondary sources of data; Tavares et al. (2020) explore the contribution of blockchain for environmental investments, within a case that is on the process of acquiring maturity; Ning et al. (2021) evaluate the influence of blockchain specifically on efficiency and impartiality. Rukanova et al. (2021) evaluate the value of blockchain in the context of supply chain in one case that is implemented and in production. Therefore, it is possible to note the interest on the topic of the value of the technology in the context of the public sector, although the findings of most studies present just the potential benefits of the technology, since most cases analyzed by the studies are in the initial stages of development.

To facilitate the presentation of motivations and potential benefits, the results of the literature review are organized according to the value propositions of blockchain, which are: decentralized data infrastructure and membership management, automation and analytics, crypto economic models, and decentralization of governance (Zutshi et al., 2021). Table 4 presents the papers that are related to the value propositions, the description of the value propositions, motivations, and benefits.

Table 4*Value propositions, motivations, and benefits*

Authors	Papers	Value propositions	Characteristics of the value propositions	Motivations to adopt block-chain	Benefits
Al-Barghuthi et al. (2019), Alabri et al. (2019), Amelin et al. (2019), de Souza and Ross (2021), Dhinakaran et al. (2021), Elisa et al. (2019), Gao et al. (2021), Geneiatakis et al. (2020), Hang et al. (2019), Hao et al. (2019), Hassija et al. (2021), Kadam et al. (2020), Kamaruzaman et al. (2018), Kaur et al. (2020), Khan et al. (2018), Khan et al. (2020), Konashevych and Poblet (2019), Kumar and Sharma (2019), Leite et al. (2020), Malik et al. (2019), Moura and Gomes (2017), Mukherjee et al. (2020), Pandey (2018), Piao et al. (2021), Pradana et al. (2018), Rukanova et al. (2021), Saho, (2021), Sanchez (2019), Satish (2020), Shen et al. (2021), Shuaib et al. (2020), Toapanta et al. (2019), Wang et al. (2021), Wattagama et al. (2021), Westerlund et al. (2021), Xu et al. (2019)	36	Decentralized data infrastructure and membership management (DDI & MM)	Storage of transactions, events, and assets. Functions to deal with identity management and privacy management.	- Increase security and data integrity - Promote decentralization and reduce the problems with centralized solutions, as the single point of failure - Improve transparency, reducing corruption, fraud and tampering	- Security, integrity, and immutability - Decentralization of control and storage, reducing issues with intermediaries - Transparency, audit, traceability, and reliability of the updates in the ledger, prevention of fraud and unauthorized activity - Efficiency, automation, and reduction of the time required to perform some process, resulting in cost benefits
Alnafrh and Mouselli (2021), Baranwal (2020), Cao et al. (2019),	23	DDI & MM and Crypto	Use of economic incentives to validate transactions and reward	- The need to transfer assets - The need to prevent fraud,	- Decentralization - Transparency of

Coffie and Saint (2021), Collo-mosse et al. (2018), Denny et al. (2017), Dhagarra et al. (2019), Dubey et al. (2020), Garcia-Font (2020), Hardwick et al. (2018), Iyer et al. (2019), Jaffer et al. (2020), Krogsboll et al. (2020), Manoj et al. (2020), Mintah et al. (2020), Musoke et al. (2021), Olnes and Jansen (2018), Singh et al. (2021), Tavares et al. (2020), Thosar et al. (2020), Tseng et al. (2018), Wang and De Fillipi (2020), Yadav and Kushwaha (2021),		economics models (CEM)	stakeholders.	forgery and illegal activities in transactions that involve the transfer or selling of assets or goods - The need of decentralization and to improve security and efficiency - The need to establish incentive mechanisms for the execution of some activities	transactions, increase of trust and the reduction of corruption, due to the support of the technology in the transfer or selling of assets or goods - Creation of incentive mechanisms and new economic models - Representation of assets and its trade
Aranda et al. (2019), Dhagarra et al. (2019), Ezzine and Benhlila (2020), Gomez Rivera and Tosh (2019), Iyer et al. (2019); Jamil et al., (2020), Mishra and Maheshwari (2021), Shih et al. (2018), Somayaji et al. (2020), Vanany et al. (2020), Zhang et al. (2021)	11	DDI & MM and Automation and analytics (AA)	Use of smart contracts, especially in the context of external data collection from IoT devices. Use of data analytics with big data and machine learning.	- The need to improve security - Decentralized environment - Difficulties related to data, such as provenance, access, sharing and reliability - The lack of transparency, traceability, and data of goods - To avoid tampering, traceability of information related to goods - The proper identification of sensors	- Automation - Transparency and the tracking of information of goods - Security and data integrity - The increase in transparency and trust, enabling the supervision by the public sector and cost reduction - Decentralization - Data provenance and new ways to

					monitor sensors' authentication
Demir et al. (2020), Guo et al. (2021), Li et al. (2021a), Pu and Lam (2021), Song et al (2021), Zhang et al. (2019)	6	DDI & MM, CEM and AA	All the value propositions together except with the decentralized governance	- Improve security - Need of transparency, lack of trust, and need to avoid fraud - Decentralization - The need to have economic incentives	- Security and data integrity - Transparency, tracking, traceability and trust, reduction of fraud and tampering - Automation - Decentralization
There is no initiative exploring this value proposition in the context of the public sector in the papers selected	0	Decentralized governance	Collective governance, with decentralized ownership and decision making.	- Decentralized ownership and decision making	- Community participation in the management of the platform

The value propositions are explained in the following text, including the motivations and potential benefits related to them:

- **Decentralized data infrastructure and membership management (DDI & MM)**

The two major value propositions that all blockchains provide are decentralized data infrastructure and membership management. Decentralized data infrastructure involves storing a record of transactions, events, and assets in a distributed ledger instead of a centralized system. Membership management is related to the availability of functions such as identity management, relying on private and public keys; privacy management, the possibility to use zero knowledge proof and permission management (Zutshi et al., 2021). Most of the papers that present ideas and initiatives restricted to these two value propositions consider the use of private networks, using the Hyperledger Fabric (Hao, 2019; Leite, 2020; Piao, 2021; Xu, 2019).

Some of the motivations to use blockchain in the context of these value propositions are related to the need to reduce fraud, tampering and corruption, to reduce the problems with centralized solutions, and to increase security (Gao et al., 2021; Geneiatakis et al., 2020; Al-Barghuthi et al., 2019).

The reduction of fraud, tampering and corruption are some problems faced by notarial offices that use traditional systems based on centralized infrastructure, controlled by third parties. Some potential benefits provided by blockchain are the prevention of security threats, and it is possible to audit and trace the updates in the ledger, creating a mechanism of accountability that can minimize the risks of counterfeit (Gao et al., 2021).

In the context of cross border services, the motivations to use blockchain are related to drawbacks of one central service that is responsible for the dissemination of information to the other participants of the system, posing the risk of single point of failure. The service would benefit from blockchain due to data integrity, immutability, and transparency (Geneiatakis et al., 2020).

The use of blockchain in the context of political voting systems is motivated by the need of secure and transparent elections, avoiding vote tampering, since traditional voting system may lack security and privacy features, and it might be prone to fraud and fail-

ure, such as miscounted votes. The implementation of blockchain-based electronic voting systems would enable integrity, immutability and it has the potential to limit voter fraud, preventing unauthorized activity (Al-Barghuthi et al., 2019).

The motivations to use blockchain in the context of identity management encompass the falsification of documents and the time-consuming process related to the verification or application for documents. Blockchain offers the potential benefits of efficiency, reliability, immutability, security, and transparency, reducing the time required for document verification due to the automation, reducing the number of employees required for this process (Malik, 2019).

There are also other examples of ideas and initiatives which use blockchain in the context of the decentralized data infrastructure and membership management, such as in the context of tender and procurement (Hassija, 2021), healthcare (Hang et al., 2019, Saho, 2021) and public registries and records (Pradana, 2018).

- **Crypto economics models (CEM)**

In this value proposition, economic incentives may be offered to miners to perform cryptographic validation functions to ensure the addition of valid transactions in the blocks of permissionless blockchain (Zutshi et al., 2021). In permissioned blockchains, tokens can be used to incentivize certain conditions (Iyer, 2019). Consensus algorithms such as proof of work and proof of stake have some form or associated cryptocurrency or token to incentivize the validators and reward stakeholders. This enables the creation of economic models for payments, transfers, and other different functions. The difference among this value proposition and the previous one (which is the decentralized data infrastructure and membership management) is that the cases restricted to the previous do not need tokens or cryptocurrencies, since permissioned blockchain has known participants as validators, that may not need additional financial rewards to verify transactions and to maintain blockchain nodes (Zutshi et al., 2021)

Crypto economic models enable payments, investments, lending and borrowing, insurance, among others. It may allow the representation of assets like stocks and real state as tokens, that can be traded in digital exchanges (Zutshi et al., 2021).

Although there is great potential to use blockchain and to innovate with crypto econom-

ic models, the ideas and initiatives to use the technology in the context of the public sector are yet in preliminary stages of development. Most of the initiatives are prototypes (Collomosse et al., 2018; Krogsboll, 2020; Musoke, 2021) and proof of concept (Coffie & Saint, 2021; Garcia-Font, 2020; Hardwick, 2018). Most of the ideas and initiatives explored in the papers are related to public records of land and real estate (Coffie & Saint, 2021; Thosar, 2020; Yadav & Kushwaha, 2021).

The main motivations to use blockchain in this context are the need to transfer assets, the need to prevent fraud, forgery and illegal activities, the need of decentralization and the need to improve security and efficiency (Coffie & Saint, 2021; Collomosse et al., 2018, Garcia-Font, 2020; Hardwick, 2018; Krogsboll, 2020; Musoke, 2021; Thosar, 2020; Yadav & Kushwaha, 2021).

Specifically in the context of land registry and real estate, the main motivations to use blockchain are the reduction of fraud and illegal selling of land since centralized systems may facilitate corruption. The main potential benefits in using the technology are related to decentralization, transparency of transactions, increasing trust, reducing corruption, due to the immutability enabled by the technology (Coffie & Saint, 2021; Thosar, 2020; Yadav & Kushwaha, 2021).

Coffie and Saint (2021) cite the fraudulent activities and inefficiencies of real estate market in many African countries, creating lack of trust and increasing costs. They propose a proof of concept, using Ethereum, to enable registration and transfer of properties. Inspired by the tokenization of the assets of Ghana, they suggest a similar approach to other services of the public sector, such as identity management and certificates management.

There are other examples of ideas and initiatives exploring crypto economic models, related to smart cities (Garcia-Font, 2020), tender and procurement (Hardwick, 2018), digital identity (Musoke, 2021) and the registry of national archives (Collomosse, 2018).

- **Automation and analytics (AA)**

This value proposition encompasses the automation enabled by smart contracts, in which the clauses of business contracts may be machine readable, and then the execu-

tion of the business contracts can happen without human intervention. Applications related to this value proposition are considered one of the most promising, considering an increase in the use of Internet of Things (IoT) and 5G. This is because external data can be collected through IoT devices and sensors such as RFID, making it possible to use big data and machine learning to provide data analytics (Zutshi et al., 2021).

There are few papers that explore this value proposition and many of them rely on the use of the Internet of Things (IoT) devices (Gomez Rivera & Tosh, 2019; Iyer, 2019; Jamil et al., 2020; Zhang et al., 2021), RFID (Vanany, 2020) and QRCode (Zhang et al., 2021) to capture external data.

Some of the motivations of the ideas and initiatives related to the value proposition of automation and analytics are the need to improve security, the need to use a decentralized environment, difficulties related to data, such as improving data access and ensuring data reliability and the lack of logistics data in the context of supply chain (Gomez Rivera & Tosh, 2019; Guo et al., 2021; Iyer, 2019; Jamil et al., 2020; Zhang et al., 2021).

In the context of supply chain applications, there are motivations of transparency and traceability of food (Vanany, 2020; Zhang et al., 2021), in which the public sector participates in a multi stakeholder network, facilitating supervision of information by authorities and the issuing of certificates (Vanany, 2020). Some of the potential benefits identified are automation, the tracking of information, the integrity of data, the increase in transparency and trust, enabling the supervision by the public sector and cost reduction (Vanany, 2020; Zhang et al., 2021).

The motivations to use blockchain in the context of smart cities for the management of critical national infrastructure (Gomez Rivera & Tosh, 2019), energy (Guo et al., 2021) and reusable water (Iyer, 2019) involve the problems with centralized environments, such as single point of failure, the proper identification of sensors and the need to improve security. Some of the potential benefits identified are security, data integrity, new ways to monitor sensors' authentication and data provenance (Gomez Rivera & Tosh, 2019; Guo et al., 2021; Iyer, 2019).

There are also some ideas and initiatives in the context of healthcare, such as the use of blockchain to monitor patient vital signs, in which some informed motivations are privacy and data sharing and the potential benefits cited are decentralization and transpar-

ency (Jamil et al., 2020).

There are two ideas of application of blockchain within this value proposition that utilize crypto economics models, which are related to energy (Guo et al., 2021) and water reuse (Iyer, 2019). In the former, it is considered the use of smart contracts for the execution of transactions related to solar energy and subsidy distribution, analyzing the subsidy expenditure of the government. In the latter, it is proposed a wastewater recycle control system to coordinate the use of water among the public and private sector. In this scenario, tokens are provided to industries and the rules for issuing or trading tokens are written as smart contracts. The system relies on IoT meters to collect data about wastewater reuse and generation.

- **Decentralized governance**

The value proposition of decentralized governance is related to systems that are based on collective governance, with decentralized ownership and decision making. Many blockchain projects such as Bitcoin and Ethereum are open source, relying on a community, and built on the principles of decentralized governance. These projects were crowdfunded instead of relying on a few investors, and their management is often based on community voting and community participation (Zutshi et al., 2021).

None of the ideas and initiatives presented in the papers explore specifically the motivations or potential benefits of this value proposition. This may be related to the high complexity and high disruptive potential of a totally decentralized governance, its far-reaching implications, and the considerable challenge of implementation (Zutshi et al., 2021).

Globally, considering the analysis of the literature regarding the motivations to use blockchain and its value, the following gaps are particularly relevant in the context of this study:

- Despite the growing reputation of blockchain, there is a lack of applied cases (Tavares et al., 2020) and a lack of concrete evaluation of its use (Al-Megren et al., 2018). There is a need to move the research related to blockchain from descriptive and theoretical studies to empirical analysis of actual imple-

mentations and assessments based on real cases, including a rigorous analysis of the benefits of the technology (Cagigas et al., 2021; Ning et al., 2021).

- There is a need to understand the skillset required to use blockchain in the context of the public sector (Cagigas et al., 2021).
- Although the technology offer potential to developing countries, there is reduced research in this area (Zein & Twinomurizi, 2019) and there is a small number of studies and cases related to South America (Moura & Gomes, 2019; Tavares et al., 2021; Toapanta et al., 2019), which is in Latin America, where there are countries with high levels of corruption (Casallas et al., 2020).

Hitherto, it was presented the motivations to use blockchain and its potential value in the context of the public sector in the previous paragraphs and topics.

Considering that the value of IT in the context of the public sector also involves the creation of public value (Picazo-Vela et al., 2018; Rose et al., 2015), the next section explores value in the context of the public sector and value of IT. This part supports the creation of the Theoretical Framework that guides data collection and analysis regarding the value of blockchain initiatives in the public sector.

2.4.2 Value in the public sector and the value of IT

The adoption of IT in the context of the public sector has the potential to create public value (Chatfield & Reddick, 2018) and this section explore this topic, to shed light on the potential public value created by the initiatives using blockchain.

This section is organized in two parts: the explanation about value in the context of the public sector (a) and the explanation of the specific value of IT in the context of the public sector (b).

a) Value in the public sector

Considering the focus of this research on the value of blockchain specifically in the context of the public sector, it is relevant to highlight some differences between the private and the public sector, because although both exist to serve people, their concerns are distinct.

The public sector organizations not only consider money income for sustainability, but also have an additional concern about public value (Twizeyimana & Andersson, 2019), dealing with problems that must be addressed, while private sector is driven by feasibility considerations (Sethibe et al., 2007). Consequently, the objectives of private sector are often expressed in terms of financial profitability while public sector is judged about the achieving of their policy mission (Sethibe et al., 2007). In the same way that managers in the private sector are profit-seeking, public managers, on behalf of the public, should actively strive to generate greater public value (Pang et al., 2014).

Value in the context of the public sector may vary according to some conditions, due to a dynamic environment. Economic, political, and social trends evolve indefinitely, and technology advances rapidly and sometimes disrupt business and society at large (Pang et al., 2014). The implications of growing challenges for society are exacerbated by increasing interconnectedness and the complexity of the escalating pace of globalization (Nabatchi, 2011). In this uncertain context, the needs and expectations of citizens are not constant. What is publicly valued may depend on the needs and desires of the public, as well as on the social and environmental circumstances of society (Pang et al., 2014).

Considering this evolving scenario, the challenge of defining IT value in the public sector context may be related to the criticism regarding public value, since it is considered vague, dealing with a lack of theoretical bases (Pang et al., 2014), although there are some efforts to reduce this gap (Nabatchi, 2011).

There are some challenges to define value in the context of the public sector. Value can be contradictory and conflicting (Gil-Garcia & Pardo, 2005; Goh & Arenas, 2020; Nabatchi, 2011; Rose et al., 2015), it may be subject to different interpretations, and it may need more clarity (Bannister & Connolly, 2014). Clarity is relevant because the assimilation of the types of value has real world implications and the inadequate way to handle values may promote systemic policy failures and it may let public managers ill-equipped to deal with increasing challenges (Nabatchi, 2011).

Regarding the challenge of conflicting types of value, Goh and Arenas (2020) explain that public organizations values are often competing, and the pursuing of one value may compromise another. As an example, there is a value-based conflict between cost reduc-

tion and being responsive to citizens since the act of being responsive requires investment in resources.

On the one hand, public values are considered relevant guides that enable an appropriate balance, rationality, and methodology to deal with real world challenges in the context of the public sector (Nabatchi, 2011). On the other hand, the conception of public value is yet to occur, since its theoretical foundation is still emerging (Pang et al., 2014).

Considering the environmental uncertainties and the difficulty to define public value (Nabatchi, 2011; Pang et al., 2014), it is expected that its measure would not be straightforward as it is in the private sector, which has measures such as sales revenues, market share and profit, which does not capture primary objectives of the public sector. Therefore, there is the acknowledgment regarding the challenge to define and measure non-market and multidimensional values such as transparency, democracy, and rule of law (Pang et al., 2014).

b) Value of IT in the public sector

Since an introduction regarding value in the context of the public sector was presented, it is possible to explore the research related to the public value of IT in the same context. The literature regarding the public value of IT enabled the identification of four types of value, which are the following: professionalism and development of trust; internal effectiveness and efficiency; quality of the public services; participation and engagement. Each of them is presented in the following paragraphs:

- ***Professionalism and development of trust***

Professionalism and development of trust (Karunasena et al., 2011; Pedersen, 2017; Rose et al., 2015; Twizeyimana & Andersson, 2019) refers to the provision of robust, independent, and consistent administration, and it encompasses the creation of durable and competent institutional capacity (Rose et al., 2015, Twizeyimana & Andersson, 2019). This public value considers the maintenance of fundamental beliefs and constitutional principles, the facilitation of democratic will (Bannister and Connolly, 2014; Twizeyimana & Andersson, 2019), ethical behavior (Twizeyimana & Andersson, 2019),

accountability (Bannister and Connolly, 2014; Ndou, 2004; Rose et al., 2015; Twizeyimana & Andersson, 2019), compliance with the law, responsibility (Bannister and Connolly 2014; Twizeyimana & Andersson, 2019), and the reduction or elimination of the risk of corruption (Ndou, 2004; Twizeyimana & Andersson, 2019) and of the abuse of the law by public servants (Twizeyimana & Andersson, 2019). This value also contemplates integrity, honesty, rectitude, fairness, equality, and impartiality (Bannister and Connolly, 2014; Twizeyimana & Andersson, 2019).

This value encompasses transparency (Ndou, 2004; Twizeyimana & Andersson, 2019) and trustworthiness (Twizeyimana & Andersson, 2019), which affects the trust in the public sector (Karunasena et al., 2011). The authors consider that the development of trust between citizens and government is a relevant aspect of the public value of IT. Trust may be related to the security of citizen's information (Bannister and Connolly, 2014; Patola et al., 2016) and transparency (Karunasena et al., 2011).

IT supports the value of professionalism with the maintenance of accurate durable records (Twizeyimana & Andersson, 2019), providing a flexible and secure public record and supporting standardized administrative procedures. The contribution of IT to this value is manifested in interoperability, infrastructure, IT governance, IT architecture (Rose et al., 2015) and better security of public data (Rose et al., 2015, Twizeyimana & Andersson, 2019).

This public value considers the achievement of different desirable social outcomes (Bannister & Connolly, 2014; Karunasena et al., 2011; Rose et al., 2015; Twizeyimana & Andersson, 2019) related to the improvement of the quality of life (Avila et al., 2017) and well-being, freedom, peace, empowerment, poverty reduction (Twizeyimana & Andersson, 2019), increased safety and crime reduction (Avila et al., 2017; Twizeyimana & Andersson, 2019), and better health and educational conditions (Twizeyimana & Andersson, 2019). Other outcomes also include justice, equality (Bannister and Connolly, 2014; Twizeyimana & Andersson, 2019), equity (Patola et al., 2016) and the promotion of the use of IT by other sectors of society (Ndou, 2004).

The literature regarding blockchain in the context of the public sector indicates that trust is a potential public value enabled by the technology (Ali et al., 2021; Koster & Borgman, 2020; Li et al., 2021a; Pu & Lam, 2021; Toufaily et al., 2021; Zhang et al.,

2021). Blockchain enables trust in data sharing and records management (Ali et al., 2021) due to the peer-to-peer and distributed network (Li et al., 2021a), and due to security, immutability, and transparency of data (Koster & Borgman, 2020). Therefore, there is no need for a trusted authority or central server (Li et al., 2021a).

- ***Internal effectiveness and efficiency***

IT influences the enhancement of internal effectiveness and efficiency of the public sector organizations (Picazo-Vela et al., 2018), leading to capacity building (Twizeyimana & Andersson, 2019) and capacity increment (Ndou, 2004). IT also has an enabling effect on public organizations, allowing them to execute activities that were not possible before (Avila et al., 2017). The effectiveness of the public sector is achieved through the use of IT (Avila et al., 2017; Patola et al., 2016; Rose et al., 2015; Twizeyimana & Andersson, 2019) when the public institutions produce a desired result or reach a defined goal (Avila et al., 2017). The efficiency of the public sector enabled by the use of IT (Avila et al., 2017; Karunasena et al., 2011; Ndou, 2004; Rose et al., 2015; Twizeyimana & Andersson, 2019) consists in helping the public organizations to execute an activity and to produce a desired result with the least possible quantity of resources (Avila et al., 2017).

The transformation of public administration by digital technologies affects efficiency in different ways (Karunasena et al., 2011; Rose et al., 2015), as related to (i) process improvement (Twizeyimana & Andersson, 2019); (ii) enabling communication between agencies (Karunasena et al., 2011; Ndou, 2004; Twizeyimana & Andersson, 2019); (iii) reducing costs (Chatfield & Reddick, 2018; Karunasena et al., 2011; Ndou, 2004; Picazo-Vela et al., 2018; Rose et al., 2015; Twizeyimana & Andersson, 2019); (iv) building and increasing capacity (Ndou, 2004; Twizeyimana & Andersson, 2019), supporting better performance (Adnani, 2014; Karunasena et al., 2011; Patola et al., 2016; Picazo-Vela et al., 2018; Twizeyimana & Andersson, 2019) and promoting better use of resources (Twizeyimana & Andersson, 2019), as the following:

- Efficiency is related to process improvement, the reduction of administrative burden and bottlenecks. Operations may be more systematic, sustainable, flexible, lean, and agile (Twizeyimana & Andersson, 2019), reducing inefficiencies,

contributing to the elimination of mistakes from manual procedures, and speeding up transaction processing (Ndou, 2004).

- The communication between agencies is enabled by strategic connections between them (Karunasena et al., 2011), which supports better collaboration and cooperation (Twizeyimana & Andersson, 2019), allowing data sharing across departments, and promoting faster and more informed decision making (Ndou, 2004).
- The efficiency enabled by IT is also related to cost reduction of process, operations, and management (Karunasena et al., 2011; Ndou, 2004; Picazo-Vela et al., 2018; Twizeyimana & Andersson, 2019), promoting economy (Rose et al., 2015; Twizeyimana & Andersson, 2019) and improving the financial return of investments (Karunasena et al., 2011).
- The creation and increase of the capacity of the public sector is influenced by IT in the reorganization of internal administration processes, communications, interrelationships, easy information flow and cost reduction, enabling public empowerment (Ndou, 2004; Twizeyimana & Andersson, 2019). This allows different departments to share databases and to pool skills and capacities for problem solving. These facilities enable faster and better decision-making processes, reducing bottlenecks (Ndou, 2004). Therefore, better performance is achieved (Karunasena et al., 2011; Patola et al., 2016), enabling strategic goals (Adnani, 2014), through enhancement of the productivity of employees, the reduction of personnel expenses required to complete some tasks (Patola et al., 2016), the reduction of the administration burden and finally the better management of public resources (Twizeyimana & Andersson, 2019).

Regarding the literature about the value of blockchain in the context of the public sector, there is an indication of the potential value of internal efficiency (Cagigas et al., 2021; Denny et al., 2017; Hao et al., 2019; Malik, 2019; Rukanova et al., 2021).

The adoption of blockchain in initiatives of the public sector indicates the benefit of processes efficiency, in the sense that results can be produced using the smallest quantity of resources, such as time, material, capital or labor. This is a consequence of the automated means to store data in a shared, tamper resistant, secure, and digital format, leading to reduction of costs (Cagigas et al., 2021). One example is the potential to in-

crease the efficiency of the public sector, due to the use of blockchain for data sharing among multiple departments (Hao et al., 2019; Rukanova et al., 2021).

Another example is found in a study that indicates the potential use of blockchain in the context of identification, enabling automation and cost reduction, due to the saved paper of the documents and reduced manpower in the institutions (Malik, 2019).

- ***Quality of the public services***

While the public value of internal effectiveness and efficiency is related to improvements inside the organizations of the public sector, the public value of quality of the public services is related to improvements in the services offered for citizens, individuals, or businesses.

The traditional model of public service delivery sometimes involves procedures that are long and time consuming. For example, if a business wishes to obtain a license, it is necessary to fill out many application forms, visit different public offices and spend a considerable amount of time. The consequences for situations like that are high costs and dissatisfaction of individuals and business (Ndou, 2004).

When the public sector invests in IT and provides appropriate digital services for individuals or businesses, there is a reduction of bureaucracy, offering round the clock accessibility and faster transactions, enhancing the quality of services in different ways (Bannister & Connolly, 2014; Chohan, 2020; Karunasena et al., 2011; Makasi et al., 2021; Ndou, 2004; Pedersen, 2017; Rose et al., 2015; Sorongan & Hidayati, 2020; Thompson et al., 2005; Twizeyimana & Andersson, 2019).

IT promotes the quality of the services provided to individuals and business through higher effectiveness of services and greater efficiency (Bannister and Connolly, 2014; Scott et al., 2016; Twizeyimana & Andersson, 2019), contributing to increase the satisfaction of the users involved (Karunasena et al., 2011; Krishnan et al., 2010).

The effectiveness of public services (Bannister and Connolly, 2014; Twizeyimana & Andersson, 2019) is related to high availability of the public services (Patola et al., 2016), utility and completeness of the needs and demands of the citizens and stakeholders by the services provided (Martins et al., 2019). The effectiveness encompasses the functionalities of the digital services and relevant features (Patola et al., 2016). It is also

related to the availability of online payment transactions (Patola et al., 2016; Rose et al., 2015), the facilitation of the access to information (Rose et al., 2015), the availability of information (Karunasena et al., 2011) that are accurate and up to date (Patola et al., 2016), contributing to increase transparency (Bannister and Connolly, 2014; Twizeyimana & Andersson, 2019).

The efficiency of the public services (Bannister and Connolly, 2014; Twizeyimana & Andersson, 2019) is user oriented, focusing on the speed of public service processes (Patola et al., 2016) and the time required to solve the needs of the users, with quick results and answers (Martins et al., 2019). Therefore, it is possible to achieve shorter response times of online transactions (Rose et al., 2015) and higher responsiveness (Bannister and Connolly, 2014). The efficiency gains contribute to cost reduction for the individuals (Avila et al., 2017; Karunasena et al., 2011; Patola et al., 2016; Rose et al., 2015; Twizeyimana & Andersson, 2019), in comparison to traditional services (Karunasena et al., 2011).

The quality of the digital public services is judged by the satisfaction of the users (Krishnan et al., 2010), related to the personal experience of using the services, which depends on the perceptions regarding their expectations and needs (Karunasena et al., 2011) and it can be measured by feedbacks and evaluations (Martins et al., 2019).

The literature regarding the value of blockchain in the context of the public sector that is related to the value proposition of decentralized data infrastructure and membership management does not explore whether or how this public value is created. The rest of the studies indicate the quality of the public services as a potential value created (Alexopoulos et al., 2019; Jaoude & Saade, 2019). The technology has the potential to improve the public services by the simplification of processes, reduction of bureaucracy, increasing transparency, and making information open and accessible to citizens and business (Alexopoulos et al., 2019). The use of smart contracts allows the execution of complex operations in a streamlined way, influencing the quality of the services (Jaoude & Saade, 2019).

- ***Participation and engagement***

IT supports the increased engagement of civil society in government programs (Picazo-

Vela et al., 2018) and policy development, in accordance with the public good (Rose et al., 2015; Twizeyimana & Andersson, 2019). Namely, IT enables the participation of individuals in government actions and public discussions (Karunasena et al., 2011; Picazo-Vela et al., 2018; Rose et al., 2015; Twizeyimana & Andersson, 2019), network and community creation (Ndou, 2004), community empowerment, increasing electronic democracy with the focus on the needs of the citizens (Rose et al., 2015), co-creation of public services (Chohan, 2020) and giving more control of governmental actions and decisions to the public (Scott et al., 2016; Twizeyimana & Andersson, 2019).

Participation and engagement are related to the cooperation and collaboration of society in solutions demanded in the context of the public sector (Martins et al., 2019; Twizeyimana & Andersson, 2019). The participation and engagement of the public rely on appropriate tools and conditions, such as the availability of websites (Ndou, 2004), online forums and communities (Karunasena et al., 2011; Ndou, 2004; Patola et al., 2016; Twizeyimana & Andersson, 2019), the availability of shared data from different public agencies (Ndou, 2004), and mechanisms for policy development (Patola et al., 2016).

Websites that are designed appropriately can be valuable resources to give transparency for governmental information (Ndou, 2004), facilitating policy development (Patola et al., 2016). Some tools such as forums and online communities' networks (Karunasena et al., 2011; Ndou, 2004; Patola et al., 2016) facilitate the consultation of citizens (Bannister and Connolly, 2014) and the continuous interaction between government, citizens, and business. Listening to the ideas, shared knowledge, suggestions, needs and requirements of these stakeholders is essential for a better decision-making process and governmental discussions (Ndou, 2004; Patola et al., 2016). Therefore, the improvements in the speed and quality of decision-making rely on the willingness and capacity of government to deal with new information and to process large amounts of data. It is also necessary to shift from a hierarchical public administration model to a more flexible and less centralized one (Ndou, 2004). The use of shared data from different public agencies and departments is also necessary to support decisions and to better serve the community (Ndou, 2004).

The consequences of the participation and engagement of society in the context of the public sector are better policy development (Ndou, 2004; Rose et al., 2015; Twizeyima-

na & Andersson, 2019), greater quality of decision making (Karunasena et al., 2011; Ndou, 2004) and increased trust (Ndou, 2004; Twizeyimana & Andersson, 2019).

The public sector capacity to tap wider sources of information, perspectives, ideas, and solutions enables a more appropriate policy development, which faces increased complexity (Ndou, 2004) and problems (Nabatchi., 2011). The quality of decision making is achieved by the active involvement of citizens (Karunasena et al., 2011) and by the transparency of the process of interaction between society and the public sector. All of this influences the trust of citizens in the governmental institutions (Ndou, 2004; Twizeyimana & Andersson, 2019).

The literature regarding the value of blockchain in the context of the public sector just indicates that blockchain offers the potential public value of participation, without an in-depth explanation about it (Cagigas et al., 2021; Olnes and Jansen, 2018). According to Olnes and Jansen (2018), the governance and distributed control enabled by blockchain is related to democracy and participation, and this would challenge the existing regime of authority and control of many governments.

Finally, and in summary, the literature about the value of IT considers that public sector organizations have different concerns from the private sector organizations, which is the search for public value. The public values enabled by IT were organized in four, namely: professionalism and development of trust; internal effectiveness and efficiency; quality of the public services; and participation and engagement. The explanation, description and characteristics of each value were presented. The analysis of the types of value encompasses the challenge to deal with intangible and conflicting goals of the public sector (Goh & Arenas, 2020), and with the diversity of stakeholders involved (Pang et al., 2014; Sethibe et al., 2007).

In the literature regarding the value of blockchain in the context of the public sector there is one study that explores the public value of blockchain, which is related to a platform for the negotiation of forest credits related to environmental services. The application seems to be a pilot and according to the authors, it is in the process of acquiring maturity (Tavares et al., 2020). There are other studies that just cite some few examples of the potential to create public value, without an in-depth explanation about it (Alexopoulos et al., 2019; Cagigas et al., 2021; Jaoude & Saade, 2019; Olnes and Jansen,

2018). Therefore, it is not clear whether and how the technology influences the creation of public value and neither about the resources or capabilities that may influence the public value creation (Goh and Arenas, 2020; Pang, 2014) in the context of blockchain adoption.

2.4.3 Synthesis and research gaps

The limitation of the literature regarding the value of blockchain is expected since the technology is emergent. There are few cases in the context of the public sector (OECD, 2018; Warren and Treat, 2019) and the appropriate evaluation of value depends on more time and more cases of adoption addressed by researchers. The following gaps were identified:

- The lack of studies encompassing empirical data and applied applications of the technology (Tavares et al., 2020) is notable. It is not a surprise that most studies encompass ideas and initiatives about the use of blockchain in early stages of development (Hang et al., 2019; Jamil et al., 2020; Yadav & Kushwaha, 2021). Therefore, these studies present just the expected value of the technology.
- The literature regarding the value of IT indicates the expected public value created in the context of the public sector (Bannister & Connolly, 2014; Twizeyimana & Andersson, 2019). There is an indication of the potential of blockchain to create public value (Alexopoulos et al., 2019; Cagigas et al., 2021; Denny et al., 2017; Hao et al., 2019; Jaoude & Saade, 2019; Olnes and Jansen, 2018; Rukanova et al., 2021), nonetheless, empirical studies are necessary for more clarification. This research expects to contribute to fill this gap, exploring the influence of initiatives that are using blockchain in the creation of public value.

This topic presented the literature regarding the motivations to use blockchain in the context of the public sector, the value propositions of blockchain and the public value of IT. It was revealed some research gaps from previous studies and the expected contribution of this research.

The next topic explores the resources and capabilities that influence the value creation of IT in the context of the public sector, relying on the strategic management, information systems and digital government literature, encompassing the resource-based

view and the dynamic capability view.

2.5 Resources and capabilities that influence value creation

This section discusses the findings of the literature regarding the resource-based view (RBV) and dynamic capabilities view (DCV), which are theoretical lenses used to analyze the value of IT in the context of the public sector. The findings support the creation of the Theoretical Framework to guide the analysis of the influence of resources and capabilities in the value creation of blockchain in the context of the public sector. The end of the section encompasses the synthesis of the studies analyzed and some research gaps that were found.

The value creation of IT in the context of the public sector relies on the strategic management, information system and digital government literature, encompassing the theoretical lenses of the resource-based view (Chan et al., 2011; Dahiya & Mathew, 2016; Janssen and Joha, 2007; Kanungo & Jain, 2011; Pang et al., 2014; Picazo-Vela et al., 2018; Zhao & Fan, 2018; Zhao & Fan, 2021; Zheng et al., 2013) and the dynamic capabilities view (Abdullah et al., 2020; Chatfield & Reddick, 2018; Janssen and Joha, 2007; Kanungo & Jain, 2011; Luna-Reyes et al., 2020; Pang et al., 2014; Waring et al., 2018). There are some authors that conduct studies related to the value of IT in the context of the public sector which considers capabilities or resources, but without a detailed or specific statement regarding the importance of RBV and DCV (Alshaher, 2021; Goh and Arenas, 2020; Makasi et al., 2021; Pedersen, 2017).

RBV is considered one of the most compelling theoretical backgrounds in business and in information systems disciplines to explain the relationship between resources and outcomes, enabling the definition and execution of strategies (Zhao & Fan, 2018). RBV is also used to analyze the relationship between resources and the public value of IT in the context of the public sector (Picazo-Vela et al., 2018).

The definition of resources encompasses capabilities, organizational processes, firm attributes, knowledge, strengths, and assets that firms use to conceive and implement their strategies (Barney, 2001; Barney et al., 2012). Resources and capabilities are generally treated as synonyms (Barney et al., 2021; Zheng et al., 2013) and they may be tangible, such as financial capital, physical capital, equipment, or intangible, such as

human capital, experience and training, organizational culture, relations, structure, controlling systems, and reputation (Barney, 1991; Barney, 2001; Barney et al., 2012). The RBV considers that the resources and capabilities are used by managers to conceive of and implement strategies (Barney, 2021).

The RBV assumes that firms may be heterogeneous in terms of the resources they control, and these resources may not be perfectly mobile across firms (Barney, 1991). The resources and capabilities related to sources of value creation are co-specialized, which means that they are more productive when used together. They are also valuable, rare, costly to imitate, non-substitutable, and it involves situations that are socially complex, path dependent and/or causally ambiguous (Barney et al., 2021). Therefore, the RBV considers that a subset of resources in an organization creates superior performance in the long term. Firms differ in the resources they control because of different reasons, such as resource-market imperfections, discretionary managerial decisions (Amit and Schoemaker, 1993), resource-picking mechanisms and capability building mechanisms (Makadok, 2001).

The RBV has been criticized for ignoring factors surrounding resources, assuming that they simply exist. DCV attempts to bridge the firm resources and the changing environment, adjusting the resource mix and maintaining the sustainability of the organization (Janssen & Joha, 2007).

The dynamic capability view considers that the sources and methods of wealth creation in environments of rapid technological change rests on distinctive processes, assets positions and evolution paths (Teece et al., 1997). According to DCV, resources configuration, or the ability to use dynamic capabilities to alter the resource base, is a source of value (Eisenhardt & Martin, 2001). Makadok (2001) cites that capabilities and resources that are at least partially imitable or substitutable are sources of economic rent. Dynamic capabilities related to the sensing and seizing of new opportunities, together with the reconfiguration of tangible and intangible assets, sustain long run enterprise performance in a context of rapid innovation (Teece, 2007).

It is relevant to explain what a dynamic capability is and what are its main characteristics. Dynamic capabilities represent the ability of the organizations to integrate, build and reconfigure internal and external competences to address changing environments

(Teece et al., 1997). Dynamic capabilities are a set of specific and identifiable processes that create value for firms in dynamic markets, and since they can be duplicated across firms, their value lies on the specific resource's configuration created by them (Eisenhardt and Martin, 2000). Dynamic capabilities contrast with ordinary or operational capabilities because dynamic capabilities involve long term commitments with specialized resources (Winter, 2003).

Since some foundations about RBV and DCV were presented, we now move to explore the studies that rely on them to shed light on the value creation of IT in the public sector. This enables the investigation of whether and how possible similar mechanisms may influence the value creation of blockchain technology in the context of the public sector.

Research on how the use of IT in the public sector affects performance and value remains under examined (Pang et al., 2014), although IT constitutes an important drive for innovation in the public sector (Luna-Reyes et al., 2020). This is in part due to a lack of theoretical bases for investigating IT value in the public sector (Pang et al., 2014).

Previous studies demonstrate the influence of strategic management practices on value creation, in the context of the public sector (Abdullah, 2021). The literature reveals that the resources and capabilities that influence value creation of IT in the context of the public sector may be organized in three types, namely: dynamic capabilities, IT resources and capabilities, and other resources and capabilities. Table 5 presents some studies related to the different types of resources and capabilities.

Table 5

Types of resources and capabilities

Authors	Type	Description	Examples
Abdullah et al., 2020; Chatfield and Reddick, 2018; Janssen and Joha, 2007; Kanungo and Jain, 2011; Luna-Reyes et al., 2020; Waring et al., 2018	Dynamic capabilities	Strategic and organizational routines by which resource-based strategies are defined by managers to develop value-creating strategies	Sensing, seizing, reconfiguring
Abdullah et al., 2020; Brown and Brudney, 1998; Cunningham et al., 2007; Dahiya and Mathew, 2016; Goh and Arenas,	IT resources and capabilities	Resources and capabilities related to information technology	IT knowledge, technical knowledge, IT managerial

2020; Luna-Reyes et al., 2020; Pang et al., 2014; Zhao and Fan, 2018; Zhao and Fan, 2021; Zheng et al., 2013			knowledge, software, hardware
Chan et al., 2011; Goh and Arenas, 2020; Makasi et al., 2021; Pang et al., 2014; Pedersen, 2017; Picazo-Vela et al., 2018; Zhao and Fan, 2021; Zheng et al., 2013	Other resources and capabilities	Other resources and capabilities which are not IT neither dynamic capability	Planning, internal processes, financial resources
Abdullah et al., 2020; Chan et al., 2011; Picazo-Vela et al., 2018; Zhao and Fan, 2018;	Mixed or not specific	The definition of the resource or capability is related to more than one type, or there is not enough information about the type	Knowledge, tangible resources, internal resources

The following subsections explores the main types of resources and capabilities found in the literature review:

2.5.1 Dynamic capabilities

Dynamic capabilities have been used as the basis to analyze the influence of IT in the context of the public sector (Abdullah et al., 2020; Chatfield & Reddick, 2018; Janssen & Joha, 2007; Kanungo & Jain, 2011; Luna-Reyes et al., 2020; Waring et al., 2018). These dynamic capabilities are sensing (Chatfield & Reddick, 2018; Kanungo & Jain, 2011; Waring et al., 2018), seizing (Kanungo & Jain, 2011; Waring et al., 2018) and reconfiguring (Janssen & Joha, 2007; Kanungo & Jain, 2011).

The development of dynamic capabilities is not a fast process, it is nurtured and refreshed over time (Waring et al., 2018). Organizations that have mature dynamic capabilities will have processes for decision making, they will use systems to sense possibilities, and they will have staff whose role is to scan the environment for opportunities, which would be presented for internal committees (Waring et al., 2018). The sensing of needs is related to the use of relevant information (Chatfield & Reddick, 2018). According to Waring et al. (2018), sensing involves systems and individual capacities to sense, learn, filter, shape and calibrate opportunities. Sensing encompasses process to identify changing needs of users and customers (Chatfield & Reddick, 2018; Waring et al., 2018) and to scan external IT developments (Waring et al., 2018; Zheng et al., 2013).

The process of sensing is creative, it may involve different stakeholders, including IT professionals, users, suppliers, among others (Waring et al., 2018).

The sensing of external opportunities enables managers to exploit resources. Top management teams from the public sector should sense the adoption of IT, and support the integration of resources with other organizations (Zheng et al., 2013). The managerial skills needed to sense are different from those needed to seize and reconfigure, and organizations should build and use all of them (Waring et al., 2018).

Sensing is related to the capacity to choose emerging and enabling IT. It involves routines to identify, assess, filter, and reach conclusions regarding the timing and viability of IT. There is indication that this capability may be weak in the presence of bureaucracy, lack of process for sensing and lack of competent individuals (Kanungo & Jain, 2011).

The sensing capability is aligned with the capacity to deliver value (Waring et al., 2018) and with improved performance (Chatfield and Reddick, 2018). The role of sensing was explored by Chatfield and Reddick (2018) in the context of IT public value creation. They analyzed the importance of sensing the needs of customers in on-demand services of a municipal government. The agility of sensing is considered dependent on the understanding, absorption and use of relevant information and knowledge. Waring et al. (2018) explored the importance of sensing in the generation of benefits in the context of the public health system.

Seizing is another dynamic capability indicated by the literature as influencing the value creation of IT. It involves decision making protocols, processes to manage and deliver benefits through portfolio of projects, the training of staff, the creation of commitment and the focus on the delivery of benefits and strategic priorities (Waring et al., 2018). Seizing is related to the enterprise structures, procedures, and design to seize opportunities (Waring et al., 2018). Enterprise structure may influence the quality of decisions, affecting performance. In centralized organizational structures, there are layers of approvals, concentration of power and authority, which may lead to low enthusiasm and interest of individuals (Zhao and Fan, 2018).

The seizing capability is called by Kanungo and Jain (2011) as matching, and it is defined as the capability to effectively see how information technologies match value-

adding opportunities. The inputs for the capability of seizing come from the sensing capability and it includes department priorities and infrastructural assessments.

There are some studies that do not specifically address the dynamic capability of seizing, although they consider the influence of other capabilities that are dynamic (Chatfield & Reddick., 2018; Janssen & Joha, 2007; Kanungo & Jain, 2011; Luna-Reyes et al., 2020; Abdullah et al., 2020; Pang et al., 2014) or other capabilities that are not dynamic (Chan et al., 2011; Dahiya & Mathew, 2016; Goh & Arenas, 2020; Makasi et al., 2021; Pedersen, 2017; Picazo-Vela et al., 2018) in the value creation of IT in the context of the public sector.

Finally, the dynamic capability of reconfiguring is also explored in the literature regarding the value of IT in the context of the public sector (Janssen & Joha, 2007; Kanungo & Jain, 2011). The DCV takes the dynamic environment into account and emphasizes the renew of resources, so internal and external competencies are reconfigured into new functional competences. Since the environment of organizations is constantly changing, the continuous reconfiguring and transformation is extremely important in addressing changing requirements and demands from the internal and external environment (Janssen & Joha, 2007).

According to Kanungo & Jain (2011), the reconfiguring or executing capability is the capacity of the organizations to reconfigure the resources, processes, products, and services to get change done. This capability assumes that the organization evaluated inputs, matched them with opportunities, selected strategic options and it is committed to reconfigure its resources.

Considering that inter-organizational collaboration requires a combination of skills (Makasi et al., 2021) that is important in the context of the creation of blockchain solutions (Toufaily et al., 2021), it may be valuable to reconfigure the resources and capabilities of different organizations to achieve the benefits expected. The appropriate reconfiguration of resources and capabilities among organizations may be a way to reduce the problems with collaboration, communication, and coordination in blockchain implementations (Dhagarra & Choudhury, 2018).

Janssen and Joha (2007) presents the role and importance of reconfiguration of resources and capabilities in efficiency and effectiveness, in the context of a decentralized

network of municipalities, in which the capacity and resources of each single municipality were too limited for the development of new services.

This subsection explored the dynamic capabilities that influence the value creation of IT in the context of the public sector. The next subsection discusses the IT resources and capabilities with a similar effect.

2.5.2 IT resources and capabilities

There are some studies that considers the influence of IT resources and capabilities in the value creation of IT in the context of the public sector (Abdullah et al., 2020; Alshaher, 2021; Dahiya & Mathew, 2016; Goh & Arenas, 2020; Pang et al., 2014; Picazo-Vela et al., 2018; Zhao & Fan, 2018; Zhao & Fan, 2021).

IT capabilities are considered a critical factor for the success of system implementation and of organizations, and there is a shortage of studies related to it, especially in the context of the public sector (Alshaher, 2021). Dahiya and Mathew (2016) consider that although IT skills have become commodity-like, IT architecture has strategic significance when it provides interoperability and when it has flexibility to respond to changing needs of the organizations.

Previous studies consider similar definitions for IT capabilities, IT resources, IT infrastructure, IT assets and technical capacity, as discussed in the following paragraphs.

Alshaher (2021) considers the definition of IT capabilities as the ability of the organizations to integrate, assemble and deploy resources based on information technology. According to Abdullah et al. (2020), IT capabilities encompass hardware, software, IT infrastructure, etc. For Dahiya and Mathew (2016), IT capabilities are related to competencies, practices, and the management skills of various components of an architecture, like the application layer, communications layer, data layer and services layer.

Dahiya and Mathew (2016) indicate IT infrastructure as an IT asset encompassing IT components, IT skills, shared IT services and applications. IT infrastructure is related to hardware, software, and facilities to develop, test, deliver, control or support IT services. IT resources encompass IT infrastructure, IT competence, IT investments and IT information management capability (Pang et al., 2014). Picazo-Vela et al. (2018) state

that previous studies have considered IT resources as IT systems, equipment, generic IT, IT spending, IT skills, etc.

According to Zhao and Fan (2018), technical capacity encompasses the technical skills of the employees of agencies from the public sector. Zhao and Fan (2021) consider technical capacity as the level of expertise held by the government in the implementation of an initiative.

Previous studies that rely on IT resources and capabilities to understand value creation in the public sector were conducted in the context of government linked companies in Malaysia (Abdullah et al., 2020), e-government services in Iraq (Alshaher, 2021), services of property registration and land record in India (Dahiya and Mathew, 2016), public organizations in an European country (Goh & Arenas, 2020), and public agencies in China (Zhao & Fan, 2018; Zhao & Fan, 2021).

The research of Abdullah et al. (2020) indicates that there is a positive relationship between IT capabilities, the adoption of strategic management practices and value creation. The study of Alshaher (2021) confirms the importance of the crucial role of IT capabilities in influencing the success of IT in the context of the public sector. The importance of IT capabilities is also explored in the study of Dahiya and Mathew (2016). They identified that IT capability has a positive effect on the performance of IT in the context of the public sector, leading to improvements in the services provided for citizens.

Pang et al. (2014) present the influence of IT resources and organizational capabilities on public value and Goh and Arenas (2020) find evidence of IT resources driving innovative capability. According to the authors, the innovation driving is enabled when the organizations from the public sector are able to sense the changing and emerging needs of society, enabling the provision of more innovative solutions.

The study of Zhao and Fan (2018) encompasses the direct influence of technical capacity in value creation in the context of open government data and another research of Zhao and Fan (2021) indicates the role of technical capacity on the implementation of open government data.

This subsection presented the findings of the literature review about the influence of IT

resources and capabilities in the value creation of IT in the context of the public sector. These findings will be considered as the theoretical support to define the Framework to explore the influence of resources and capabilities in the value creation of blockchain in the context of the public sector. The Theoretical Framework considers that, as the same way that IT resources and capabilities influence the value creation of IT in the context of the public sector, IT resources and capabilities may also influence the value creation of blockchain. The details of the Theoretical Framework are discussed in the Chapter 3.

2.5.3 Other resources and capabilities

There are some studies that indicate some capabilities and resources that influence the value creation of IT in the context of the public sector which are not considered by the authors as dynamic capabilities, neither they are defined as IT resources and capabilities (Abdullah et al., 2020; Chan et al., 2011; Makasi et al., 2021; Pedersen, 2017; Picazo-Vela et al., 2018; Zhao & Fan, 2021), such as rules and regulations (Zhao & Fan, 2021), top management commitment (Zheng et al., 2013), planning, delivery, review and exploitation (Pedersen, 2017), organizational capabilities (Goh & Arenas, 2020; Pang et al., 2014), heterogeneity of human capital (Abdullah et al., 2020), among others, as the following:

- Rules and regulations are considered as operational guidelines for the implementation of some initiatives in the context of agencies from the public sector. The guidelines indicate the capacity of some initiatives from the agencies to affect performance (Zhao & Fan, 2021).
- Top management commitment is related to the sensing of external pressures by top management and the action of shaping the internal capabilities and leveraging resources to make adoption decisions (Zheng et al., 2013).
- Planning, delivery, review, and exploitation are capabilities for benefit realization, empirically analyzed in the context of national and local organizations of the public sector, according to Pedersen (2017).
- Organizational capabilities are considered in the studies of Goh and Arenas (2020) and Pang et al. (2014) as public service delivery, resource acquisition, innovation, co-production, and public engagement. According to the authors,

these capabilities and IT resources influence public value.

- The heterogeneity of human capital is related to experience, skills, knowledge, educational level of managers, how problems are addressed, etc (Abdullah et al., 2020). Their research presents the relation among strategic management practices, IT capabilities and the heterogeneity of human capital.

Then, this subsection presented other resources and capabilities that influence the value creation of IT in the context of the public sector, which are different from IT and from dynamic capabilities. The next subsection embraces the synthesis and research gaps identified in the literature.

2.5.4 Synthesis and research gaps

Section 2.5 presented the resources and capabilities that are associated with the value creation of IT in the context of the public sector. The following highlights are particularly relevant in the context of this study:

- There is a lack of theoretical bases for investigating IT value in the context of the public sector (Pang et al., 2014).
- The RBV and DCV have been used to evaluate the value creation of IT in the context of the public sector (Kanungo and Jain, 2011; Pang et al., 2014).
- Previous studies indicate that dynamic capabilities are considered as elements that influence the value creation of IT in the context of the public sector (Abdullah et al., 2020; Chatfield & Reddick, 2018; Kanungo and Jain, 2011).
- IT resources and capabilities are considered relevant to understand the value creation in the context of the public sector (Abdullah et al., 2020; Dahiya & Mathew, 2016; Goh & Arenas, 2020; Pang et al., 2014).
- Some authors consider that the extant literature is inadequate to explain how IT resources and capabilities contribute to value creation in the context of the public sector, which are not subject of competitive forces and rent-seeking shareholders (Pang et al., 2014).
- There are capabilities that are not identified in the literature as dynamic, and resources and capabilities that are not related to IT, which may nonetheless influ-

ence the value creation of IT in the context of the public sector (Abdullah et al., 2020; Pedersen, 2017; Zhao & Fan, 2021). Some of them are experience, knowledge and education level of managers, encouragement and support towards innovation, organizational arrangement, rules, and regulations.

- There is complementarity of different types of resources and capabilities in the value creation of IT in the context of the public sector (Abdullah et al., 2020; Chatfield & Reddick, 2018; Dahiya & Mathew, 2016; Goh & Arenas, 2020; Kanungo & Jain, 2011; Pang et al., 2014; Picazo-Vela et al., 2018; Waring et al., 2018; Zhao & Fan, 2018).
- Research related to dynamic capabilities has tended to be focused on open economies in rapid technological change environment and it has highlighted the organizational and management competences that enable organizations to achieve better performance and competitive advantage. In the context of the public sector, it is considered that dynamic capabilities should be incorporated into strategic management (Waring et al., 2018).
- It is suggested the investigation of the relationship between IT capability and the performance of the use of IT in the context of the public sector (Dahiya & Mathew, 2016).
- Research may go beyond conventional economic performance measures related to IT, such as cost efficiency and productivity and explore a more variety of non-economic, societal value, such as transparency and trust in government (Pang et al., 2014).
- Without a sufficient body of knowledge related to the use of IT in the public sector, the researchers would not be able to effectively inform and interact with the public sector managers as their audience (Pang et al., 2014).

This chapter encompasses some highlights and research gaps related to the literature review associated with the value of blockchain in the context of the public sector, the public value of IT and the resources and capabilities influencing the value creation of IT. The next chapter discusses the research questions of this study and the Theoretical Framework created to support data collection and analysis.

3 RESEARCH QUESTIONS AND THEORETICAL FRAMEWORK

3.1 Introduction

This chapter presents the research gaps identified in the literature of strategic management, information systems, and digital government related to the value of blockchain and IT in the context of the public sector, encompassing some omissions and situations that are not well clarified yet. With the aim to respond to those gaps, this chapter formulates the research questions (section 3.2) and presents the proposed Theoretical Framework (section 3.3).

3.2 Gaps and research questions

The literature review presents research gaps related to the motivations to use blockchain, regarding the value of the technology in the context of the public sector and regarding resources and capabilities that may influence the value of blockchain. The gaps related to the motivations to use blockchain are the following:

- It is not clear why should blockchain be used in the public sector (Konashevych and Poblet, 2019).
- Previous studies that state the motivations to use the technology in specific areas of application (Table 4) are based on ideas and initiatives that are in the initial stage of development (Alnafrah & Mouselli, 2021; Yadav & Kushwaha, 2021), as architectures and prototypes. The analysis about the motivations to use the technology in initiatives that are fully implemented are not clear, hindering the assessment of the fulfillment of expectations.

To fulfill this gap, we propose the following research question:

RQ1: Why does the public sector adopt blockchain?

The gaps related to the value of blockchain in the context of the public sector are the following:

- There is a lack of empirical evidence about the use of blockchain (Ali et al., 2021; Cagigas et al., 2021). It is necessary to move from theoretical analysis to real-world insights (Sanchez, 2019). Previous studies that present the potential

value of the technology (Table 4) rely on ideas and initiatives that are in initial stages of development, as models and frameworks (Alnafrh & Mouselli 2021; Guo et al., 2021; Li et al., 2021a), architectures (Yadav & Kushwaha, 2021), and prototypes (Hang et al., 2019). These conditions difficult the understanding of the real value of the technology.

- Although it is expected that IT influence the creation of public value (subsection 2.4.2) in the context of the public sector (Chatfield & Reddick, 2018), it is not yet clear what is the contribution of blockchain in this regard. Just one study analyzes the public value of blockchain, but it considers only one case that is in the process of acquiring maturity (Tavares et al., 2020). There is a lack of evidence regarding the public value created by blockchain initiatives.
- Considering that the literature regarding the value of IT explores the public value created in the context of the public sector (Bannister & Connolly, 2014; Twizeyimana & Andersson, 2019), there is an indication of the potential of blockchain to create public value (Alexopoulos et al., 2019; Cagigas et al., 2021; Denny et al., 2017; Hao et al., 2019; Jaoude & Saade, 2019; Olmes and Jansen, 2018; Tavares et al., 2020; Rukanova et al., 2021), Nonetheless, empirical and in-depth studies are necessary for more clarification.
- There is limited research regarding the use of the technology in the context of developing countries (Zein & Twinomurinzi, 2019) and in the context of South America (Moura & Gomes, 2019; Tavares et al., 2021; Toapanta et al., 2019), hindering the comprehension of the impact of the initiatives in the public sector of those countries.

To address the above gaps on the lack of empirical evidence regarding the value of blockchain specifically in the public sector, we formulate the next research question:

RQ2: What is the value of blockchain in the context of the public sector and how is value created?

Regarding resources and capabilities that may influence the value of blockchain, previous studies that evaluate the influence of IT in the context of the public sector rely on dynamic capabilities (Kanungo & Jain, 2011; Waring et al., 2018), IT resources and capabilities (Abdullah et al., 2020; Dahiya & Mathew, 2016; Goh and Arenas, 2020;

Pang et al., 2019; Zhao & Fan, 2018) and other varied resources and capabilities (Abdullah et al., 2020; Chan et al., 2011; Makasi et al., 2021; Pedersen, 2017; Picazo-Vela et al., 2018; Zhao & Fan, 2021), as presented in Table 5. It is not clear what are the resources and capabilities that influence the value creation of blockchain and how this influence occurs in the context of the public sector.

Then, to contribute to the understanding of this issue, the study addresses the next research question:

RQ3: What are the resources and capabilities that influence the value creation of blockchain in the context of the public sector and how does this influence occur?

By researching the proposed questions, we expect the contribution of this research to be the following:

- Clarify the motivations to use blockchain in the public sector (Konashevych & Poblet, 2019) and verify whether the value of the technology fulfill the initial expectations.
- Contribute to the advance of knowledge regarding the value creation of blockchain, moving the research related to the technology from theoretical and technical studies to empirical and rigorous analysis (Cagigas et al., 2021; Ning et al., 2021) in the context of the public sector.
- Understanding regarding the public value created by blockchain initiatives (Alexopoulos et al., 2019; Cagigas et al., 2021; Denny et al., 2017; Hao et al., 2019; Jaoude & Saade, 2019; Olnes and Jansen, 2018; Tavares et al., 2020; Rukanova et al., 2021) based on specific and in-depth analysis.
- Since the RBV and DCV has been used to evaluate the value creation of IT in the context of the public sector (Kanungo and Jain, 2011), this research expects to clarify which resources and capabilities contributes to the value creation of blockchain.
- This study expects to deliver insights about the use of the technology in the context of developing countries (Zein & Twinomurinzi, 2019) and in the context of South America (Moura & Gomes, 2019; Tavares et al., 2021; Toapanta et al., 2019), since the cases selected are related to countries from this region.

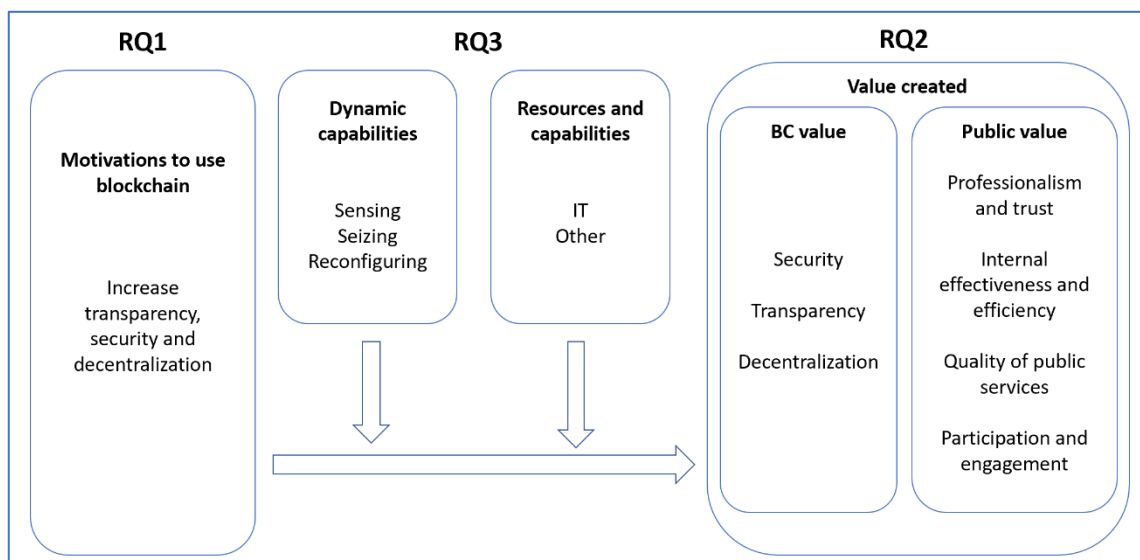
3.3 Theoretical Framework

Building on the literature review and related to the gaps presented, Figure 9 proposes a Theoretical Framework that integrates the research questions, the dimensions associated with each of them, and some values expected. The comprehensive literature review was particularly useful, as there is no information available on how similar research issues have been explored in the past, so more information was needed for developing a viable framework (Sekaran and Bougie, 2013). This step supported the creation of the Theoretical Framework and the definition of the plan to collect, analyze and report data.

Specifically, the Theoretical Framework builds on the literature and research questions. The left side represents the motivations to use blockchain in context of the public sector. The right side represents the potential value of blockchain initiatives. In the middle, there is an indication of the possible resources and capabilities that may contribute to the value creation of blockchain in the context of the public sector.

Figure 9

Theoretical Framework



Considering the RQ1, the literature review indicates that the main motivations to use blockchain in the context of the public sector are related to security (Al Barghuthi et al., 2019; Gao et al., 2021; Geneiatakis et al., 2020; Kadam et al., 2020; Kaur et al., 2020;

Malik et al., 2019; Wang & Huang., 2021), decentralization (Gao et al., 2021; Geniatakis et al., 2020; Hassija et al., 2021; Kadam et al., 2020; Satish Babu & Suresh Babu, 2020; Shuaib et al., 2020; Wang & Huang, 2021; Westerlund et al., 2021) and transparency, including the reduction of fraud, tampering and corruption (Al Barghuthi et al., 2019; de Souza-Daw & Ross, 2021; Hassija et al., 2021; Moura & Gomes, 2017; Pandey, 2018; Satish Babu & Suresh Babu, 2020; Wang & Huang, 2021). Therefore, these motivations are included in the Theoretical Framework.

The Theoretical Framework addresses the RQ2 considering the main potential benefits of the use of blockchain presented in the literature, which are security, transparency, and decentralization (Hang et al., 2019; Pradana et al., 2018; Xu et al., 2018), and the potential of blockchain initiatives to create the public value of professionalism and trust, internal effectiveness and efficiency, quality of public services, participation, and engagement. These motivations and potential value are related to the value proposition of decentralized infrastructure and membership management. It is worth to highlight that the ideas and initiatives of blockchain adoption identified in the literature review are in initial stages of development, such as models, framework, architecture, and proof of concept.

The RQ3 is addressed by the Theoretical Framework considering that previous studies state the contribution of resources and capabilities in the value creation of IT in the context of the public sector, but the resources and capabilities related to the value creation of blockchain is not clear. The literature review presents the contribution of dynamic capabilities (Kanungo & Jain, 2011; Waring, 2018), IT resources and capabilities (Abdullah et al., 2020; Dahiya & Mathew, 2016; Goh & Arenas, 2020; Pang et al., 2014) and other resources and capabilities (Abdullah et al., 2020; Pedersen, 2017; Zhao & Fan, 2021). The Theoretical Framework assumes that similar resources and capabilities may influence the value creation of blockchain, and it will contribute to clarify what are these resources and capabilities and how the influence may occur.

In summary, this is the Theoretical Framework that guides the data collection and analysis. It is expected that the research questions represented in the framework would support the understanding of the value of blockchain in the context of the public sector and would clarify the resources and capabilities that may influence the value creation.

The literature of IT in the public sector has focused more on technical aspects, and there is a call to move to value-based studies (Goh & Arenas, 2020). Twizeyimana and Andersson (2019) claim for research where frameworks are tested in actual implementations of IT for public organizations, and this study aims to contribute to the better understanding of the value of this emerging IT in the context of the public sector.

This chapter discussed the research gaps related to the value of blockchain in the context of the public sector, proposed the research questions and the Theoretical Framework. The next chapter encompasses the methodology defined to address the research questions.

4 METHODOLOGY

4.1 Introduction

This chapter discusses the methodology of this study, namely the research design components (4.2), which includes the unit of analysis and case selection criteria, the steps related to data collection (4.3) and data analysis (4.4).

A method is a tool available to the production of new knowledge and while researchers faithfully consider the impact of the method on the quality of the output, they frequently neglect practical considerations and ease of use. It is believed that a valuable methodology should improve the rigor of research work (Templier & Pare, 2015).

The research design is the logical sequence that links the research questions to the data to be collected and, ultimately, to the conclusions. Its main purpose is to avoid situations in which the evidence does not address the initial research questions (Yin, 2014).

This study is approached by case study research because its goal is to explore how blockchain technology may create value in the context of the public sector. According to Yin (2018), case study research is the preferred method in situations when: (i) the main questions involve “why” or “how”, (ii) when the researcher has little or no control over the events, and (iii) when the focus of the study is a contemporary phenomenon. Therefore, the case study approach is considered appropriate because the questions involve why the public sector adopts blockchain, how the influence of resources and capabilities occurs in the value creation of blockchain and how the value of blockchain is created in the context of the public sector. The researcher has no control over these events, and the focus of the study is a contemporary phenomenon of adoption of an emergent technology.

The definition of case study is an empirical enquiry that investigates a contemporary phenomenon in depth and within its real-world context, that involve important contextual conditions. The case study approach is used in this research also because the context is considered too complex for survey or experimental methods, and the exploratory and explanatory research is adopted (Yin, 2018). The exploratory characteristic seeks to reveal what is the value of blockchain and what are the resources and capabilities influencing value. The explanatory approach aims to support the explanation of why the

public sector use blockchain, how the value of the technology is created in the context of the public sector and how resources and capabilities influence the value creation of the technology.

Considering that one of the aspects of the value of blockchain is that it may be intangible, as well as the capabilities and resources involved, the qualitative approach for this research seems appropriate, since previous studies related to RBV has highlighted the challenge to measure what is intangible. Therefore, qualitative methods support the research that encompasses intangible elements (Barney et al., 2001).

This research considers the data collection and analysis of multiple cases. A multiple case study is considered more appropriate than a single case study. Although multiple case study is more time consuming and it is more expensive to conduct, single-case designs are vulnerable if all the efforts are concentrated in only one case. There are criticisms that single-case studies reflect the fears about the uniqueness or artifactual conditions surrounding the case. The analytic benefits from having two or more cases may be substantial and more powerful (Yin, 2014).

4.2 Research design components

The research design encompasses the following components: the case study questions, its propositions, unit of analysis and the criteria for interpreting the findings (Yin, 2014). The research questions were mentioned previously, and the study proposal is related to the Theoretical Framework created to drive the empirical part of the research (Yin, 2014).

The definition of the unit of analysis to be studied is critical to the research design (Yin, 2014) and in this research, the unit of analysis is represented by initiatives that use blockchain.

The understanding of a phenomena depends on choosing the cases well (Stake, 2006). The criteria to select the cases were (1) being initiatives that are using blockchain in the context of the public sector, which (2) are in advanced stages of development or completed implemented solutions (that are in production), that (3) are not restricted to cryptocurrency, to address the gap of different applications for the technology and finally,

that (4) are from developing countries, specifically from South America, since there is a small number of studies regarding blockchain in the public sector in this region (Moura & Gomes, 2019; Tavares et al., 2021; Toapanta et al., 2019).

Initiatives in advanced stages of development offer the chance to evaluate the real value created by the technology with more assertiveness, in comparison with initiatives in early stages of development. The initiatives from the public sector in South America enable the understanding of the use of the technology in a region with more restrictions regarding access to technology and resources.

Literal replication was considered, since it is used in the selection of cases where it is possible to predict similar results. This approach is opposite to the theoretical replication, where contrasting results are predicted for anticipated reasons. The cases selected are related to the value proposition of decentralized data infrastructure and membership management (Zutshi et al., 2021). This was not a criterion to select the cases, but it was expected, since the literature review indicated that most of the studies are related to these value propositions, which are the most basic, involving lower complexity and disruption. Therefore, according to our search, there is a reduced variety of initiatives related to the value propositions, due to the recent nature of the phenomenon and there is the possibility to have similarities among the cases selected, and the literal replication was expected. This option enables a deeper understanding of the type of cases integrated in the study, allowing the identification and exploration of similarities and differences among them.

4.3 Data collection

The data collection was defined from the insights of the literature review, research questions and Theoretical Framework, that supported the creation of the case study protocol, to enable the data collection through interviews.

Interviews were chosen because the research questions involve “why” and “how” an event or phenomenon occurred, and the contributions of individuals with an in-depth explanation about the phenomenon under analysis is considered valuable. Although semi structured interviews may be more challenging because the interactions are not as

structured as in surveys closed-ended questionnaires, it allows to enrich the understanding of a phenomenon. Interviews are the most important source of case study evidence, it is fluid, rather than rigid and it aims to satisfy the line of inquiry, while putting relevant open-ended questions (Yin, 2018) that would shed light on the phenomenon under analysis.

Interviewees were business and technical leaders, or team members involved in the initiatives that adopt blockchain, because they were involved in the early stages of the initiative's planning and knew the motivations to use the technology. It was expected that they would keep track of the development of the initiatives and would know the resources and capabilities that influenced the value creation of blockchain. And it was expected that these professionals, and the users could identify the benefits and public value created by the initiatives.

Data collection from primary sources involved 16 interviews, involving 14 individuals, related to 06 cases, and internal and confidential documents. Data collection from secondary sources involved information from newspapers, reports, consultation in government platforms and other websites with information provided by the organizations involved in the cases. It is expected that the multiple sources of data collection enrich the understanding and analysis, supporting complementarity and triangulation of data from different sources of evidence (Stake, 2006; Yin, 2018).

The interviewees were people involved in the blockchain initiatives in the context of the public sector under study, according to the details of Table 6. The interviews were recorded, transcribed and the transcriptions were sent to the Interviewees. According to Yin (2012), the interviews can offer richer and more extensive material than data from surveys or even the open-ended portions of survey instruments. With the aim of increasing the consistency of the findings, people with business background, technical background, team members and users were invited for the interviews. These different perspectives are important because qualitative research is interested in diversity of perceptions (Stake, 2006). In cases where the initiatives were developed by more than one organization, professionals from the other organizations were also invited. In this way, according to Yin (2012), it is possible to establish converging lines of evidence, to increase the robustness of the findings. For the author, the most desired convergence oc-

curs when 3 or more independent sources all point to the same set of facts, events, or interpretations. The details regarding the interviewees and the interviews are presented in Table 6.

Table 6

Interviews

Case	Organization	Interviewee	Role or Responsibility	Interview duration (h:m)
A	A1	A1.1	Project manager	01:10
	A2	A2.1	Department of international trade systems	00:57
	A1	A1.2	Responsible for the initiative in the customs office	01:04
	A2	A2.1	Department of international trade systems	00:15
	A1	A1.2	Responsible for the initiative in the customs office	00:15
B	B1	B1.1	Leader of the information governance office	00:48
	B1	B1.2	Research manager and IT specialist	00:57
	B2	B2.1	IT coordinator	00:25
C	C1	C1.1	Product owner and specialist in civil aviation	01:59
	C1	C1.2	Project manager	00:53
D	D1	D1.1	Project leader	01:34
	D2	D2.1	Blockchain specialist	01:13
E	E1	E1.1	Healthcare systems development coordinator	01:10
	-	E2.1	Final user of the initiative	00:09
F	F1	F1.1	Project manager	00:57
	F1	F1.2	Business analyst	01:07

The case study protocol that guided the interviews is presented in Table 7.

Table 7

Case study protocol

Perspectives	Questions
Information about the initiative and the motivation to adopt blockchain (RQ1 - Why	Please, describe the initiative. Why was the initiative developed? What was the problem or opportunity identified? What are the main goals of the initiative? Is the initiative supporting a process or service? Please, describe the process

does the public sector adopt blockchain?)	or service. Was the process or service adapted to take advantage of the characteristics of the technology? How? In your opinion, why was blockchain chosen? What were the motivations to adopt blockchain? (Konashevych & Poblet, 2019). Were other technologies evaluated for the same purpose? Please, describe the participants of the network and how they interact.
The creation of the initiative, resources and capabilities, and organizations involved (RQ3 - What are the resources and capabilities that influence the value creation of blockchain in the context of the public sector and how does this influence occur?)	How was the opportunity to use blockchain in the initiative identified? Are there specific processes in the organization for the prospection of new technologies and opportunities for digital transformation? Please, describe them. How did the planning of the initiative come about? Were different organizations involved in the definition of technical and governance issues? Why and how were they involved? What were the incentives of the organizations to create the initiative together? Did the organizations involved in the initiative have the resources and competences necessary for the implementation of the initiative? Otherwise, how were they developed or acquired? What were the resources and capabilities of each organization involved? How was the process of interaction between the organizations? In your opinion, what were the resources that influenced the value creation of blockchain in this initiative? How do they influence the value creation? In your opinion, what were the capabilities / competences / processes that influenced the value creation of blockchain in this initiative? How do they influence the value creation? Was the initiative considered strategic? Why?
Value or benefits of blockchain and public value of the initiative (RQ2 - What is the value of blockchain in the context of the public sector and how is value created?)	In your opinion, what is the value / benefit of blockchain for the initiative? Please, describe how the value was created. What characteristics of the technology enabled the achievement of the benefits? What is your level of experience with previous online services of government? (<i>question for users</i>) (Scott, 2016) In your opinion, what is the value / benefits / public value of the initiative for the users / stakeholders involved? How has each user / stakeholder benefited from the initiative? In your opinion, what are the most relevant benefits and why? How were the benefits measured? Are there metrics or indicators? Is it possible to compare the execution of the process or service addressed by the initiative before and after the use of blockchain? (Scott, 2016)

	In your opinion, is there any negative aspect in relation to the use of the technology? Why is it negative? How it was / would be overcome? (Andersen & Danziger, 1995)
Future benefits	What is your opinion about the evolution of blockchain and the potential value / benefits for the public sector in the future?

4.4 Data analysis

A content analysis of the material collected from the interviews and other sources (documents, etc) was conducted. NVIVO was used and a database was created. The data analysis was performed using thematic analysis (TA) with a deductive approach.

The TA supports the identification, analysis, and interpretation of patterns of meaning or themes, in the context of qualitative data, such as interviews. TA is used in the context of case studies with different numbers of participants, and it supports the development of codes and themes, considering the active role of the researcher in this process. The codes are the smallest unit of analysis that capture interesting features which might be relevant to the research questions. The codes are the building blocks for the themes. TA does not simply summarize data content, but it supports the identification and interpretation of the features of data, guided by the research questions, to support rigorous and high-quality data analysis (Braun & Clarke, 2017).

The content of the transcription of the interviews was coded in nodes, using the dimensions of the Theoretical Framework and the values expected. Classifications and comparisons were performed. The dimension of analysis and the values expected for them are presented in Table 8.

Table 8

Dimension of analysis and values expected

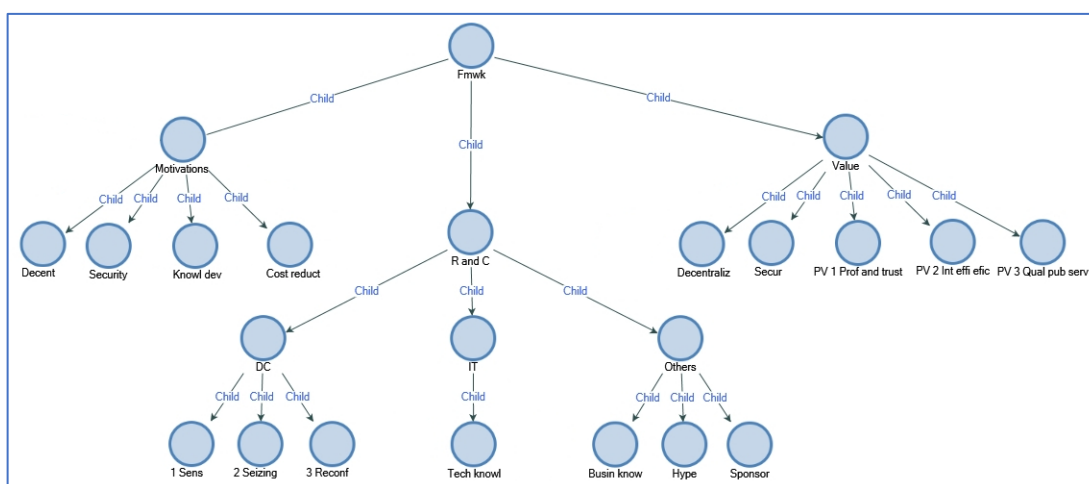
Dimension of analysis	Values expected
The motivations to use blockchain	Transparency, security, and decentralization
The value of blockchain in the context of the public sector	Security, transparency, decentralization, and the public value of professionalism and trust, internal effectiveness and efficiency, quality of public services, participation and engagement.
Resources and capabilities that influence the value	Dynamic capabilities: sensing, seizing, and reconfiguring

creation of blockchain in the context of the public sector	• IT resources and capabilities • Other resources and capabilities
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When necessary, new nodes representing new values not related to the Framework were created. All the nodes generated in NVivo are presented in the Figure 10.

Figure 10

Nodes created in NVivo



As stated by Yin (2014), the research design for case study is adaptative (it should not be interpreted as less rigor), and themes that were not included in the initial model emerged, calling for an interplay between the data and the theory, e.g., with the addition of new literature to enrich and interpret the results.

The thematic analysis performed was based on the phases of theme development proposed by Vaismoradi et al. (2016) and Kiger and Varpio (2020). According to Vaismoradi et al. (2016), the phases encompass initialization (to read the transcriptions of the interviews and to highlight meaning units), construction (classification, comparison and label of the information), rectification (immersion and distancing of the information) and finalization (developing a story line). According to Kiger and Varpio (2020), the framework to conduct thematic analysis involves the following six-step process: familiarization of the researcher with the data, generation of initial codes, the search for themes, the revision of themes, the definition and naming of themes and finally, the production of the report.

Therefore, in this study, nodes were created using NVivo, in accordance with the main themes or subthemes or codes that would support the answers for the research questions. The deductive approach used considers that a preexisting framework was used (Kiger & Varpio, 2020). A revision of the nodes was performed, allowing comparisons within the same cases and among the different cases. Iterative and forward-backward movements and comparisons of code clusters in relation to the whole data (Vaismoradi & Snelgrove, 2019) were performed. Then, the plan for the reporting was defined. It was possible to identify nodes or themes related to the Theoretical Framework and also new nodes, as presented in Figure 10 and explored in the next chapter. As recommended by Stake (2006), the “report” for the cases was written, presenting the answers for the research questions for each one of the cases. The report of the cases was submitted to the other researchers to receive feedback regarding possible issues or need of clarification. Then, the cross-case analysis was performed.

This chapter encompasses the methodology proposed for this research, including information regarding the research design components and procedures involved in data collection and data analysis. The next chapter discusses each of the six case studies.

5 CASE STUDIES PRESENTATION AND ANALYSIS

5.1 Introduction

This chapter comprises the data collected and analyzed of the empirical part of this research, regarding the value creation of blockchain in the context of the public sector. The chapter presents six cases in separated sections (section 5.2: Case A; section 5.3: Case B; section 5.4: Case C; section 5.5: Case D; section 5.6: Case E; section 5.7: Case F), which share the same internal structure (Motivations to use blockchain and its value, Resources and capabilities influencing value, Synthesis and Conclusions).

The chapter encompasses cases that were chosen according to the criteria presented in the chapter of methodology, which are (1) being initiatives that are using blockchain in the context of the public sector, which (2) are in advanced stages of development or completed implemented solutions (that are in production), that (3) are not restricted to cryptocurrency, to address the gap of different applications for the technology and finally, that (4) are from developing countries, specifically from South America, since there is a small number of studies regarding blockchain in the public sector in this region. The data collection regarding the cases occurred between June 2021 and June 2022. The following sections discuss each case.

5.2 Case A

Case A contemplates an initiative in the context of the public sector that uses blockchain with the aim to support data exchange related to foreign trade. The data is shared among the customs of some countries, and it is related to mutual recognition agreements and companies that are considered authorized economic operators.

Mutual recognition agreements are deals that can be constituted among countries or regions, and it considers, among other things and details, that a country would certify the organizations that have good practices related to foreign trade. Then, each country that entered the agreement informs the other countries of the list of companies with certificates.

The certification of the companies involves a process that follows a methodology, defined by an international organization. A certified company is considered an authorized economic operator and the certificates offer some advantages for the companies in the context of foreign trade, such as granting benefits to accelerate the entering of goods in a country. Then, the initiative allows data exchange regarding the certified companies among the countries that established agreements related to exportation. In this way, each country would know which are the companies that would have some benefits.

Foreign trade represents an important part of the gross domestic product of countries. Usually, the countries establish agreements, and the customs deal with the challenge of security versus simplification and the exchange of information among the countries and regions needs to be efficient and secure.

In the moment of the interviews, there were 4 countries from Mercosur that were participating in the network of this initiative. Each one of these countries has the possibility to include data in the blockchain. The countries include information of the certified companies, and it is available for the other countries, to support the identification of the benefited companies during international trade transactions.

The initiative involves a private and permissioned network, which is using Hyperledger Fabric. The solution entered production (it was fully implemented and in operation) in the beginning of 2020.

The interviews occurred with professionals of Organization A1 and A2. Organization A1 is a Secretary subordinate to the Ministry of Economy, responsible for the administration of taxes, including social security taxes and related to foreign trade. The Secretary supports the Federal Administration in the formulation of tax policy, in the prevention and combat of tax evasion, counterfeiting, piracy, the illicit traffic of narcotics, the international traffic of firearms, the laundering or hiding of assets, among others. Organization A2 is a public organization linked to the Ministry of Economy, that has developed information technology solutions for more than 40 years.

Three professionals were interviewed: Interviewee A1.1 and Interviewee A1.2 from Organization A1 and Interviewee A2.1 from Organization A2:

- Interviewee A1.1 is responsible for the project management of the initiative in

Organization A1, and he has been involved in the discussions regarding the initiative since when it was envisioned.

- Interviewee A1.2 is responsible for the system in the customs of one of the countries involved in the initiative.
- Interviewee A2.1 is responsible for the department of international trade systems in Organization A2.

The next subsection presents the motivations to use blockchain in this initiative and it explores the benefits created by the technology.

5.2.1 Motivations to use blockchain and its value

The motivations to use blockchain in the context of foreign trade of some countries of Mercosur were related to decentralization and security. The value created by the technology in this initiative is aligned with the expectations, and it encompasses decentralization, security, professionalism and trust, internal efficiency, and quality of public service. The motivations are available in the following topics:

a) The motivation of decentralization

Regarding the motivations, decentralization was required since it was necessary a system to allow data exchange about certified companies among the countries without the need of a specific country to assume a central role, that would control the data of the other countries.

Previously to the development of the initiative, other ways to exchange data were tried, but none of them were considered appropriate. Before the use of blockchain, customs were sending the information about certified companies by e-mail, but it was considered unsuitable, since timeliness was required. A centralized solution, controlled by one country would not be proper in this context, because sovereignty is appreciated when dealing with information from multiple countries. In the context of a centralized solution, it would be difficult to define who would be responsible for the data, who would maintain it, and these kinds of definitions were not considered simple. A country would assume the responsibility for keeping the data, but other countries would probably not trust the centralized approach. According to the words of Interviewee A1.1:

It was necessary to exchange information with sovereignty and independently, it was a matter of who is the owner of the information (...) When we talk about international agreements, when we talk about systems that will be built to provide information to countries (...) there is no possibility of saying that one country is superior to another or that one country will command the others.

Therefore, decentralization was one of the motivations to explore the use of blockchain in this case. The countries would like to avoid the control and decision making by a centralized entity or country.

b) The motivation of security

Security was the other motivation to use blockchain in this initiative, since it was necessary to guarantee that the data would not be inappropriately modified through time. There was the need to ensure the integrity of the transactions. When dealing with foreign trade and the exchange of information from multiple countries, security is an important requirement. Usually, in the context of international transactions, the exchange of information is a considerable challenge, and it is challenging to define a secure way to exchange information among nations, since there may be a lack of trust. It is necessary to guarantee that the information is legitimate, that it has not been tampered with.

According to Interviewee A1.1, “*there was the need to allow data exchange with security (...), in the international area, there is a great difficulty regarding the sharing of data, and it usually takes [a long time] discussing the securest way to exchange data among countries*”.

The motivations to use blockchain in this initiative are available in Table 9.

Table 9

Case A - Motivations and value

Motivations		Value	
Framework	Case A	Framework	Case A
Security	Security	Security	Security
Transparency	-	Transparency	-
Decentralization	Decentralization	Decentralization	Decentralization
		Professionalism and trust	Professionalism and trust
		Internal effectiveness and efficiency	Internal effectiveness and efficiency
		Quality of the public service	Quality of the public

			service
		Participation and engagement	-

The value created by blockchain is presented in the following topics, as well as the public value created by the initiative:

a) The value of decentralization

Decentralization was one of the benefits enabled by blockchain in this initiative. Decentralization was achieved through the conditions created to allow data exchange between the countries in a way that the sovereignty of the countries is maintained, since there is no country with a superior position in dealing with negotiations, decisions and data.

Interviewee A1.2 declares that *"The main benefit (...) is for the issue of data exchange between customs, between governments, it solves the issue of data ownership"*. According to Interviewee A1.1 *"this is a problem that blockchain solves. Nobody is the owner of the information, everybody is the owner at the same time, each participant that has a node on the network is the owner of the information"*.

Interviewee A2.1 states that *"we have a network where everybody [all the participants of the network] writes the data and consult the data, the data are for everybody, and everyone uses the same source (...) there is sovereignty"*.

It is considered that the use of a centralized solution that would be maintained by just one country usually creates diplomatic issues, and decentralization facilitates negotiations among the countries. Interviewee A1.2 considers the following:

We have some [solutions] running here in Mercosur, and they imply in a central server that needs to be maintained in some country, and this usually generates (...) diplomatic issues, and with this initiative we solve this, because I don't have a central server, I don't have a central node that receives or validates all the transactions."

The benefit of decentralization was achieved and the exchange of information among customs from different countries was enabled. In this way, each participant with a node is allowed to include information under its responsibility and consult information provided by the other countries. The sovereignty of the countries over the data is main-

tained, and there is no country in a superior position.

b) The value of security

Blockchain enabled security and it offers mechanisms to increase reliability in data. There is the certainty that from the moment the data entry in the ledger, it cannot be tampered with or deleted. According to Interviewee A1.1, *“I am absolutely sure that the information (...) has not been altered, it has not been tampered with, so blockchain gives me this security”*. Interviewee A2.1 states that *“[there is] warranty that data, from the moment in which it was included in the network, it will never leave it, it gives me security (...) for some type of operations, especially among countries, this is very important”*.

The security provided by blockchain is related to cryptography and the use of smart contracts, that can be defined according to the agreements established among the countries. According to the words of Interviewee A2.1:

(...) the countries sign an agreement (...) [and there are] the smart contracts (...) and this agreement is signed by the countries (...) ensuring that the network is receiving data only from those that are actually part of it. This guarantees that the origin of the data is a reliable source.

Interviewee A1.2 stated that *“[With this initiative], each country applies its own [security] key to upload the data package. So, we believe in the data package that is on the network”*.

Then, the value of security was observed in this initiative, allowing data integrity and supporting data provenance, facilitating the interactions among different countries.

c) The public value of professionalism and trust

This initiative supported the creation of an intangible benefit, which is the recognition of public sector organizations involved in this case as innovative. There is national and international recognition that the organizations have the competencies to innovate, to use new technologies. The initiative has been presented in international events, as forums, seminars, and intergovernmental organizations. Many countries demonstrate interest in the solution and approached the organizations involved in the development of the initiative, to ask for more details. According to the words of Interviewee A1.1:

There is also an intangible benefit, which is related to the presentation (...) [of the institution where I work] as an organization that is focused on innovation, an organization that is ahead of its time, an organization that is bringing new technologies (...) not only at the national level, but at the international level, this is also happening. So, we have already presented this solution in international forums (...) and I participated in a panel talking about this, I received a lot of feedback from several colleagues from other countries, asking for information, asking for meetings to deal with this subject.

The recognition of the initiative's success affects the perceptions regarding the public sector and the organizations involved in the creation of the solution and it increases the respect for these institutions. This is positive because it makes the organizations be perceived in the context of foreign trade not only as participants, but as who has the capacity to innovate, to generate efficiency and to influence the national and international environment, as stated by the words of Interviewee A1.1:

We want this to be disseminated worldwide to facilitate this exchange of information, so this intangible value is that this institution and the Custom of our country is ahead, and it is providing a useful tool, an innovative tool, so this is certainly an intangible gain, right? And it brings respectability to the Custom of this country, it makes the Custom positioning in the forums as an opinion leader, not as a mere participant.

According to Interviewee A1.2, the innovation is driven by the need, and many countries are interacting with them, to learn more about the initiative, as stated by his own words:

We are called by several organizations (...), the [international organization related to customs], we received requests for informal conversations with several countries to explain how our initiative was, what problems we faced. (...) I think the fact that we implemented the initiative (...) does bring this aura that we have this greater domain, and we are innovating. (...) So we are recognized internally and even externally as innovators, and our main engine of innovation is necessity. If we do not innovate, if we do not improve, we will succumb, we will not have enough staff to handle the volume [of work], (...) so innovation ended up in

the ADN, it ended up in the "blood" of the institution by necessity.

Therefore, the public value of professionalism and trust was enabled, since one of the intangibles benefits of the initiative was the recognition of the organizations and countries involved in its development as innovative. This recognition influences the image and perceptions about the organizations involved, it demonstrates their capacity to influence the national and international environment and it contributes to increasing the respect for these institutions.

d) The public value of internal effectiveness and efficiency

The initiative of this case promoted more effectiveness and efficiency to the process of data exchange regarding the certified companies among the countries that participate in the network.

Previously to the adoption of blockchain, the information of certified companies was exchanged using e-mail, in a periodicity considered inappropriate, and each country would take the information and publish it according to their own ways. There was not an integrated system to enable the updates of the list of the certified companies. According to Interviewee A1.1, *"the prior solution for this exchange had no cost involved, let's say, it was email exchange, ok? But the e-mail exchange was once a month, (...) it was completely inappropriate"*.

Interviewee A1.2 explains that the use of the initiative simplifies the process, in comparison with the use of e-mails. According to his own words:

Apart from the whole problem of trust, [using] e-mail for information exchange (...), you will always have the issue of work, you need someone to prepare the e-mail and send it. "Ah, (...), but we can automate that." All right, but I will have the work of retrieving the information, assembling the package, automating, moving the information (...), etc." (...) From the moment that I have a network and this network can be connected to several other countries, my work is simpler.

After the use of blockchain, from the moment that a company is certified in one country and the country includes this information on blockchain, the information is available to the other countries allowed to receive it. Then, the update of the register regarding the

certified companies was simplified and standardized, increasing the agility to perform the process. Interviewee A2.1 informs the benefits achieved and state that *“this makes us gain a lot of celerity”* and Interviewee A1.2 explains the simplification by his own words:

Why does this [initiative] help me (...)? Because from the moment I make an agreement, for example, to exchange OEA information in Mercosur, I have already done all the work on my end to put together the OEA data packages, so I just need to adjust within the solution that line, that flow of information to Mercosur. If I make the same agreement with [another country], for example, I simply need to adjust the solution for the connection to the other country. Using this solution, I simply place the package inside the chain (...) So yes, this is a great advantage, compared to the other ways that we have of exchanging information.

Blockchain created the advantage of process improvement and efficiency gains without some concerns, such as related to high costs and related to how to share the costs, which are usual concerns related to the use of a centralized solution. In a centralized solution, it would be necessary to define how to share the costs involved and with whom. This case uses Hyperledger Fabric, which is available for anyone to use, and the costs related to training, development, storage, etc., are considered relatively low, and each participant of the network manages its own costs. Interviewee A2.1 states that the low costs involved with the use of blockchain are welcomed, especially for countries with shortage of resources *“it helps a lot those countries (...) that want to use the technology, that have problems with financial resources”*.

Therefore, the process of data exchange supported by blockchain involved relatively low cost, and it allowed a gain on internal efficiency, because of the agility and effectiveness, due to standardization, which has, as consequence, an improvement on the quality of the public service offered by the countries that are participants in the network, as presented in the next topic.

e) The public value of quality of the public service

As explained before, the information about the companies that are authorized economic operators was not frequently updated. From the point of view of the certified compa-

nies, it would take some days for the other countries to receive the information about their certification and it would impact them directly. This is because the companies that receive the certification have some advantages. Then, the reduction of time to exchange data means less time for them to start enjoying the benefits. According to Interviewee A2.1, *“we are perhaps talking about a few days, but this can mean a lot in the transit of the goods of [a] particular company”*.

Interviewee A1.1 informs that when a company is certified, *“at the end of the day there is the sending of updated information to the network, and as of tomorrow the customs (...) will know that this company is (...) entitled to receive the export benefits”*. Then, the new solution brought agility to the process and the companies are allowed to take advantage of their benefits in less days.

As stated by Interviewee A1.2, it is possible to harness the benefits of blockchain to expand the current system, covering more processes, such as risk analysis: *“We are going to expand [the initiative] to other situations, we are working to exchange customs declarations for risk analysis purposes”*.

Therefore, the internal efficiency in this process directly impacted the quality of the public service offered to the companies that are certified. The streamlining of the internal process creates, consequently, more agility to start receiving benefits in the import and export transactions.

The next topic presents the resources and capabilities that influence the value creation of blockchain in this case.

5.2.2 Resources and capabilities influencing value

It was identified that the dynamic capabilities of seizing and reconfiguring influenced the value creation of blockchain in this case, and they are presented in the following topics:

a) Dynamic capabilities

A professional of one of the organizations involved in this case was on a meeting of an international organization where one presentation regarding blockchain was made. At

the end of the meeting, it was proposed that the countries should analyze the opportunity to use blockchain in the context of foreign trade. After this, two of the public organizations involved in the initiative started to analyze the technology and tried to understand if it could be an option to improve the current process of data exchange among countries.

According to the interviewees, the dynamic capabilities of seizing and reconfiguring influenced the value creation of blockchain in this case. The seizing capability was recognized as relevant because the coordination of the efforts among the Organizations A1 and A2 enabled the creation of an initial proposal to the other countries. Organization A1 supported the business perspective analysis and Organization A2 supported the technical perspective, evaluating possible ways to take advantage of blockchain in the context of foreign trade. According to Interviewee A1.1 “*[the] coordinating competence is important*”. Therefore, a preliminary proposal was created and presented to the other countries, and it was possible to show to “*the other countries, that this tool was a tool that would fit for the purpose, and it would bring good results*”, according to Interviewee A1.1.

Interviewee A2.1 complements that Organizations A1 and A2 presented to the other countries all the problems that would be addressed with the use of the technology, and according to his own words, “*we worked together, we said ‘look, the technology (...) will solve several problems that we have’*”.

Therefore, the proposal to use the technology was accepted by the other countries and according to Interviewee A2.1 “*when we showed the advantages of the model we were proposing in relation to all existing models, the proposal was immediately accepted.*”.

The other dynamic capability that influenced the value creation of blockchain in this case was reconfiguring. After the recognition of the countries about the opportunity they had, the efforts to reconfigure resources and processes started. The countries agreed to promote a training with their teams. Then, a special meeting was organized, and the training was promoted. The countries decided to define a facilitator to support the development of the initiative, by voting. Interviewee A2.1 clarifies that:

We had four countries (...) they (...) decided to hold a vote, and then they elected me to be the group facilitator, and the link between the technical part and the

business part. It is easier, when you have someone who has this recognition by the group and is able to conduct the issues (...), this makes things move faster.”.

The countries established the frequency of meetings to monitor the development of the initiative and the way that they would interact to achieve the main results. Interviewee A2.1 presents some information about the efforts related to the reconfiguring capability:

It is difficult to establish deadlines and commitments with teams and with companies. Between countries, this difficulty multiplies even more, because each country thinks in its own way, it has its priorities, its deadlines, but the integration between this group was so good that this allowed us to get the technology running (...) in some months.

The results of this initiative in the context of foreign trade are attributed to the integration of the efforts of all the countries involved. Two countries were more involved in the development phase and the dynamic capability of reconfiguring resources, competencies and processes was recognized as influencing the value creation of blockchain in this case.

It is possible to note that the dynamic capability of sensing was not identified as influencing the value creation of blockchain. This may be due to the way that the use of blockchain in the context of data exchange regarding customs was first glimpsed. This occurred in one of the meetings organized by an international organization, as explained by Interviewee A1.1:

In one of these meetings, if I'm not mistaken, it was in 2017, the secretariat [of an international organization] brought a representative from [a blockchain organization], and he made a presentation about blockchain. And at that time, it was (...) a novelty (...). And at the end of that meeting it was proposed that the countries should investigate the use of blockchain in the context of data exchange between customs (...) So at that moment in 2017 this idea of testing blockchain (...) was launched, and that's where it started. The first steps were taken in 2017, the idea was launched in 2017, in 2018 we talked a lot, and in practice the project started in 2019.

Then, the identification of the opportunity to improve data exchange using blockchain

was indicated in a meeting, and not in the execution of a specific activity or process of Organization A1, to evaluate changing needs of users and emerging technologies.

The next topic presents the resources and capabilities related to IT.

b) IT resources and capabilities

It was identified that technical knowledge influenced the value creation of blockchain in this case. The technical team had some previous knowledge about the technology, and it was enhanced during the development of the initiative.

The technical knowledge regarding existing blockchain platforms and the necessary knowledge to use the chosen one was considered relevant. The team of one organization enhanced this competence and shared their knowledge with the team of the other countries involved. According to the words of Interviewee A1.1:

I think the [main] competence (...) is the knowledge regarding Hyperledger Fabric (...). And not only in relation to (...) Fabric, but in relation to blockchain solutions in general, because what happens today is that we have “n” blockchain solutions, (...) Fabric is just one of them. (...) We have (...) Besu, Corda, Ethereum, Quorum, and etc., there are several solutions, so the first competence is to know what blockchain is, and secondly, after defining the tool, learn how to [use it], and this was a role that [Organization A2] had, sharing this [knowledge] to colleagues from other countries (...), so this was an important issue.

The next topic presents other resources and capabilities that influence the value creation of blockchain in this initiative.

c) Other resources and capabilities

Finally, the other resources and capabilities that influenced the value creation of blockchain in this initiative were business knowledge, sponsorship, and hype.

The business knowledge encompasses the understanding regarding international trade, information exchange requirements, international agreements, legal conditions and secrecy issues. According to Interviewee A1.1:

Another important issue, an important competence, which is related to the busi-

ness area, is the (...) knowledge of international trade, mainly the issue of the need to exchange information, what type of information should be exchanged between countries. And also, the (...) knowledge of international agreements, because it is not just a matter of one country's customs having an interest in exchanging information with the customs of another country. There is the internal legal part of the country (...) there is the signature of agreements that are necessary, (...), there are issues of secrecy of information (...).

The sponsorship was considered relevant and Organizations A1 and A2 offered support to the initiative development because they were aware that the use of technology in this initiative represented an initial step to disrupt other processes related to foreign trade or related to other interactions among countries. According to the words of Interviewee A2.1:

There was a great encouragement from the management of Organization A1 and A2, exactly because they understand that this is a disruptive model. This was a great novelty that we were learning (...) even though this system is not necessarily a large system, (...) it puts a foundation on what is the future of the customs transactions that we will have from now on. And we are talking about customs transactions, but we can talk about any other information that needs to be exchanged between countries.

It was also identified that the hype around blockchain and the consideration that the technology would create many benefits represented an incentive to explore the use of the technology. As explained by the words of Interviewee A1.1:

Blockchain (...) [is] prestigious nowadays (...), it is something that is being considered as a new technology that will generate many benefits. So, this issue of blockchain being in fashion, let's say, was also a factor that gave a boost to the system.

To sum-up, Table 10 presents the resources and capabilities that influence the value creation of blockchain in the context of this case.

Table 10*Case A - Resources and capabilities*

Dynamic capabilities		Resources and capabilities (R&C)	
Framework	Case A	Framework	Case A
Sensing	-	IT R&C	IT - Technical knowledge (enhanced)
Seizing	Seizing	Other R&C	Other - Business knowledge
Reconfiguring	Reconfiguring		Other – Sponsorship
			Other – Hype

5.2.3 Synthesis and conclusion

- The main motivations to use blockchain in Case A were decentralization and security.
- The analysis of the value of blockchain in this case presented that the technology provided the benefits of decentralization and security, which are aligned with the initial motivations. The initiative promoted the public value of professionalism and trust, internal effectiveness and efficiency, and quality of the public services.
- The analysis of the resources and capabilities indicates that the dynamic capabilities of seizing and reconfiguring, technical and business knowledge, sponsorship and hype influenced the value creation of blockchain in this case.
- The dynamic capability of sensing was not identified as influencing value. This may be because the action to explore the technology for foreign trade was triggered due to a presentation and suggestion in a meeting, and not due to a specific activity of sensing, to identify changing needs of users, to assess, filter and calibrate opportunities to use emergent technologies. It is possible that the preliminary identification of the opportunity occurred in an informal way. If it was a part of a specific process of sensing, which involved the efforts of a specific team responsible for collect data, collect needs of individuals or companies, analyze technologies, among others, maybe this dynamic capability would be recognized as valuable.

The discussion of the findings of this case is furthered in Chapter 6, which encompasses the cross-case analysis.

5.3 Case B

The second case is related to an initiative that uses blockchain for information exchange among regulators entities in the context of the financial sector. The goal of the initiative is to support the process for managing the authorization of financial institutions operation.

The platform enables data exchange related to the indication of individuals to occupy management position in financial institutions. Interviewee B1.1 presents an example of the use of the platform to support the authorization process:

(...) for example, a person is indicated to be a director (...) of a financial institution [X]. An authorization is requested to the [Institution Y] (...) So, the [Institution Y] receives this request and from then on, [Institution Y] makes several analyses, ok? In relation to the institution and to the person. To be part of the analysis, the [Institution Y] needs some information (...) from several bodies, from several sources. Then it asks (...), for example, 'look, this person here, this candidate for director of the financial institution, what is his reputation (...)? Has he ever received a fine? Has he ever had a warning, or is he answering a lawsuit?' (...) So, I want to know this person's background, to know if he has any issues on his resumé [CV] that could be a problem for him to occupy a management position in [Institution X].

Before the use of the platform, the information exchange was done by e-mail or using paper documents. The time involved in it could take about three or four days. After the use of the platform, it takes just a few seconds.

The initiative started in 2017 and it considers a private and permissioned network, which uses Quorum. Quorum is an open source blockchain platform built on Ethereum (Consensys, n.d.). It is expected that in the future, the initiative will include more information from different sources, such as regarding judiciary, trade, and international organizations. The project was developed by Institution B1, and the use of the initiative involved two more institutions as participants, which are Institutions B2 and B3. All the three Institutions are regulators from the financial sector.

Institution B1 is a federal public administration institution. Some of the attributions of

Institution B1 are the formulation, execution, monitoring and control of monetary policies; policies related to foreign exchange and credit, and financial relations policies with foreign countries. It is also responsible for the organization, discipline, and supervision of the national financial system and for the management of the system of payments.

Institution B2 is a Superintendency which is associated to the Ministry of Labor and Social Security, and it is responsible for the inspection of the activities of the pension entities and for the execution of the policies for the complementary pension. Some of its attributions are: (i) to inspect the activities of the complementary pension entities and their operations; (ii) to analyze and judge infractions and to apply penalties; (iii) to issue instructions and establish procedures for the application of the norms relative to its competence, among other obligations.

Institution B3 is responsible for the operation, integrity, and development of the capital market, promoting a balance between the initiative of the agents and the protection of investors. Some of its attributions are market development, market efficiency and functioning, investor protection, enforcement, and punishment.

The interview participants in this case are Interviewee B1.1, Interviewee B1.2, and Interviewee B2.1. Interviewees B1.1 and B1.2 are both from the same institution (B1), which is the one that developed the initiative, and they are, respectively, a leader of the information governance office and a research manager and IT specialist. Interviewee B2.1 is an IT coordinator of Institution B2.

5.3.1 Motivations to use blockchain and its value

The motivation to use blockchain in the process of analysis and authorization of executive managers of financial institutions was decentralization and security, according to the following topics:

a) The motivation of decentralization

Decentralization is a challenge in the context of the public sector and there is an expectation that institutions from this sector would be able to collaborate and work together, in an integrated manner. Meanwhile, this is a difficult task, since different public bodies have their own technology, processes, and priorities. At the same time, a centralized

solution was not welcomed in this case, due to the lack of trust, security issues and cost involved. Then, since the idea was envisioned, it was expected a decentralized model to support the information exchange.

Interviewee B1.2 explained that it was expected a solution that would be appropriate for the context involved, considering that *“each institution has its own reality, each one is autonomous, one body is not subordinate to another, but within a philosophy of collaboration, in a decentralized way, in a more direct exchange, in a more flexible way”*. Then, from the beginning, according to Interviewee B1.1, *“the idea was to create a decentralized network where sensitive information would be stored, [under the responsibility of] its own curators”*.

Therefore, one of the motivations to use blockchain was to enable the use of a decentralized model, as presented in the words of Interviewee B1.2:

The driver doesn't have to be the technology itself; the driver is the model. So, we wanted to change from a centralized model (...) of information exchange (...) [to a] really decentralized model. And when we were looking at the decentralized model, the blockchain idea kind of seemed to fit in it. (...) I want to implement a really decentralized model and I have the technology that was born for decentralized models. So, we started, 'it seems to fit well, so let's go deeper, let's try it', and we started, and we saw that it fits well.

In addition to the motivation of decentralization, security was also a driver to use blockchain in this initiative, as explored in the next topic.

b) The motivation of security

The other motivation to use blockchain in this initiative was security. The platform store confidential information and there was a concern regarding the authentication of the participants, the use of cryptography to exchange information and the reduction of the risk of data leakage, since this could affect the image of the institutions involved. According to the words of Interviewee B1.1:

Regarding confidentiality (...) the platform was thought precisely because of the existence of sensitive data being shared. Well, there is the authentication of the

members, to participate in the network. [Regarding] the services, (...) we can discriminate which institutions can have access to the services. All the information exchange (...) is stored in the ledger in encrypted form. (...) I think that what is fundamental, (...) is that you have a technological platform that meets the business requirements, right? So, all this issue that I mentioned, it is sensitive information, the institutions worry too much about this information, with (...) [the risk of] leakage, and the use of information in a wrong [way], it can bring serious damage to the image, both of [Institution B1] and of [other] institutions.

Then, the initiative deals with sensitive information and security was a concern and a motivation to use blockchain. The motivations to use blockchain in this case and the value identified are presented in Table 11.

Table 11

Case B - Motivations and value

Motivations		Value	
Framework	Case B	Framework	Case B
Security	Security	Security	Security
Transparency	-	Transparency	-
Decentralization	Decentralization	Decentralization	Decentralization
		Professionalism and trust	-
		Internal effectiveness and efficiency	Internal effectiveness and efficiency
		Quality of the public service	-
		Participation and engagement	-

The value created by blockchain in this case was decentralization and security, and the initiative allowed the creation of the public value of internal effectiveness and efficiency, as presented in the following paragraphs:

a) The value of decentralization

Regarding the value created with the use of blockchain, it was informed that the expected decentralization was achieved, and the institutions involved in the initiative do not have any concerns about hierarchy, there is no central control, respecting the role of each institution. It is considered that since the public sector needs to promote integration

of its work, and exchange data, blockchain is perceived as appropriate to do so with decentralized governance.

According to Interviewee B1.2 the benefit of blockchain is that *“you are allowed to build a more decentralized solution, where the participants are members of a network. In this case, in the information exchange network, there is no hierarchy between them, within a philosophy of a really decentralized governance”*.

Thus, the expectation regarding decentralization was achieved, facilitating the exchange of information among regulators entities of the financial sector in a collaborative way.

b) The value of security

The benefit of security was identified, and it was appreciated that the history of transactions can be consulted with the certainty that information was not edited or deleted. This immutability was considered relevant in the context of the exchange of the sensitive information. According to the words of Interviewee B1.1:

So, every exchange of information that occurs on the network is registered on the blockchain, (...) it cannot be erased, and since everyone is authenticated, if [member X] sends information to (...) [member Y], this exchange of information is registered: when it occurred, who delivered the information, what information was delivered. So, there is no way for member Y to say that they received information that is different from what is (...) in the ledger, so there is no way for someone to say, "ah, no, but this [individual] here, you told me it was [ok]". In fact, you just have to check the ledger and you can see exactly what information was exchanged, and you can also know that it was really member X who made that information available to member Y. (...) So, (...) the fulfillment of some requirements, of security, of non-repudiation, of authenticity, that the tool brings [was very important].

Interviewee B1.2 gave an example in which one organization may ask another to check whether an individual may have penalties. Once the other Institution answers it, it is recorded on the blockchain. Supposing that the person has no penalties, this result is recorded. If, in the future, there is any disagreement about the information available, it is possible to check the ledger, since it maintains the integrity of data, avoiding doubts

about the data exchanged. According to the words of Interviewee B1.2 “if there is a divergence (...) we go to the ledger (...) to know which information was really sent, which information was really exchanged”.

Interviewee B2.1 highlights the importance of immutability, and according to his own words:

The most interesting thing about the implementation using blockchain is exactly the guarantee of immutability of the records (...). So, if our area consults [Institution B1] about the information of a certain legal or physical person and [Institution B1] says "look, there is nothing in it", this is registered in the blockchain, and we can guarantee that in one, two, three months this answer will not change. [Institution B1] will not say "look, do you know three months ago when I said that this person did not have any impediment? Actually, he did." or "No, I didn't say he didn't have an impediment, actually he does". That's recorded in the blockchain, so none of us can change the answer given because the blockchain guarantees immutability.

Then, the benefit of security was achieved, and immutability was considered relevant in this initiative.

c) The public value of internal effectiveness and efficiency

The platform allows the creation of the public value of internal effectiveness and efficiency because it contributes to reduce errors and it increases the agility of the process of authorization of financial institutions operation. Therefore, institutions have access to information in a faster way. According to the words of Interviewee B1.1:

And the most important thing it solves is to give agility to the public service (...). In general, it facilitates or contributes for the institutions' work processes to be carried out in a more agile way. (...) Formerly, a person [would] have to send a paper letter to get a paper reply, imagine how long that it takes. Not today, today he uses the platform and receives the information immediately.

Interviewee B2.1(2022) informed that before the use of the platform, the exchange of information was done using paper, according to his words:

So, (...) this exchange of information used to take place via official letter (...) on paper that went to [Institution B1]. (...) After a while, we implemented [a sys-

tem], which is the electronic information system, and this exchange continued to be done via official letter, but the letter was processed digitally. So [the letter] went (...) from the Ministry of Economy to [Institution B1], this was handled there, this letter was answered, it went back to the [Institution B2] system, but it was still a letter in the sense that the consultation was not automated. Someone had to issue a letter, write the letter, send it to [Institution B1], and someone there had to do the same thing and then come back, and on this side the person had to open the result, analyze it, and then proceed (...) Now, with [the platform], this is all automated. We can even have a system here doing the online query and receiving the return and already giving the analyst the result of the query, (...) so automation brought (...) efficiency in this process, a process that before could take more than a month to run, now it can be executed end to end in a few seconds.

The initiative also influenced the creation of effectiveness since automation reduced the incidence of human errors. According to the words of Interviewee B2.1:

There is another benefit [which is a consequence of automation], which is the (...) lower incidence of errors, because when writing a letter, you may eventually type some wrong data, suddenly you consult a certain [document number], [and there is the risk of incorrectly typing a number]. When you start to query (...) this kind of human error is mitigated, because you are reading the information from the database (...) a machine is receiving [a request], consulting and giving back the return, so I think it has a lower incidence of errors in the process, it can be characterized as a great benefit.

Interviewee B1.2 informed that efficiency is achieved with the use of this new solution, which provides flexibility, since different processes and services may use the information available in the network. According to this Interviewee, “*we are managing, in an automated, faster, safer, more efficient way (...) you can plug different processes into this platform to speed up [them]*”.

Therefore, the initiative contributed to the creation of the public value of internal effectiveness and efficiency. Then, the motivations to use blockchain, and the benefits created by the technology and by the initiative were explored. The next section discusses the

resources and capabilities that influenced the value of blockchain in this initiative.

5.3.2 Resources and capabilities influencing value

In this case, the resources and capabilities that influence the value creation of blockchain are the dynamic capabilities of sensing, seizing and reconfiguring; technical knowledge, and sponsorship, as presented in Table 12 and discussed in the following paragraphs.

Table 12

Case B - Resources and capabilities

Dynamic capabilities		Resources and capabilities (R&C)	
Framework	Case B	Framework	Case B
Sensing	Sensing	IT R&C	IT - Technical knowledge (enhanced)
Seizing	Seizing	Other R&C	Other - Sponsorship
Reconfiguring	Reconfiguring		

The opportunity to use blockchain in the context of this case was envisioned when an agreement was evaluated by three institutions (B1, B2 and another) that had the purpose to exchange information that was not public, it was confidential information. One of these institutions (B1) had a previous experience with blockchain and started to analyze the use of the technology in the context of the partnership that was being established.

The resources and capabilities identified as influencing the value creation of blockchain in this case were the following:

a) Dynamic capabilities

The dynamic capabilities of sensing, seizing, and reconfiguring were considered relevant in this case, and they were identified as influencing the value creation of blockchain in this initiative.

The sensing capability was performed by Institution B1, when this institution had a previous experience with blockchain, when an internal research group promoted an analysis of three blockchain platforms and possible use cases. The research group developed a proof of concept regarding a backup system for the Reserve Transfer System. In this

experience, Institution B1 had the chance to evaluate the use of the technology for other purposes different from cryptocurrencies. Therefore, due to this previous experience with blockchain, the institution started envisioning a new platform, encompassing the efforts of different areas within Institution B1, as the innovation area, the data governance office, and the IT development area.

Interviewee B1.2 explained that the work developed in their first contact with the technology in the past was reported in a paper. According to his own words “*This work (...) ended up culminating in a publication (...) consolidating this work that we did, the proof of concept with blockchain.*” In their first contact with the technology, they analyzed Hyperledger Fabric, Corda and Quorum. Then, when the opportunity to use blockchain in this initiative was envisaged, they already had a previous knowledge about the difference between the platforms, and it was easier to choose the one that would better fit for the needs identified. According to the words of Interviewee B1.2:

At that time, we chose Quorum. Why? Because Quorum was the only one that, at that time, had a feature that was essential to this model, which was to allow two nodes in the network to exchange information privately, then, the other nodes could not see the information exchanged, which was confidential. Of course, with the evolution of technology, other platforms have already internalized this, like Hyperledger and others, but at the time of the project, the most robust platform was Quorum.

Therefore, the preliminary experience of one of the Institutions involved in the initiative, in which they analyzed other different blockchain platforms, was considered relevant and it influenced the value creation of blockchain in this initiative. Due to this experience, it was easier to understand the differences among the platforms and to choose the most appropriate one for the challenges they were facing with the new initiative.

Regarding the seizing capability, Institution B1, taking advantage of the knowledge acquired with the previous proof of concept using blockchain, created a prototype to the participants involved in the new agreement. Institution B1 presented to the other institutions how their process could be improved using blockchain. They presented how it would work, how data could be included and consulted and the history of the requests. This preliminary analysis and presentation of the potential to use blockchain in their

process supported the decision to advance with the technology adoption.

Interviewee B1.2 explains that *“we built just a small prototype, for people to see, 'oh, here are your models, here are your datasets, I'm saving them', and you can see the requests that were recorded, the time when the request was recorded, the search (...)”*.

Considering this initial demonstration, people were able to understand when the technology was appropriate or not, since at that time the technology had some limitations, although the limitations were not an issue for this specific case. Interviewee B1.2 declares that *“then we saw that (...) the limitations of the technology were not problems, and the (...) technology (...) delivered value within this process that we would like to perform”*.

Therefore, the efforts to delineate the possible solution for the initial problem, the dedication of the team of Institution B1 to the preliminary analysis about the potential of the technology, and the presentation of the possibilities to convince the other participants about the opportunity envisaged were steps considered relevant. These steps characterize the seizing capability, and it influenced the value creation of blockchain in this case.

The dynamic capability of reconfiguring was also considered relevant, because in the context of the use of new technology by different entities, governance is a challenge, and the efforts to define the governance of the network influenced the value creation of blockchain in this case.

The efforts of governance were assumed by a Committee composed of regulators of the capital market. Directors and Presidents of Institutions B1, B2 and B3 were members of the Committee. The Committee supports discussions of cross-cutting issues related to capital market regulation and it supported the decision-making process around this case. Some decisions are, for example, regarding the approval to start the development of the platform, regarding the establishment of priorities and deadlines, about the allocation of resources, etc. The committee assumed an important role in the governance of the network and promoted the collaboration of the parties involved in the initiative. Interviewee B1.2 states that:

At the time we had help, because we had an instance that was (...) the committee of capital market regulators, (...) it ended up being an instance of governance

for this process, so it helped a lot. Sometimes it may be difficult when you don't have an instance of governance that represents this decentralized model.

Interviewee B1.2, gave some examples of the discussions held in this committee “*the solution is this, are you all in agreement?*” “*Yes, we are.*” “*We are with that timeline, are you in agreement?*” “*Yes, we are.*” Priority. “*Can you be here at this moment, put people to do this?*”. Then, these are some examples of the discussions and commitments promoted by the committee.

Therefore, the Committee supported the reconfiguring capability, enabling intra-organizational decisions and the reconfiguration of resources, processes and changes, to allow the creation of the platform, promoting the alignment of expectations and the achievement of the expected results.

b) IT resources and capabilities

Technical knowledge was identified as influencing the value creation of blockchain, and the team had already some previous experience with the technology. Previous experience supported important decisions, due to a better understanding regarding the characteristics, usefulness and limitations of blockchain. According to the Interviewee B1.2, in the preliminary experience with blockchain it was possible to:

"(...) understand in which way the technology works and in which way the technology does not work. So, for example, (...) the blockchain platform, at that time, (...) has scalability problems, and if you need many transactions per second, it doesn't work, but this was the typical process that didn't need to have thousands of transactions per second, (...) [Another] example, (...) a big gap at the time (...) was regarding the network governance tools. Since the network is small, [with] few institutions, it was not a problem at that time, you know? So, we began to see that even the limitations of the technology were not problems, and the advantages they brought really delivered value within this process.

c) Other resources and capabilities

The sponsorship of Institution B1 and of the Committee that supported the governance of this initiative influenced the value creation of blockchain in this case. In 2017, when

the platform was envisaged, it was difficult to find information about blockchain adoption cases. According to the Interviewees, it is easier to understand the potential of the technology nowadays, but at that time, it was more challenging.

Furthermore, in the public sector in general, there is conservatism and risk aversion. Investment in innovation involves the inherent risk of failure. Innovation encompasses trade-offs, and there is the chance of failure and the chance of great opportunities for efficiency gains. In this context, according to Interviewee B1.2:

A great aspect that influences [the value creation of blockchain] is maybe the strategic sponsorship for these innovative solutions, because (...) sometimes you can talk about blockchain now that it's 2021, but it wasn't so simple to talk about blockchain stuff in 2017 (...) strategic sponsorship is another fundamental part.

The sponsorship was both from the committee composed of regulators of the capital market and from inside the institutions. Interviewee B1.2 considered that “*the committee ended up being the strategic body that was looking at the project and gave the sponsorship, that transversal body that sponsored the project*”. In Institution B1, for example, the initiative was considered as a strategic project of the innovation area, and scarce resources were allocated to this initiative, which received support for the development of new competencies.

5.3.3 Synthesis and conclusion

- The motivations to use blockchain in this case were decentralization and security.
- The analysis of the value of blockchain in this case indicates that the technology enables the decentralization and security expected for the process and participants involved, and the platform allowed the creation of the public value of internal effectiveness and efficiency.
- Therefore, the motivations to use the technology were materialized by the benefits created by blockchain.
- The analysis of the resources and capabilities indicates that the elements that influenced the value creation of blockchain in this case were the dynamic capabili-

ties of sensing, seizing and reconfiguring, technical knowledge, an IT resource, which is a platform that represents one part of the solution developed, and the sponsorship for this initiative, granted by the Institutions and by the Committee that supported cross-institutional decisions.

This section presented Case B and further discussions about it are explored in Chapter 6, which is devoted to the cross-case analysis.

5.4 Case C

This case represents an initiative of blockchain adoption by a Regulatory Agency of Civil Aviation. The initiative has the goal to automatize the registration process of the flight log. The flight log encompasses the registration of several information regarding a flight, as data and time of engine start, takeoff location, landing location, engine cut-off, pilot and copilot code, the crew, mechanical and airworthiness occurrences, among others.

The flight log is standardized by the International Civil Aviation Organization, and it is a primary registry of aircraft operations. It is accepted by many countries, and its register is traditionally made in paper format. At the end of each air travel, the pilot includes the information of the flight log, manually, before leaving the aircraft. At any time after the aircraft landing, a civil aviation inspector can request an inspection of the flight log.

The register of the flight log is mandatory, and it may be preserved for several years. From the primary record of the flight log, it is derived different types of controls, as the control of hours for maintenance of aircrafts, among others. Then, the flight log is a core information, from which the details about the life of the aircrafts are preserved. The responsibility for the preservation of the flight log is of the operator, which may be the owner of the aircraft or not since the owner and the operator of the same aircraft may not be the same.

Blockchain was envisioned in this context to facilitate the registration of the flight log. The initiative is on the pilot stage, and it was sponsored by a Regulatory Agency. The development of the initiative started in 2019, by a company hired by the Agency, and it is using Hyperledger Fabric. It is a private and permissioned network, and the participants of the network are the regulatory agency, the IT company that provides the soft-

ware and possibly other partners of the agency. At the time of the interview, in 2021, it was expected that the initiative would be totally implemented (in production) in a few months.

The interview participants of this case are Interviewee C1.1 and Interviewee C1.2, which are from the same agency that sponsored the use of blockchain, and they are, respectively, the product owner and specialist in the regulation of the civil aviation; and the project manager of the initiative.

5.4.1 Motivations to use blockchain and its value

The motivation to use blockchain in this case was security, the value identified in the pilot stage of the initiative was security and the public value enabled by the initiative is quality of the public service.

Regarding the motivations to use blockchain, security was considered fundamental in this initiative, because the data of the flight log needs to be preserved for several years. The flight log is an important register about the aircraft's life, which is inserted in the flight book. The register of data in the flight book occurs in a similar way to the characteristics of blockchain, in respect to the chain of information and to the importance attributed to data integrity. Traditionally, the information of the flight log is included in the flight book in a way that guarantees a chain of information. The information about the flight operations is inserted in the lines of the flight book. When a page of the flight book is totally filled, it is necessary to manually sum up all the hours that the aircraft have been flown and add it at the end of the sheet, close the sheet, and transfer some data to the next sheet. So, there is traceability and a history about how many hours the aircraft has flown.

The flight log is the central core information that is already associated, or may be associated in the future with the aircraft maintenance, the control of hours flown, inspections, charging for aircraft parking, etc. Therefore, integrity, immutability and traceability of data is essential. Interviewee C1.1 explains some concerns about it:

How to ensure the integrity of this record? (...) One possible technology is (...) blockchain. So, blockchain was perceived as a possible electronic substitute for the mandatory chaining of records of the flight book (...). Therefore, given the

similarity between this chaining technology and the traditional flight book, with numbered sheets, it was decided to take advantage of the similarity of these characteristics and propose the adoption of blockchain as a chaining format that ensures immutability (...). A record can only be changed, once released, in a registered way, and preserving the original record. So, the blockchain has an important characteristic, that it doesn't allow the extinction of a block once it is released. It can be replaced by a revision, but the original remains, and this is something totally convergent with the need to preserve flight records. That is why the adoption of the blockchain was proposed.

Interviewee C1.1 states that it is important to have the original data of the flight log preserved in an immutable and verifiable way because the data will be used in other procedures of the Regulatory Agency, as presented in his own words *“The great value that we give to this technology is that we will extract data that will feed the acts of the regulatory agency. Control acts, supervisory acts and eventually police acts”*.

Therefore, security was the motivation to use blockchain in the context of the register of flight logs since integrity and immutability were considered essential. Table 13 presents the motivation to adopt the technology and the benefits identified in the pilot phase of this initiative.

Table 13

Case C - Motivations and value

Motivation		Value	
Framework	Case C	Framework	Case C
Security	Security	Security	Security
Transparency	-	Transparency	-
Decentralization	-	Decentralization	-
		Professionalism and trust	-
		Internal efficiency and effectiveness	-
		Quality of the public service	Quality of the public service
		Participation and engagement	-

Regarding benefits, it was identified that blockchain creates the value of security and the initiative, when fully implemented and in use, has the potential to create the public

value of quality of the public service. These values are presented in the following topics:

a) The value of security

The value of security identified in the context of this initiative is aligned with the initial expectation. Blockchain uses cryptography and preserves the data regarding the flight logs in nodes. The network allows the availability of data even if one node is unavailable, facilitating access. The rules in this case define that the registers of the flight logs need to be shared with the Regulatory Agency. According to the words of the Interviewee C1.1, *“by business rule, it’s necessary to preserve the records authenticated and it needs to be shared with the agency, and this can be done in a completely asynchronous way (...) we have our own infrastructure for data preservation, data monitoring”*.

The integrity of data, its availability, immutability, and traceability are very appreciated in this initiative. An appropriate and secure infrastructure is the basis and the contribution of the public sector to create an environment that potentially can unfold benefits for the airline sector, since the flight logs are central to other procedures, as explained previously. Interviewee C1.2 considers that *“we are creating, as a regulatory agency, our role, the government’s role, is to create an environment, a healthy ecosystem, so that aviation can develop”*. Therefore, the benefit of security was identified in this initiative.

b) The public value of quality of the public service

This initiative of flight logs digitization indicates that, when fully in production, it may influence the creation of public value, specifically regarding the quality of public services provided by the Regulatory Agency to the airline sector ecosystem.

One of the contributions of the initiative is related to the digitization of a process that is manually performed nowadays, since the information about the flight logs are written in paper documents (the flight book). Therefore, the initiative has the potential to eliminate some procedures of the airline sector participants since many aircraft operators were including the information or part of the information of the flight log in their own internal systems. Then, the register of the flight log in the blockchain provided by the Regulatory Agency and in the internal systems of the operators would be redundant and the

use of the internal systems would be dismissed.

The use of the data of the flight logs in the context of other procedures has the potential to create value to the airline sector ecosystem. For example, in the context of the control of the pilot's proficiency, the flight logs are a relevant data source. The data would be useful as proof of experience of the pilots, which is useful data to enable their class change, which depends on the number of hours of demonstrated experience. Therefore, the use of this data is favorable to the aeronauts and for the Regulatory Agency.

Another possibility envisioned is the use of the flight logs in the context of the aircrafts' maintenance, since the aircraft need to follow specific maintenance plans, and this operation is burdensome. The data of the flight logs may also be useful in the context of the control of arrivals and departure, and in the control of the charges involved. All these possibilities may improve different procedures in the airline operations.

According to Interviewee C1.1, *"by having the primary data in a digital form, they propagate to aspects of the aircraft's life and of the performance of the aeronauts"*. Therefore, the digitization of the flight logs and its appropriate and secure storage may reduce or eliminate some procedures and it may provide agility to other processes in the airline sector. Then, these efficiency gains may improve the quality of the services in which the public and the private sector interact.

As presented by the words of Interviewee C1.1, *"you see that it is information that radiates and has the potential to modify by automation various processes in which the regulatory agency has a role or an interface"*. He adds that *"the agency main goal is to make aviation both safe and as simple as possible. So, eliminating steps that do not add value is one of the purposes of our work"*.

Then, the value of blockchain in this case and the potential public value provided by the initiative were presented. The next topic explores the resources and capabilities influencing these benefits.

5.4.2 Resources and capabilities influencing value

The resources and capabilities that influence the value creation of blockchain in this case are technical knowledge, sponsorship, and hype, as presented in Table 14.

Table 14*Case C - Resources and capabilities*

Dynamic capabilities		Resources and capabilities (R&C)	
Framework	Case C	Framework	Case C
Sensing	-	IT R&C	IT - Technical knowledge (enhancing)
Seizing	-	Other R&C	Other - Sponsorship
Reconfiguring	-		Other – Hype

Before the presentation of each element, a brief explanation about the development of the initiative is provided. The initiative to use blockchain in the context of the flight log digitization was sponsored by the Regulatory Agency, which does not develop software with its own capacity. Therefore, the agency hired the development of the initiative from an external organization. In parallel, the Agency contracted another organization to support and control the software development. The organization responsible for the solution development had his contract finalized after a certain period of time and a new external organization was contracted for the solution development, and it was involved with the development until the time of the interviews.

Once the context of the initiative development was presented, the following topics encompass the resources and capabilities that influence the value creation of blockchain in this case:

a) IT resources and capabilities

It was identified in this case that technical knowledge influenced the value creation of blockchain, according to Interviewee C1.2. He informed that the Regulatory Agency has two ways to develop new competencies, which are by public tender or contracting an external organization. Since the Agency did not have the knowledge to develop the solution, as stated previously, they decided to hire an organization to develop the solution. The contribution of the company was considered relevant to this initiative. As stated by Interviewee C1.2:

For sure the most important thing was to get this partnership, to get these contracts (...), to be able to move in this way. Of course, internal management capacity is always necessary (...), and also the agency's knowledge and willingness to deal with this, but certainly, the external partnership (...) was the most im-

portant thing. (...) The blockchain, the network (...) [it was] all external development, there was absolutely nothing done internally by the agency.

As stated previously, it was necessary to contract a second company to develop the initiative, because the contract with the first one was closed. Although Interviewee C1.2 highlighted the importance of the knowledge of the developers, Interviewee C1.1 considered that “[the second company] does not yet fully master the technology, (...) it is a knowledge that is being built.”

Therefore, although the performance of the second company may be below the expectations, the contract established with it to fill the technical knowledge gaps of the Regulatory Agency was considered as influencing the value creation of blockchain in the context of this initiative.

b) Other resources and capabilities

It was identified that the resources and capabilities related to sponsorship and hype influenced the value creation of blockchain in this initiative. It had the sponsorship of the Director of the Agency, which offered the political support to the solution development. Since the Director assumed this role in 2016, he has stated that he would like to deal with conditions to transform the Agency, he encouraged digitalization, especially in the context of the flight logs. Interviewee C1.2 explains the attitude of the Director towards the rational use of the technology:

I believe that this [the sponsorship] was essential, and it continues to be nowadays (...). The Director still talks a lot, he supports the issue of innovation, and (...) this was an issue that the Director specifically brought to this project, which is 'we should not use it just because we can use it, ok? The tool is great for stamping, but do I need a stamp? Ok, if I need it then (...) it is interesting to use. Now, if I don't need it (...) no matter how good the technology is, it is better not to do it'. He is an economist, he always has this in mind, I think this was very important, so we can use it [blockchain] in an effective way and not just use it for the sake of using it.

Therefore, the Director has contributed with the political support for the initiative development, and he encouraged the use of the technology as long as it was considered

useful for the need.

The other and last element identified as influencing the value creation of blockchain in the context of this case was hype. According to Interviewee C1.2, the hype around blockchain creates enthusiasm of the team involved. Even considering the rational analysis of the characteristics and potential benefits of the technology, the hype contributed to increase the interest of people around the initiative, and many people were talking about it and willing to experiment with it. The hype and enthusiasm create the condition to make people evaluate more carefully the possibilities to use blockchain. Interviewee C1.2 explains that it is important to have the balance around hype and a critical analysis about the use the technology:

I talked about the hype on one side, that it is important that everybody is moving, everybody is wanting that. And on the other side, the foot is on the ground, considering 'Great, it is good that we are discussing this. Do we need it? What do we need? How can we simplify it? What is necessary regarding security?'. Anyway, these two things [hype and critical analysis] generate a very good balance.

Therefore, the hype and enthusiasm of the people involved in the initiative was considered as an element that influenced the value creation of blockchain in this initiative, even if this enthusiasm is balanced with a critical analysis of the technology.

5.4.3 Synthesis and conclusion

- The motivation to use blockchain in this case was security, since data integrity and immutability were considered essential.
- The analysis of the value of blockchain in the pilot solution indicated its potential to provide security and to create the public value of quality of the public services. These benefits are expected after the full implementation of the solution.
- The analysis of the resources and capabilities indicates that technical knowledge, sponsorship and hype and enthusiasm were elements that contribute to the potential value creation of the initiative.
- The dynamic capabilities of sensing, seizing and reconfiguring the resources

were not identified as influencing the value creation of blockchain. It may be because the acquiring of knowledge regarding blockchain was not the main concern for the Regulatory Agency, since they do not have a specific team dedicated to software development. Considering that dynamic capabilities are recognized as a way to influence excellence in new products and to influence performance in the long run (Teece, 2007), the sensing of the environment, the seizing of the opportunity to use blockchain, the reconfiguring of resources to develop the initiative and to achieve its goal are likely not recognized as important capabilities for the success of the agency in the long run.

This section explores Case C, further discussion about it is presented in Chapter 6, which encompasses a cross-case analysis.

5.5 Case D

This case is related to an initiative of blockchain adoption in the context of public procurement. The goal of the initiative was to support data exchange related to the public procurement of IT objects (products and services), to optimize part of the public procurement process and to reduce costs of the public sector organizations.

The public procurement process encompasses some steps, such as the price collection about a product or service that a public organization is planning to acquire. This is necessary to justify and support the definition and reservation of the appropriate budget to the procurement. Then, it is possible to hold the amount necessary to fulfill a need before the actual acquisition is formalized.

One of the stages regarding the definition of prices involves the consultation of values practiced by other organizations. The prices collected may represent a reference of the market price. In the price collection process, one public organization asks other organizations to provide data regarding a specific object (product or service) which is intended to acquire, or the public organization asks different suppliers about the prices. The problem of consulting prices directly with the suppliers is the risk of price overestimation. To reduce this risk, it is desirable to have access to practiced prices in previous acquisitions performed by other organizations, although procurement process faces the risk of collusion among a reduced number of participants, which overestimate prices.

The time to obtain data about prices with suppliers, depending on the complexity of the object specifications, may vary from 3 to 4 weeks and it can be even longer. The documents with the object's specifications may vary from 30 to 150 pages, then the process of pricing requires considerable effort and time.

There are different means to collect data regarding prices, as by telephone, e-mail, internet, or using a centralized system. This activity is cumbersome, no matter what the means to obtain the data. Sometimes it is not possible to succeed with data collection, especially for large-sized organizations, that are usually involved in high-volume acquisitions.

The use of a centralized system is considered inappropriate because each organization would like to maintain the data about its own contracts and the definition of one organization to store the data of all the other organizations would imply redundancy. There is a centralized solution available, but it is not user friendly, it does not provide appropriate filters and functionalities to facilitate data collection and analysis.

There are negative consequences related to the difficulty of the public sector obtaining data to support new acquisitions. This increases the concentration of the negotiation power on the supplier's side since there are few suppliers in the IT sector for some objects. There is an example of the same object acquired by different public organizations in which the prices vary about tenfold. Even when comparing wholesale and retail acquisitions, this huge difference seems not justifiable. Therefore, the lack of data and the concentration of power of the suppliers has led to the waste of public resources.

The goal of this initiative is to provide a network for different organizations of the public sector to share and consult public procurement data, to bring decentralization and efficiency to the public procurement process. With a decentralized system, organizations would be able to control their data and share some in a secure network. The time spent obtaining information would be reduced. With the participation of many organizations, access to detailed specifications would be facilitated, supporting efficiency gains and higher quality of the public procurement process.

Therefore, the system was developed by two organizations (Organizations D1 and D2). Organization D1 is a financial institution, which is a mixed economy society, legal entity of private law, constituted by public and private capital. Organization D2 is a public organization linked to the Ministry of Economy, that develops information technology

solutions for more than 40 years. After some time, three more organizations from the same sector were involved, although they were involved in less activities or just in some discussions (Organizations D3, D4 and D5).

The network was created using Hyperledger Fabric and it was in a laboratory stage. The initial efforts to develop and improve the network were established by an agreement between Organization D1 and D2. Some metadata regarding the public procurement process was included on the blockchain and some documents and contracts were stored off chain. After some time, the agreement was not renewed, and the network was turned off. At the time of the interview, the organizations involved were waiting for executive and interorganizational definitions, specially from Organizations D1 and D2.

The initial idea of the solution was to concentrate in the step of data collection regarding prices. In the future, it could evolve to encompass the public procurement life cycle, taking full advantage of the smart contracts, with the possibility to use artificial intelligence to improve data analysis. This has not evolved yet (confirmed in July 2022) due to the need for the agreement's renewal.

The interview participants of this case are Interviewee D1.1 and Interviewee D2.1, which are from different organizations, and they were part of the initiative as, respectively, a project lead and specialist in public procurement process of Organization D1, and a blockchain specialist of Organization D2.

The following subsection presents the motivation to use blockchain and the benefits of the technology in this initiative.

5.5.1 Motivations to use blockchain and its value

The motivations to use blockchain in the context of the public procurement process were security, decentralization and knowledge development and they are presented in the following topics:

a) The motivation of security

In the initial evaluations regarding the use of blockchain in the public procurement process, it was identified that security was necessary, especially because there was the idea that, in the future, the platform could be used in the context of more activities related to

the procurement process, including activities of post contracting and monitoring of the acquisitions. According to the words of Interviewee D1.1:

At that moment the blockchain technology was mentioned, because the concern we had was to (...) ensure the security (...) of this information (...) [it was also glimpsed] the evolution [of the initiative] for other actions beyond these acquisition actions, as in the post-contracting, (...) the monitoring of contracts, but the initial need would be the exchange of information [related to contracts and prices].

Then, security was a motivation to use blockchain, and the initial scope of the initiative would be useful to understand the potential of the technology to accommodate other parts of the procurement process with the level of security required.

b) The motivation of decentralization

Decentralization was expected in this initiative because the organizations would like to avoid a central control and also because the decentralized solution was considered less costly than a centralized one. It was believed that the initiative would reduce the involvement of people in the data collection process, and it would reduce the time and efforts to obtain data from other organizations. Decentralization was also intended because on the one hand the responsibility and control of each organization over their contracts would be maintained, and on the other hand, part of the data could be shared.

The centralization of data in one system under the responsibility of one of the organizations involved would create duplicate data and costs. With a decentralized system, each participant of the network takes care of the costs involved with infrastructure and deal with the data under its responsibility. Interviewee D1.1 explains that:

It would not make sense for one of these companies to store all the contract information of all the public entities (...) in a single source, [where] any other public entity could access this information. Even because each public entity has a storage of this information. Thus, it would be a duplication of storage (...) it would not make sense with the technology [that] we have today.

Interviewee D2.1 agrees that decentralization was a motivation to use blockchain in this initiative, as explained by his words:

There are internal initiatives in the institutions to obtain information and control their own contracts, while there is also a centralized government solution (...). We saw that with blockchain, we can have both things in a single solution. We can have an internal node to be able to do internal processing, in the institution, and have a network interconnecting these nodes that allows us to embed solutions that meet the entire network, that meet the needs, for example, of a controlling body, or the federal public administration. Therefore, this is the dynamic of blockchain, that we saw that it is interesting, more interesting than having an isolated database within my institution to manage my contracts and then having to expose this data to another database that will also be centralized (...) to do this management as well. We can have a single solution that guarantees both things.

Therefore, decentralization was a motivation to use blockchain in this initiative since it would avoid a centralized control and it would involve lower costs in comparison to a centralized solution, not only the costs of the infrastructure, but also related to the simplification and agility of the data collection process.

c) The motivation of knowledge development

Organizations D1 and D2 promoted some meetings where they identified that both organizations would like to develop more knowledge about blockchain. Some professionals had already some knowledge, but the idea was to enhance it. Then, the technical and business teams of these organizations promoted design thinking workshops where they discussed many challenges and they identified a common pain, related to difficulties on the public procurement process. They concluded that the application of blockchain in this context would make sense.

According to Interviewee D1.1, both organizations were interested in using blockchain and concerned about tackling the challenges related to public procurements, and after some analysis, they visualized an opportunity. According to his words:

And then it started, the technical area wanting to develop something, the need we had identified [regarding public procurements], and then the business need was integrated [...] with the interest of the technical area. Moreover, this happened from both companies (...) the Organization D2 said 'look, we also want this project to meet this business need, but we also want this to develop

knowledge (...) regarding this technology'.

Interviewee D2.1 highlights that since the initial discussions, the idea was not only to learn about blockchain, but it was really to find a case that would be functional, that would encompass real problems of the business areas of the organizations. As presented by the words of Interviewee D2.1:

From the beginning, the goal was to create something really functional, this was a concern that we had (...). The idea was not simply to create a project to study blockchain or to put something in practice using blockchain (...). Since the conception, until the delivery, we always validated this with the business area.

Then, knowledge development was considered a motivation to use blockchain, under the condition that real problems from the business area would be addressed, as explained.

Therefore, security, decentralization and knowledge development were the motivations to adopt blockchain in the context of this initiative. The motivations to use blockchain and the value of the technology are presented in Table 15.

Table 15

Case D - Motivations and value

Motivations		Value	
Framework	Case D	Framework	Case D
Security	Security	Security	Security
Transparency	-	Transparency	-
Decentralization	Decentralization	Decentralization	Decentralization
-	Knowledge development	Professionalism and trust	Professionalism and trust
		Internal efficiency and effectiveness	Internal efficiency and effectiveness
		Quality of the public service	-
		Participation and engagement	-

Considering the network in a laboratory environment, it was identified that blockchain enables security and decentralization and this initiative contributed to create the public value of professionalism and trust, and of internal effectiveness and efficiency, as pre-

sented in the following topics:

a) The value of security

In this initiative, blockchain enables security in the data exchange among the institutions that joined the project, as stated by Interviewee D1.1:

And the blockchain technology entered this part to ensure that only companies that join the project participate [in the network] and with the security that the information will be shared only for the entities that join the project.

Interviewee D2.1 complements that the way to identify the participants and the consensus mechanisms that allows the validation of data increases the trust needed to deal with data. As presented by his words:

[There is] user identification, (...) [there is] consensus (...) and validation of the data that are in the tool (...) this makes you have confidence to work with the data inserted there.

b) The value of decentralization

As presented in the motivations, decentralization was required to avoid central control and to allow each organization involved in the network to take care and make their own investments and decisions about the data under their responsibility. The network participants would work interconnectedly and independently at the same time. As stated by Interviewee D2.1, the independence of the organizations was a benefit observed, as presented by his own words:

The main benefits that we see: first, the independence that the base has, it is not a system that is only inside the data center of Organization “X” or “Y”. It is a system that is really distributed, and in our case, both the data repository part and the business logic part (...) I understand that it is very important, this independence.

Therefore, the benefit of decentralization was achieved, allowing the organizations to take care of the data under their responsibility and to share part of it with the other participants, enabling interconnection and independence among them.

c) The public value of professionalism and trust

This initiative offered an opportunity to the organizations to collaborate and to develop knowledge about an emergent technology, increasing the capacity of the organizations to create other solutions in the future. The goal to develop knowledge regarding block-chain was achieved and the team acquired new competencies, as stated by Interviewee D1.1:

So, the collaboration, the collaborative spirit, the dedication, the commitment of these people, from the technical area, to make knowledge available, and it was a knowledge that they had to search for this knowledge (...) it was something that involved a lot of work, that brought difficulties, but that brought a lot of learning, which was one of the objectives declared (...), at least in this organization.

The goal to develop knowledge was shared by the two organizations that were more involved in the creation of the solution, and it was considered achieved also in organization D2. According to Interviewee D2.1, not only knowledge development was achieved, but the initiative also promoted collaboration, which is not usual in traditional IT development:

I believe that within the context that we had, the transfer [of knowledge] was done and the collaboration between the teams was fruitful (...). One of the main indirect benefits, I would say, that technology brings is precisely this possibility of collaboration between agencies (...). What we usually see is the specification of a solution by some government department, the execution of this project by some IT company (...) and finally, we see the institutions having to start using this solution, being a government solution, and following a normative instruction. Then, there is little collaboration in a traditional technology scenario. Usually, you have someone specifying, someone developing, and the users are just using it, being called to use the system at the end, when it is already done. And with this technology, we had collaboration from the beginning. So, one advantage I see in this blockchain model is exactly this, to promote collaboration between institutions.

Therefore, collaboration among institutions and knowledge development were achieved and this process was different from the traditional way of developing software. Knowledge development allows the creation of capacity to deal with new initiatives that

may be benefited from the use of blockchain in the future, characterizing the public value of professionalism and trust.

d) The public value of internal effectiveness and efficiency

This initiative, even when in the laboratory stage, demonstrated its ability to create the public value of internal efficiency and effectiveness. The system has a glossary to support the identification of objects, since different organizations usually consider distinct terminologies for the same objects, hindering the step of price collection and analysis. The storage of data was standardized, filters were created to access data, so it was easier to deal with it, reducing the need to send e-mails to other organizations, decreasing the necessity of human intervention and lowering the time involved to perform the activity. According to Interviewee D1.1:

We also were aware about the need to create this glossary, precisely to (...) standardize the communication (...) another benefit is to be faster, because when we send an e-mail, it will depend on the availability of the colleague from the other public entity, normally we ask for a deadline for giving an answer, sometimes even informing the deadline, asking like this, 'look, we would need an answer within five working days' and so on, but many times we don't even get an answer.

In the laboratory stage of the initiative, information about a few hundred contracts was available and the easiness to consult data was demonstrated, as presented by the words of Interviewee D2.1:

What benefits had we achieved even in this more experimental phase? We had the contract data from Organizations D1 and D2, from a large [period] of time, something like three years, in the system's base, and this already brought an easiness for the team that was what? To be able to query these contracts.

Therefore, the public value of internal effectiveness and efficiency was identified through the creation of the glossary, the standardization of data and communication, facilitating the use of data and decreasing the efforts and time to deal with it. It was informed that in the future, the use of smart contracts to support the complete life cycle of public procurement would allow more internal effectiveness and efficiency, but this

depends on some executive definitions that are explored in the next section.

5.5.2 Resources and capabilities influencing value

In this case, the resources and capabilities that influence value are the dynamic capabilities of sensing, seizing, and reconfiguring; technical and business knowledge. Before the presentation of the resources and capabilities, a brief explanation regarding the initiative development is presented. The development of the initiative went through two phases. The first one involved Organizations D1 and D2, in 2019, when it was decided to develop a minimum viable product. The network was running in a laboratory environment and a few hundred contracts were considered.

In the second phase, new functionalities were developed, and the team was just waiting some executive definitions to migrate the initiative to the production environment (the real-world environment, in which the solution is used after being fully implemented, tested and approved). In this environment, the plan was to share a few thousand current and closed contracts. Organizations D1, D2, D3 and D4 participated in the second phase, and discussions and negotiations with Organization D5 were being held. There is the intention to invite more organizations to join the network when it is fully running. The evolution of the second phase depends on some executive decisions, as explained in the next topics. The resources and capabilities that influence the value creation of blockchain in this case are presented in Table 16.

Table 16

Case D - Resources and capabilities

Dynamic capabilities		Resources and capabilities (R&C)	
Framework	Case D	Framework	Case D
Sensing	Sensing	IT R&C	IT - Technical knowledge (developed and enhanced)
Seizing	Seizing	Other R&C	Other - Business knowledge
Reconfiguring	Reconfiguring		

The resources and capabilities that influenced the value creation of blockchain in this initiative are explored in the following topics:

a) Dynamic capabilities

The dynamic capability of sensing was identified as influencing the value creation of blockchain in this case. Organizations D1 and D2 were looking for partners to develop a blockchain initiative. After some meetings, they scheduled a design thinking workshop where they analyzed many different challenges from distinct areas, and they identified the same difficulties regarding public procurements.

During the design thinking workshops, the teams identified the challenges that should be addressed, what the blockchain technology could provide, the functionalities that would be available in a minimum viable product (MVP) and in future releases. Individuals who deal with the procurement process were interviewed, to understand their needs, since they were potential users of the initiative. Then, the opportunity to use blockchain to address the challenges of public procurements was initially identified.

According to Interviewee D2.1, this step was important to influence the value creation of blockchain and in his own words:

[The design thinking workshops] were very important (...) we started looking for problems that were common to both institutions, by coincidence there were people from the procurement area from both (...) institutions, and we ended up moving towards this issue of dealing with the problem of public procurement contracts (...) and we decided to start with IT contracts (...) it was there [in the workshops] that we defined what the objectives would be, what the technology could bring as a differential, we separated the functionalities that would be available in the MVP, and which functionalities we were interested in having in future releases, we were able to interview (...) the potential users of the tool, to meet their needs.

The design thinking workshops were supported by design thinking specialists from an innovation team of Organization D1, as explained by the words of Interviewee D1.1:

Innovation is not only a new technology, and it is not only linked (...) to the technology area (...). But here in our area (...) there is a manager who has a team that takes care of communication and innovation. It is not that the team [centralizes] the area's innovation, they foment it and give support to it. Someone says, 'look, I'd like to change this here, I'm thinking about this', so they give

this support, there are specialists in design thinking, there are also other tools (...). This was the team that gave support in the beginning, that I told you about [in the design thinking workshops].

Therefore, the sense of the opportunity was enabled by the design thinking workshops provided by an innovation team, and the workshops were considered a relevant step to understand the needs and challenges of business areas and the characteristics of the technology that would be useful to address them.

The dynamic capability of seizing was also identified as influencing value. After the Organizations D1 and D2 agreed to invest in the opportunity identified in the sensing activity, they established a Technical Cooperation Agreement (TCA), which defined the resources that should be made available by the organizations to allow the creation of the MVP. The technical and business team of Organizations D1 and D2 were involved in the TCA. Interviewee D2.1 informs the resources negotiated, which were knowledge and infrastructure:

From then on, we put together a team, with the staff from Organization D1 and from Organization D2. A TCA was established, a Technical Cooperation Agreement, where each institution entered with the manpower and its own infrastructure. There was no hiring from Organization D1 or D2, ok? The exchange was really in terms of personnel and equipment from each one [of the organizations].

Therefore, in the seizing activity, the initial outline of the solution was defined, the means to seize the opportunity and to manage and deliver benefits were established, and the institutional and formal instruments to set the interorganizational commitment were created.

The dynamic capability of reconfiguring was also considered as influencing the value of blockchain in this initiative. Organization D1 and D2 had complementary capabilities and they tried to take advantage of the competencies of each organization. Organization D1 contributed more with the front-end part and organization D2 contributed more with the back-end part. They detailed the activities, responsibilities, and the management process of the project. They organized regular meetings to monitor the project evolution and take care of the knowledge transferring among the organizations involved in phase

1 and 2, which involved 2 and 4 organizations, respectively.

Interviewee D2.1 explains the involvement of Organization D1 and D2 in the solution creation. They assumed initial responsibilities, but it would be changed, when necessary, as explained by his words:

It was all done with four hands. The team of Organization D2 that was allocated in this project had more knowledge regarding the technology that was selected, which was the Hyperledger Fabric, than the team [from Organization D1] that was allocated [in this project]. So, Organization D2 was mainly responsible for the infrastructure part, and Organization D1 assumed more of the front-end part. However, this was not fixed and in the course of time, the team of Organization D1 developed knowledge about the infrastructure part.

It was highlighted that the collaboration and commitment of the teams were relevant to influencing the value creation of blockchain in this case. According to the words of Interviewee D1.1:

The technology, the platform, the blockchain, all of these are important technological resources and decisive for us to achieve the goal, but without the people involved we wouldn't achieve anything. So, for me, what was decisive was the will and dedication of the people involved (...) the collaboration, the collaborative spirit, (...) the commitment of these people (...) This is what I think was decisive for us.

Interviewee D2.1 also highlighted the importance of collaboration among the organizations and among the technical and business teams, according to his own words:

[A] valuable resource, without a doubt, was the collaboration of these teams. Both from Organization D2 and from Organization D1, and from both technical teams and business area teams.

Therefore, the dynamic capabilities of sensing the opportunity, seizing it among the organizations involved, and reconfiguring the resources of each organization was declared as influencing the value creation of blockchain in this initiative.

b) IT resources and capabilities

Technical knowledge was identified as an important element that influenced the value creation of blockchain in this initiative. Some professionals had already some knowledge, but the idea was to enhance it. Interviewee D2.1 recognizes the importance of the knowledge of the teams, not only the technical knowledge regarding how to design and create the solution, but also the business knowledge regarding the public procurement process, as stated by his words:

[An] important resource, for sure, is the knowledge of the teams that participated [in this initiative], both the public procurement teams, who helped us design the whole system and its functionalities, and the knowledge of the technical teams that allowed us to design and build the solution. So, certainly, the main resource was the time of these professionals that was dedicated to this project. The time and knowledge of these professionals. In terms of computational resources, I believe they can be considered negligible, considering the size of Organizations D1 and D2, ok? We are talking about a few virtual machines, something that in terms of value is very low. In terms of software too, (...) there was no acquisition of software to run this project.

c) Other resources and capabilities

Business knowledge, as mentioned in the previous topic, was also identified as influencing the value of blockchain in the context of the public sector, once the teams related to the public procurement process could clarify the main activities they had to execute, and the difficulties faced and explain them to the technical team. Then, together and with collaboration it would be easier to develop a solution that truly creates value.

Therefore, in the initiative of this case, it was highlighted the technical and business knowledge of the teams and the collaboration among them as relevant, which influenced the value creation of blockchain.

Finally, in this case, even in a laboratory environment, it was possible to identify the value of the technology and the resources and capabilities influencing the value creation. Meanwhile, there is a difficulty to advance with the plans for the initiative, to move to the production environment, and to formalize the continuation of the interor-

ganizational agreement.

In the beginning of the initiative, in 2019, there was sponsorship from the organizations involved in the discussions. In Organization D1, the sponsorship supported the allocation of resources and the project received priority to be developed. Interviewee D1.1 explained that *“it was [the sponsorship of] our direct manager and we also had support from the director (...) and with sponsorship it is easier”*. Organization D2 also highlighted that the commitment of executives was very relevant to the project development.

After some time has passed, many changes occurred in the two main organizations involved in the project (D1 and D2). People moved to other areas, and there was a change in executive positions. Then, the initiative lost steam and nowadays the teams are waiting for the interorganizational executive decision to proceed with the plans for the initiative. According to Interviewee D1.1:

But there is a detail, (...) the first agreement of technical cooperation (...) has already expired, it has (...) its validity terminated, and in this sense, (...) we do not have [a new] agreement of technical cooperation, it has not been formalized yet, we are working for this to be formalized as soon as possible.

The initiative has the appropriate technical conditions to move to production environment, as explained by Interviewee D2.1, *“today we are ready to go into production, from the technical point of view, but unfortunately, mainly from the political point of view, we were not able to evolve, so the project today is on hold.”*

Then, some changes in the executive positions of the companies involved in this case provoked a break in the continuity of the initiative, at least for a while.

5.5.3 Synthesis and conclusion

- The motivations to use blockchain in this case were security, decentralization and knowledge development.
- It was explained the value of blockchain in this initiative and how it was created. Blockchain enabled the benefits of security and decentralization, and the initiative enabled the creation of the public value regarding professionalism and trust and internal effectiveness and efficiency.

- The analysis of the resources and capabilities indicates that the dynamic capabilities of sensing, seizing, and reconfiguring influenced the value creation of blockchain in this initiative.
- Technical and business knowledge was identified as influencing the value of blockchain, and the knowledge and collaboration of the teams were highlighted.
- At the beginning of the initiative, there was sponsorship to develop it, but after some time, with changes in management positions, the initiative lost steam. This is an illustration of the importance of sponsorship and of the fragility regarding the continuity of public sector initiatives.

Further discussion about this initiative is presented in Chapter 6, which encompasses a cross-case analysis. The next subsection explores another initiative of blockchain adoption.

5.6 Case E

This case is related to an initiative of blockchain adoption in the context of healthcare, promoted by a public body from the federal public administration. Blockchain is just one technology integrated into an ecosystem with different solutions, technologies and components embedded. The ecosystem comprises the national platform for interoperability and exchange of healthcare data. The purpose of this ecosystem is to be a reference for clinical data of patients, creating a history of clinical assistance, that would be available for patients and healthcare professionals.

In this environment, blockchain has been used to support the storage of data regarding the covid-19 exams and vaccines. There was also an analysis and expectation, at the time of the interview, regarding the register of information about other clinical services in the blockchain.

Regarding the record of covid-19 exams and vaccines in the blockchain, the public and private laboratories that perform the covid-19 exams send the information to the blockchain network, just as the states and municipalities send the information regarding the covid-19 vaccines. In the case of vaccines, the system has already received data about 2 million vaccines in one day.

The goal with the use of blockchain in this initiative was to maintain a secure and distributed network in which the data about covid-19 exams and vaccines is available all the time, even in the case of unavailability of a network participant.

In this initiative, the citizens can consult the information about the exams and the vaccine certificates in a mobile app or in a website. The citizens can use the app to allow or deny the visualization of their information by a healthcare professional and the consent can be undone afterwards. The healthcare professional is allowed to consult the data about a person without consent only in the case of emergencies. The system maintains a log regarding who had access to the information.

Using this system, the public body can follow the health conditions of the population regarding the covid-19 notifications, and it can monitor the progress of the vaccination. The public body uses analytics to aggregate the data and to create and provide some dashboards, which are available on the internet for everyone.

The initiative encompasses a private and permissioned network, that uses Hyperledger Fabric, and the participants of the network are states, municipalities, public and private laboratories.

The initiative was developed by a public body from the federal public administration (Institution E1), with the contribution of a private organization and some consultants. Institution E1 is responsible for the organization and development of plans and public policies for the promotion, prevention, and care of health. Its function is to provide conditions for the protection and recovery of the population's health, reducing illnesses, controlling endemic and parasitic diseases, improving health, and giving more quality of life to individuals.

The interviewees in this case are Interviewee E1.1 and E2.1, which are, respectively, the healthcare systems development coordinator of the Institution E1, and an end user of the application related to covid-19 exams and vaccines.

5.6.1 Motivations to use blockchain and its value

The motivation to use blockchain in this initiative was security, which is presented in the following topic:

a) The motivation of security

In this initiative, there was the need to allow the secure storage of the information regarding covid-19 notifications and vaccines. The characteristics of the technology regarding security were perceived as promising, as its basic structure in blocks, its organization in chains and the cryptography was considered useful to support the security of healthcare data. It was appreciated that a block included in the network cannot be altered, and that there is a trail of information, which enables integrity. Interviewee E1.1 informs how he perceived security by his words:

If you want to see all the documents related to the exam results, you can see all the history, which is precisely these blocks in a chain, so you have a security of this information, from the moment it was entered until the current position (...) and all of this (...) is encrypted, to increase security.

The availability of the information regarding the exams and vaccines was also a concern in this initiative. With the use of blockchain, it was expected that if some problem occurs in some state, there would be no impact in data availability, since data is replicated among the nodes of the network, allowing access and reliability on the information. Interviewee E1.1 considers that:

So, what happens, if there is a problem in any state, it [would] not affect the other states, because the information is replicated, it is a distributed system structure. Then, this was also one of the characteristics that called our attention (...). So, if something stops, it doesn't affect the totality, which is a difference today when (...) you have a large database [where] if some service stops, some machine stops, everything stops.

Therefore, the need for data security regarding healthcare was a motivation to use blockchain, and there was necessity of data availability among the states involved in the initiative.

Table 17 presents the motivations to use blockchain in this case and the value created by the initiative.

Table 17

Case E – Motivations and value

Motivations		Value	
Framework	Case E	Framework	Case E
Security	Security	Security	Security
Transparency	-	Transparency	-
Decentralization	-	Decentralization	-
		Professionalism and trust	-
		Internal efficiency and effectiveness	-
		Quality of the public service	Quality of the public service
		Participation and engagement	-

Regarding the value of the technology, it was identified that blockchain provided security and the initiative contributed to the creation of the public value of quality of the public service, as presented in the following topics:

a) The value of security

The benefit of security was observed, and the data about the covid notifications and vaccines cannot be deleted, just added, maintaining a history. For example, if a state or municipality sends wrong information about an exam result by mistake, the information is maintained, and it is possible to update or include the right information. Then, all the history of the records is available. Interviewee E1.1 declares that:

Clinical information cannot be altered, [if] you sent information, a document, a test result, and then you say, 'I sent this wrong document, this test result', you go there and change this result, but the original remains, (...) this whole chain remains, so you can have a trail, understand? (...). If you want to see all the documents related to the exam results, you can see the entire history, which is exactly that, blocks in a chain, so you have the security of this information, from the moment it was entered until its current position, so this is a very important thing within clinical information.

With the use of blockchain, there is availability of data, and the network is maintained even if a problem occurs. If a node in a state is compromised, the other states continue to use the network normally, without interruptions or setbacks. Interviewee E1.1 states that:

If some problem occurs, the network will never stop, unless you turn it all off. For you to lose information is very difficult, and we are increasingly improving this part of the management of the information that is arriving. Then, it is distributed, [if] a state crashes, the other states continue to keep and to visualize the information. Then, this is another very important point for us, it will always be running, it will never stop. Unless [the cloud provider] goes down, we turn it off, it will always be running. (...) Therefore, it is a network that is working 24 by 7, all the time. We already had some problems (...) with this structure, but (...) it keeps working.

Therefore, security was a benefit observed in this case and the technology allows the tracking of any updates performed and data availability.

b) The public value of quality of the public service

It was identified that the initiative of blockchain adoption in the context of the covid-19 exams and vaccines created the public value of quality of the public service. The benefit is convenience, due to the availability of information for the citizens, who can have access to their data related to covid-19 exams and vaccines in the mobile application or on the website. The digital record reduces the risk of problems in dealing with certificates printed on paper, that can be lost or damaged. Interviewee E1.1 declares that:

One of the big benefits that people have today is to have their information (...). In the past, you didn't have your information (...). So, you take an exam, you have your information. I took a vaccine, I have the application where I go to get it (...) [if] you get a little paper, you lose that paper and that's it. So, the initiative facilitates what? The user has his clinical information, wherever he is, whether through an (mobile) application or on the website.

According to the Interviewee E2.1, which is an end user of the application, the usage of the app in the context of an international trip was a user-friendly experience. She was travelling inside South America, and her experience is presented by her words:

It was very easy to use, it was a very friendly experience, there was no difficulty at all. (...) I went to [Country X] and (...) [I] had to do a kind of registration in the health system there, [informing] that [I] were vaccinated. (...) And then I had to do the registration (...) 30 days in advance, or 20 days, I don't remember (...) So I needed to get the [vaccination certificate] to send it to [Country X]. So, I sent the documentation to [Country X] health system. (...) I sent a pdf file, the pdf of the vaccination certificate that [the application] generates (...) You can choose [between two languages to] generate the pdf. And then, by putting the [digital] vaccination certificate, they would release your registration faster than if you send the picture of your [paper] vaccine card. [At the airport] they asked [for the vaccine proof] at the time of boarding.

It was also necessary to use the application in the context of another international trip, from South America to Europe, and the certificate of vaccination was accepted in the airport and commercial centers, as explained by Interviewee E2.1:

And I needed it again, (...) when I went to [Country Y]. Then they asked me, when I entered in [Country Z], because I entered in Europe through [Country Z], so there they asked me also the vaccination certificate (...). It was very easy. It was at immigration, at their federal police, where they check your passport, to stamp the passport, then they asked to see if I already had the vaccine and then they saw that I had the doses of vaccine and it was very easy, they didn't ask anything. Here in [Country Y], when I arrived, to enter a closed establishment, you had to show the vaccination certificate. So, I showed it through the [application] too. All the places that asked, (...) for example, in restaurants, bars, they asked for the vaccine certificate. So, I showed my certificate through the [application]. (...) It was great, it's very easy to use, both the website and the [mobile] application are very easy, and it works everywhere, so there was no difficulty at all. (...) It was very good, (...) it makes it much easier for us.

Therefore, the benefit is the accessibility of the information regarding the covid-19 exams and vaccine certificates and the convenience to use it, also because it generates the certificate in different languages in the case of international trips. These advantages represent the higher quality of the public service, in comparison, for example, with pre-

vious situations in which paper was used.

5.6.2 Resources and capabilities influencing value

The resources and capabilities influencing the value creation of blockchain in this initiative are the dynamic capabilities of seizing, reconfiguring and technical knowledge, as presented in Table 18.

Table 18

Case E - Resources and capabilities

Dynamic capabilities		Resources and capabilities (R&C)	
Framework	Case E	Framework	Case E
Sensing	-	IT R&C	IT - Technical knowledge (enhanced)
Seizing	Seizing	Other R&C	-
Reconfiguring	Reconfiguring		

The resources and capabilities influencing the value of blockchain in this initiative are discussed in the following paragraphs:

a) Dynamic capabilities

It was identified that the dynamic capabilities of seizing and reconfiguring influence the value creation of blockchain. Regarding the dynamic capability of seizing, it was considered relevant, and the team were able to create a proof of concept that demonstrated that blockchain would be useful to address the problems they would like to solve. As in the words of Interviewee E1.1, “we did a small (...) proof of concept of the initiative, and then we saw that it works”.

Then, the proof of concept was useful to support the decision to advance with the initiative using blockchain in the context of covid-19 exams and vaccines.

Regarding the dynamic capability of reconfiguring, it was highlighted the importance to manage the team, and to be able to work in an environment where people were committed and willing to learn more about the technology and to support each other, since the initiative was considered challenging and there was a pressure to deal with a health emergency. As stated in the words of Interviewee E1.1:

The most critical [aspect] was to bring people together, you know? (...) This was a very big challenge, and we were very lucky to be able to manage it. Then we found people who were willing [to learn and help]. (...) There were changes, but the main team remained. (...) There was a time, last year, (...) we were up all night, working hard to [move forward].

Then, the dynamic capability of managing and reconfiguring the professionals was considered important in this initiative, as well as the collaboration of the team.

It was possible to note that the dynamic capability of sensing was not cited. Sensing was not identified as a capability that influenced the value creation of blockchain. It may not be considered relevant because the approach to perform the sensing of the opportunity seemed to be less formal, without the use of a specific process. According to the words of Interviewee E1.1, many conversations were performed with different countries:

We did several conversations around the world (...) we were studying (...) some initiatives around the world, and we saw that blockchain fits perfectly, that blockchain was not only cryptocurrency (...) [that] it can also be used for the health area, and we saw some cases in [four countries].

In the context of the idea and creation of the ecosystem, it was informed that conversations were performed with many IT suppliers, as in the words of Interviewee E1.1:

We talked with (...) IT suppliers, [Institution F1] has partnership with [foreign] government, (...) there are international cooperations, so we talked a lot with these people (...) we exchanged many ideas, so these companies helped (...) we talked a lot.

Then, it is possible that the sensing activity is a less structured activity, which involves the conversation with different governments and IT suppliers without a standardized process, and maybe without specific inputs and outputs to sense the external environment.

b) IT resources and capabilities

In this initiative, it was identified that technical knowledge was relevant and it influenced the value creation of blockchain. Since blockchain is an emergent technology, it is more difficult to find professionals that have advanced knowledge on it. According to

Interviewee E1.1, “[*There is a severe*] lack of professionals (...) When you find them, they are very expensive (...) professionals who master blockchain, it is very difficult [*to find*]”.

The team involved in the initiative had no advanced knowledge and they had the opportunity to learn more about the technology. The technical knowledge of the team, and its commitment were considered relevant, as stated in the words of Interviewee E1.1:

(...) as it was a new technology, nobody mastered it, everybody was learning. So, we were very lucky to find people (...) People who were very good technically, intelligent, and dedicated to take on the challenge.

The dedication of the team and the evolution of its competences enabled the evolution of the initiative, as stated by Interviewee E1.1 “*inside [our system], we were showing the evolutions (...) [and] its potential. (...) It worked and it is growing more and more, so much so that today we are [committed] to grow this network*”.

Then, the technical knowledge of the team was considered relevant and contributed to creating a system that has plans to evolve and to consider the management of other clinical information.

5.6.3 Synthesis and conclusion

- The motivation to use blockchain in this case was security and the expectation regarding the use of the technology was met.
- The value of blockchain identified was security and the public value created by the initiative was quality of the public service.
- The analysis of the resources and capabilities indicates that the dynamic capabilities of seizing and reconfiguring influenced the value creation of blockchain in this case, and also technical knowledge was considered relevant.
- Sensing of the environment was not identified as influencing the value creation of blockchain, and it may be that the sensing activity does not rely on a standardized process, with specific inputs and outputs.

Further discussion about this case is presented in Chapter 6, which encompasses a cross-case analysis.

5.7 Case F

This case is related to an initiative of blockchain adoption in the context of information sharing, promoted by a secretary from the federal public administration. The goal of the initiative is to enable data sharing regarding tax identification records, that is maintained by the secretary. The data is related to individuals (legal person or natural person). The initiative aims to enable data exchange among different institutions and organizations in a collaborative and federated way.

The need to share data was identified in an auditing process performed by an external control agency of the federal public administration that assists the national congress in the monitoring of the country's budgetary and financial execution. The agency indicated the importance of complying with a Decree of the Presidential Office. This Decree establishes mechanisms to reduce bureaucracy of data sharing in the federal public administration. The database regarding individuals was classified as data of interest within the scope of the Decree, which means that it received the authorization to be shared.

The external control agency indicated that some interactions of society with the public body could be simplified or extinguished, reducing the perception about bureaucracy and the costs involved. It also indicates that the data to be shared by the Secretary should consider the restrictions on access to data imposed by legislation.

Then, considering this context, the initiative was developed using blockchain, in 2019. The solution allows data sharing related to individuals among approximately 40 organizations that are participants in the network. The initiative is in production (it is fully implemented and in use), it is a private and permissioned network that uses the Ethereum framework. The initiative was envisioned by the Secretary of the federal public administration (Institution F1) and its development involved another public organization (Organization F2).

Institution F1 is a Secretary which is responsible for the administration of taxes, including social security taxes and related to foreign trade. The Secretary supports the Federal Administration in the formulation of tax policy, in the prevention and combat of tax evasion, counterfeiting, piracy, the illicit traffic of narcotics, the international traffic of

firearms, the laundering or hiding of assets, among others.

Organization F2 is a public organization linked to the Ministry of Economy, that develops information technology solutions for more than 40 years.

The interviewees in this case are Interviewee F1.1, which is the project manager of the initiative in Institution F1 and Interviewee F1.2, which is a business analyst also from the same institution and he has been involved in the initiative since its development, and he is still monitoring the initiative, supporting its evolution and management¹.

The next subsection presents the motivations to use blockchain in this initiative and it explores the benefits created by it.

5.7.1 Motivations to use blockchain and its value

The motivations to use blockchain in this initiative are cost reduction, security and decentralization, as explained in the following paragraphs:

a) Cost reduction and security

As explained before, Institution F1 received a recommendation of a control agency regarding the need to share more data. Then, after some analysis, Institution F1 envisioned the use of blockchain for this purpose. Initially, the idea was to share the data under the responsibility of the Institution F1 among the participants of the network. The use of the technology was idealized because Institution F1 was aware of the security of blockchain, and it was expecting a cost reduction. Then, in a preliminary analysis, the motivations were to allow the sharing of data from the Institution F1 to the other public bodies, in a secure and cheaper way, as explained by Interviewee F1.1:

(...) what was the origin of this? (...) the control bodies complained about Organization F1 that it has a lot of data, but it does not share the data. Actually, [Institution F1] shares the data (...) but the ways are expensive. So, how can you make a cheaper way to share? (...) you create a layer called blockchain (...) the idea is that in the first moment, we wanted to make a cheap way to spread the data, so we used the whole blockchain paradigm to make a monologue network,

¹ There was an attempt to invite Organization F2 to participate in this research. Organization F1 informed that it would not be possible to provide the contact of Organization F2.

where only [Institution F1] would [share data], (...) so we used (...) blockchain simply to keep the base up to date, to make the publishing transaction (...) be secure, just for that (...). We did the following in the project: you can have the data owner, and you can have the data observer. This is the monologue example that I told you about, [Institution F1] is the data owner (...) [and all the others] on the permissioned network are data observers.

The lower costs involved in the use of the technology and its security was also cited by Interviewee F1.2. Regarding the costs, Interviewee F1.2 states that *"one thing that (...) we took into account was what? The (...) reduced cost compared to a system if it was done in a more traditional way."* Regarding security, Interviewee F1.2 states that *"the probability of the information being hacked (...) is very small, almost non-existent."*

Then, the initial motivations to use the technology were the relative lower cost involved and security. A lower cost were expected because the current system used to share data was considered too expensive according to Institution F1.

b) The motivation of decentralization

During the development of the initiative, it was observed that the different participants of the network could exchange data. Then, the initial idea started to be adapted, to promote data exchange among multiple participants, in a collaborative network, in accordance with a federative environment. Collaboration was considered necessary because different participants would share the data under their responsibility. The federative environment was requested in the network to simulate the current relation among the public organizations involved, in which there is no hierarchy among them. Interviewee F1.1 gives a hypothetical example in which distinct participants of the network may have different information regarding the address of an individual, and this may start a process of diligence. According to his words:

[Supposing that] the taxpayer [Individual X] whose [identification] is 123 says that [his address] is [Place 1], but I have a collaboration from the telephone company, I have a collaboration from the water supply company, I have a collaboration from several other participants saying that he lives in [Place 2], so let's put a due diligence, let's do an activity with [Individual X] and I will validate whether he lives in [Place 1] or whether he lives in [Place 2].

The initiative represents a change for the existing centralized paradigm of public organizations, in which they are independent, and there is no collaboration among different public bodies to handle data. As explained by the words of Interviewee F1.1:

The paradigm that existed is a centralized paradigm, a paradigm of centralized and independent entities. So, the database of [Public Organization X] has no participation, no collaboration, with the database of [Public Organization Y], they don't collaborate (...) It is not a technological problem, it is a political problem.

Therefore, in the first moment, Institution F1 was aware of the lower cost involved and the security of blockchain and envisioned its use to share data. After a deeper analysis, the motivation to use the technology became decentralization, in which the federated relation among organizations would be maintained from a technological perspective, and it would be possible to promote collaboration and data exchange among different participants of the public sector. Table 19 presents the motivations to use blockchain in this initiative and the value created by it, comparing the data of the Theoretical Framework and the data collected in this case.

Table 19

Case F - Motivations and value

Motivation		Value	
Framework	Case F	Framework	Case F
Security	Security	Security	Security
Transparency	-	Transparency	-
Decentralization	Decentralization	Decentralization	Decentralization
-	Cost reduction	Professionalism and trust	-
		Internal efficiency	Internal efficiency
		Quality of the public service	-
		Participation and engagement	-

The value of blockchain in the context of this case is security and there is potential for decentralization. The initiative contributed to the creation of the public value of internal efficiency, as presented in the following topics:

a) The value of security

It was identified that blockchain provided security and the Ethereum framework guaran-

tees a layer of data security for the initiative. According to the words of Interviewee F1.1 *"then the advantages are these, you (...) use a (...) framework [Ethereum] that guarantees (...) this mature information security layer"*.

b) The value of decentralization

The creation of a network with decentralized control enables collaboration among the participants in the exchange of data, in which it is possible to maintain the current federated characteristic of their relationship. The decentralization allows to overcome a trust obstacle and it is explained by the words of Interviewee F1.1:

The benefit was you to overcome the trust barrier, it was a benefit of you creating a collaborative and federative way to deal with the data, that's the main benefit. Actually, although these words are few, these two words [collaborative and federative] adjectivize all the benefits, these two words represent a challenge (...) that you have to collaborate, to participate, to create a network that the parties collaborate with each other.

The decentralization is achieved due to the creation of rules according to some criteria, and once this is discussed and agreed by the participants, it is implemented in the network, enabling some prediction about the behavior of the network environment, and therefore enabling trust. This is explained by the words of Interviewee F1.1:

When you manage to create behavior rules and immutable governance rules, that once it is agreed upon, it cannot be renegotiated, except by obeying a criterion, a pre-defined policy; you establish this whole paradigm of trust and thus of federation and collaboration.

Then, decentralization is associated with collaboration and a federative approach, allowing that in the absence of trust among the network participants, the technology enable trust due to its characteristics and due to the rules defined, avoiding a central control. Although the collaboration and federative approach were mentioned in the context of decentralization by Interviewee F1.1, Interviewee F1.2 informed that the mechanism related to this benefit is enabled, but it is not yet in use. According to Interviewee F1.2 *"At the moment, the potential of the blockchain is being under-utilized. As I said, there is no exchange of information yet"*. To be more specific, the network is composed of

members with the role of founder, collaborator, or observer. The founder is the Secretary that envisioned the initiative and it shares the data, the observers are only allowed to receive information and the collaborators are those who would be allowed to share information. Meanwhile, the role of collaborator is not in use yet. According to the words of Interviewee F1.2:

The [Institution F1] is the founder node because the network was created by the [Secretary](...) Observer nodes are all the other nodes that receive the data shared by [Institution F1]. There is no collaborator node yet, the collaborator node would be (...), for example, [a public agency] collaborating with the database, (...) sending [a document number], for example. (...) [The public agency] could send to [Institution F1] the information: '[Person X] now has [the document number 123]' and then this data would be updated [in the dataset of this initiative] automatically. There is no need for the [Person X] to go to the [Institution F1] to say, 'My [new document number] is this'. So, this would be the collaborating node, and this doesn't exist yet. [This could happen with] "n" entities or agencies (...) [There is another example of a] telephone company. The telephone company usually has the most updated address (...) of the people, so the telephone company could also collaborate by sending the address that was last updated by a certain person.

Therefore, although there is the collaborator node, which could allow the data exchange in a collaborative and federated way, it is not in use yet. There are approximately 40 nodes, which includes the founder's node and the observers' nodes for now.

c) The public value of internal efficiency

This initiative allowed costs reduction for Institution F1 and it provided agility for data sharing. Regarding the cost reduction, the previous alternative to share data was more expensive and nowadays, the participants pay a monthly fee that is approximately a dozen times smaller than with the other system. The advantages regarding reduced costs were identified in the development and in the maintenance of the network. It was also observed that the initiative was developed in a short period of time and the costs for service provision among the participants were reduced. According to the words of Interviewee F.1 (2021):

This is all based on a cheap way of doing this activity, so (...) it is fundamental to say all this and, additively, in an economic and cheap way. (...) It is economical and cheap from the production point of view (...) you made a product that is working, it works cheaply. And it is economical, cheap and fast for you to create it (...) this project was done in 3 months. Have you ever seen a project of this size with this result done in 3 months?

Regarding the agility, it was explained that before the use of this initiative, the frequency of data sharing was low and according to the words of Interviewee F1.2:

Before [this initiative], [one of the] ways to share data was (...) [using] a system. (...) They created a mechanism (...) to send data (...) every fifteen days. (...) Before that, it was even [through] CD-ROM, they recorded it on CD-ROM and sent it to the agency, once a month. In other words, the agency was a month late.

Interviewee F1.2 explains what happened after the use of the initiative:

If you change your [document] today, by any means whatsoever, (...) either by the Internet or by the [Secretary], (...) the contracting agencies will be receiving this information. Everything that is changed until midnight tonight, and I say midnight, because (...) through the internet you can change it from anywhere in the world and change your [document], as long as you have the password for the [Secretary] portal. So, everything that is changed (...), the contracting agencies will be receiving these changes.

Therefore, the initiative allowed the reduction of time and of costs for the public sector in the provision of data sharing services, improving internal efficiency, in comparison with the previous system used by Institution F1.

5.7.2 Resources and capabilities influencing value

The resources and capabilities influencing the value creation of blockchain in this initiative was the dynamic capabilities of sensing, seizing and reconfiguring; and technical knowledge, as presented in Table 20.

Table 20*Case F - Resources and capabilities*

Dynamic capabilities		Resources and capabilities (R&C)	
Framework	Case F	Framework	Case F
Sensing	Sensing	IT R&C	IT - Technical knowledge (developed)
Seizing	Seizing	Other R&C	-
Reconfiguring	Reconfiguring		

The following topics present the dynamic capabilities and the IT resources and capabilities that influence the value creation of blockchain in the context of the public sector:

a) Dynamic capabilities

It was identified that sensing was a dynamic capability that influenced the value creation of blockchain. This was the first initiative of Institution F1 using blockchain, then Organization F1 had no previous experience about it. The willingness of the Organization F1 to invest in a person to evaluate a possible solution to the problem of data sharing with security and reduced costs was considered valuable. According to words of Interviewee F1.1:

I had a problem and I looked for the solution to the problem, so the institution didn't know about the technology. The technology was like a chosen tool, a suitable tool to solve the problem, so (...) I was assigned to solve the problem, and I researched what was available in the world and I found the technology.

The sensing procedure was performed by the research and efforts of a civil servant, that had the opportunity to learn and to participate in a congress about blockchain. The importance of the sensing procedure is attributed to the financial resources that Institution F1 was willing to allocate in the analysis of available technologies and in the discovery of the one that would suit to the challenge they had. This is explained by the words of Interviewee F1.1:

[Institution F1] invested in me, so I could go after it (...) [Institution F1] sent me to a congress, I wanted to participate in a blockchain congress, I participated, I was learning and that's what generated it. So, the main resource, I think it was the financial resource of investment in knowledge, in their civil servant. [In-

stitution F1] invested in me to learn, after I learned, I was able to come up with a solution.

The importance of the efforts of Interviewee F1.1 to sense the possibility to use blockchain was also recognized by Interviewee F1.2, according to his own words:

I would say, so, that the [central] point of the question was creativity. I give full credit to [the civil servant], who had the idea, who was inspired, who had the initial knowledge, and who proposed the blockchain. (...) I think creativity was the starting point, it was the start of the thing. (...) Until then, blockchain was what? When people talked about blockchain, they talked about bitcoin. And, so, he had the idea of saying: "No, wait a minute, this here can be used to share data and it will solve that problem that the [Institution F1] has at that moment. (...) I know that the coordination gave a lot of support to the [civil servant] in this initiative and the [Institution F1] really believed that it was a very interesting path. And [this] was proven afterwards.

During the sensing of the external environment to evaluate possibilities, Institution F1 contacted a university to evaluate the challenge and to propose a solution. The university presented a proposal, but it was discarded by Institution F1, because it was considered very expensive, and it had no deadline.

Therefore, the sensing procedure occurred due to the investment of Institution F1 in external environment analysis of technologies and knowledge acquisition by the civil servant. It was considered an important capability to allow the value creation of blockchain in this initiative, which involved creativity to envisage the use of the technology in a context considered new, different from cryptocurrencies.

The dynamic capability of seizing involved the interaction among Institutions F1 and F2. Once Institution F1 identified the potential of the technology to address its needs in the sensing step, it contacted Organization F2, an IT provider. Organization F2 deepened the analysis about the technology and proposed the specific solution to handle the challenges listed by Organization F1. According to the words of Interviewee F1.2:

[Institution F1] contributed with the idea of the use of blockchain (...) Organization F2 studied, analyzed and presented a solution, there was some discussion,

of course, to modify one point or another that [Institution F1] considered important, and it went forward, the system was developed (...) We always have this model, there is a need, there is an idea and the IT provider analyzes it, proposes a solution, it is discussed (...) in general, this is the format, and I think this has been very interesting.

In addition to the previous dynamic capabilities, it was identified that reconfiguring also influenced the value creation of blockchain. The development of the initiative involved another organization from the public sector (Organization F2² and its involvement with this other public body was considered valuable. Both the Organizations F1 and F2 had an experience of learning the technology by doing, as the words of Interviewee F1.1:

The relationship was (...) with extremely competent people and using trial and error, and effort, the professionals dived into it, because we didn't have the academic support for us to be able to do this. (...) They [Organization F2] and I participated in everything, from the start to the end.

The initiative was pioneered by the organizations and the efforts and exchange of information among them allowed the development of knowledge, as explained by Interviewee F1.2:

(...) At that time, no one was working with blockchain, no one knew anything about [it], they deepened their studies, acquired knowledge in blockchain (...). And there was a great exchange of information [among the organizations] to get to where we are now. (...) I am a case that didn't know anything about blockchain before 2019. When I joined the project, I acquired very interesting information. (...) I hear from colleagues inside [Institution F1] who also acquire (...) more knowledge [about blockchain].

Therefore, the efforts of the organizations involved in the development of the initiative, and their experience of knowledge exchange and learning by doing, was considered a dynamic capability that influenced the value of blockchain in this case.

² There was an attempt to invite Organization F2 to participate in this research. Organization F1 informed that it would not be possible to provide the contact of Organization F2.

b) IT resources and capabilities

The technical knowledge of the team members was identified as a capability that influenced the value creation of blockchain in this initiative. Organizations F1 and F2 had no previous knowledge or experience with the technology and the knowledge developed by the teams was highlighted as important to enable the creation of the solution. According to the words of Interviewee F1.2:

We had in [Institution F1] people that were interested, that had initiative, that made the proposals. And, in [Organization F2, we had] analysts and technicians who learned the new technology, invested their time and effort learning blockchain, which was an unknown thing, and they managed to put the work forward. I believe that basically people [influenced the value creation], more than financial resources, more than other types of resources.

The knowledge acquired by Institution F1 was relevant in this initiative, and it enabled involvement of the Institution in the creation of new initiatives that is using blockchain, as stated by Interviewee F1.1:

As we took a technology that is not yet crystallized, there is room for experimentation, we were able not only to give other uses for the technology, but even to make changes in the way of implementing the technology, both in the technical paradigm and in the business paradigm of the technology. So, this is what we were able to do, you see? We were able to learn a lot with this project [and with the others], there are several [projects].

At the time of the last interview, Institution F1 was involved in at least 3 more blockchain initiatives and one of them was presented in Case A.

5.7.3 Synthesis and conclusion

- The motivation to use blockchain in this case was cost reduction, security and decentralization, with the concern to promote collaboration, a federative environment and trust building.
- The value of blockchain observed in this case was security. Decentralization was identified as a benefit, but it is not enabled for now, and there are no collabora-

tors nodes yet, which are the nodes which would exchange data and allow collaboration and federation among the participants. Although the initiative encompasses the mechanism that enables decentralization, it is not in use at this stage.

- The initiative created the public value of internal efficiency, since time and costs were reduced in the procedures of data sharing among the organizations involved.
- The analysis of the resources and capabilities indicates that the dynamic capabilities of sensing, seizing and reconfiguring influenced the value creation of blockchain in this case, as well as technical knowledge.

This chapter explored the answers for the research questions, case by case. A further discussion about these cases is presented in Chapter 6, which encompasses a cross-case analysis.

6 CROSS-CASE ANALYSIS

6.1 Introduction

This Chapter aims to provide a cross case analysis through a comparison of the cases, indicating the similarities and differences among them, with the aim to answer the research questions, using the theoretical framework as a guidance. All the six cases presented in Chapter 5 are related to the value proposition of decentralized data infrastructure and membership management (Zutshi et al., 2021). Therefore, the studies used to enrich the analysis provided by the current chapter are mainly related to ideas and initiatives framed in the same value proposition, of decentralized data infrastructure and membership management, complemented with other studies that are not specific to a value proposition.

6.2 The motivations to use blockchain

In this research, we explore the motivations to use blockchain in the context of the public sector, considering initiatives in advanced stages of development, aiming at answering the first research question “RQ1- Why does the public sector adopt blockchain?”.

The Theoretical Framework available in Chapter 3 points to the main motivations to use blockchain: transparency, security, and decentralization. These motivations were cited in papers based on ideas or initiatives of blockchain that are mainly in the early stages of development. The initiatives of the six Cases from Chapter 5 revealed that the motivations to use blockchain are decentralization, security, knowledge development and cost reduction, as presented in Table 21, which compares the motivations from the Theoretical Framework with the motivations from the six cases analyzed.

Table 21

Motivations of the Cases

Motivations (Framework)	Motivations (Cases)	Cases					
		A	B	C	D	E	F
Decentralization	Decentralization	x	x		x		x
Security	Security	x	x	x	x	x	x
Transparency	-						
	Knowledge development				x		
	Cost reduction						x

The following subsections discuss the motivations of the multiple cases analyzed:

6.2.1 The motivation of decentralization

Decentralization was cited in four cases and this motivation represents situations in which different countries or organizations would like to avoid a solution with a central control.

Among different countries (Case A), decentralization is a motivation because there is the concern regarding sovereignty and autonomy of each country. The decentralized approach would be an easier way to promote negotiations among countries, in comparison to a central coordination of the initiative.

In the initiatives involving different organizations or institutions (Cases B, D, F), the motivation of decentralization refers to the avoidance of hierarchy and of central control. Decentralization was a motivation in the sense that each organization would take care of the data under its responsibility and share part of it among the other institutions. Decentralization would enable collaboration among the network participants in a federated way, replicating in the digital environment the current link that the organizations have in the real world, with a horizontally relationship.

The motivation of decentralization in the cases differs from the literature, since in the literature this motivation is mainly associated with security and the avoidance of a single point of failure or hacking attacks that centralized solutions are susceptible (Gao et al., 2021; Geneiatakis et al., 2020; Hassija et al., 2021; Kadam et al., 2020).

6.2.2 The motivation of security

Security was a motivation in all the cases, since the initiatives required integrity, immutability and availability of data, and there was the need to maintain the history of data updates over time. There was a concern regarding the authentication of the network participants, the reduction of the chance of data leakage, and the concern that a security incident could affect the image of the institutions involved in the initiatives.

Specifically in Case A, which is involving different countries, the motivation of security is related to the need to guarantee that the information is legitimate and that it has not been tampered with inappropriately over time. This supports the creation of trust in data and in the processes involving different nations.

Therefore, for the six cases, the motivation of security was related to the understanding of the characteristics of the technology regarding the chain of blocks, the cryptography, the immutability of the records, the data availability, and the history of the information updates. These characteristics were considered as a promising way to provide security for their systems, to avoid inappropriate updates and to provide data integrity.

According to the literature, the motivation of security is also related to the need to avoid fraud, falsifications, and corruption in the context of voting systems, identity documents, land registry and certificates from notarization services (Al Barghuthi et al., 2019; Gao et al., 2021; Kadam et al., 2020; Malik et al., 2020). Some studies consider the concern that the practice of corruption reduces the trust that citizens have on the public sector (Gao et al., 2021). In the literature and in the empirical research, the motivation of security is also related to the risk of damage of the institution's image in an incident event.

6.2.3 The motivation of knowledge development

Knowledge development was identified as a motivation in one of the initiatives. It was Case D, related to public procurement, and the two organizations most involved in the initiative development were interested in learning more about the technology. This motivation was not considered the main one, and the organizations would like to adopt blockchain in a real business need. In other words, the intention was not only to develop any blockchain initiative, just to learn more about the technology, but the concern was to identify a business problem that would benefit from the characteristics of the technology. Then, the organizations explored the business problem they were facing and took the opportunity to develop new capabilities.

In the literature, it was not found an idea or initiative that claimed to have this motivation. Maybe this motivation is implicit for the ideas and initiatives of the literature.

There is one study that may be related to the motivation of knowledge development. Al Barghuthi et al. (2019) conducted a survey in United Arab Emirates, with 71 organizations from the public and private sectors. The survey identified that 20% of the companies have innovation as a motivation to adopt blockchain. Although innovation is not the same of knowledge development, it is possible that these organizations may be exploring the technology for the development of new capabilities, as the example of Case D.

In summary, the motivation of knowledge development was identified in one initiative. Knowledge development was considered important for the organizations involved because it would allow them to develop new products and services in the future, taking advantage of the characteristics of the technology.

6.2.4 The motivation of cost reduction

The motivation of cost reduction was identified in the Case F. Organization F1 was aware of the lower costs associated with blockchain, in comparison to a system that they were using, with other technologies.. Organization F1 was aware that it would be possible to reduce costs and to be aligned with the federated and collaborative principles, at the same time.

Then, this topic discussed the motivations to use blockchain and more information about it is available on the synthesis of this chapter, at its end.

6.3 The value of blockchain and the public value of the initiatives

In this research, we explore the value of blockchain in the context of the public sector, with the aim of answering the research question “RQ2 – What is the value of blockchain in the context of the public sector and how is value created?”. The answer is explored in the text below.

As defined in the Theoretical Framework of Chapter 3, the value of blockchain initiatives in the context of the public sector is related to two aspects. The first encompasses a set of benefits provided by the characteristics of the technology. The second aspect is

related to the initiatives that use blockchain that may create public value for the stakeholders involved in its use.

The Framework indicates that the value of blockchain is decentralization, security, and transparency. It also indicates that the initiatives of the public sector create the public value of professionalism and trust, internal effectiveness and efficiency, quality of the public service, and participation and engagement.

The initiatives of the six Cases from Chapter 5 revealed that the value of blockchain is decentralization and security, while the public value created by the initiatives are all of the Theoretical Framework, except participation and engagement. Table 22 compares the elements of the Model with the six cases analyzed.

Table 22

Value and public value of the Cases

Value (Framework)	Value (Cases)	Cases					
		A	B	C	D	E	F
Decentralization	Decentralization	x	x		x		x
Security	Security	x	x	x	x	x	x
Transparency	-						
Public value (PV) of professionalism and trust	PV of professionalism and trust (Knowledge development)	x		x	x		x
PV of internal effectiveness and efficiency	PV of internal effectiveness and efficiency (cost reduction)	x	x		x		x
PV of quality of the public service	PV of quality of the public service	x		x		x	
PV of participation and engagement	PV of participation and engagement						

The following subsections discuss the value and public value identified in the cases analyzed:

6.3.1 The value of decentralization

Decentralization was identified as a benefit of the technology in the initiatives of Cases A, B, D and as a potential benefit in Case F. These are the same Cases in which decentralization was a motivation to use the technology.

In the context of data exchange among different countries (Case A), the benefit of decentralization was created due to the replication in the digital environment of the type of relation that exists among countries, considering their sovereignty, avoiding hierarchy. Then, there is no country in control of the initiative. It was mentioned that decentralization facilitates negotiations among the countries, since the use of a centralized solution that would be maintained by just one country usually creates diplomatic issues.

Considering the interaction among organizations in the same country (Cases B and D), decentralization is also related to the philosophy of decentralized control of the network, in which there is independence and interconnection among the organizations. Decentralization allows collaboration among the organizations, maintaining the federated characteristic of their relationship. Then, once decentralized rules are established among the participants (off-chain) and they are implemented in the system (on-chain), decentralization is enabled, allowing the creation of trust. There is just one consideration regarding the Case F, in which the mechanism to allow decentralization is in place, but it is not in use yet, and nowadays there is one founder node (one organization) that shares data with the other participants, that are considered as observers nodes.

In the cases, decentralization mainly indicates the advantage of avoiding the management and costs of centralized solutions, and it refers to the definition of rules that are agreed upon the participants, implemented in the system and there is no central control or hierarchy for decisions among the participants.

Considering that decentralization is related to the degree to which a single entity or group of entities control something (Montgomery, 2022), the private and permissioned networks of the Cases consider the benefit of decentralization in a sense that no participant have more control than the others. For example, in Case A or B, respectively, all the four countries and all the three organizations involved in each initiative agreed with the rules of the smart contracts and no entity (country or organization) has more control over the initiative than the others.

Montgomery (2022) considers that decentralization involves different layers, and if one of the layers is centralized or controlled by one entity, then the blockchain can be controlled by one party. The layers involve different questions and decisions, as the following:

- Code layer: Who implements and maintains the project?

- Specification/ Architecture layer: Who decides them and who defines the roadmap of the project?
- Consensus on-chain (implemented on the blockchain): What is the protocol used and how is consensus managed?
- Consensus off-chain (governance decisions among the participants): What is the project governance and legal framework? How are the rules above changed?
- Application layer: Are the main applications inherently decentralized?

Then, the answers to the questions involve technological, legal and social aspects. None of the interviewees explored the concept of decentralization considering all these layers. It may be because (i) the organizations or countries involved in the initiatives participate equally in all the layers, (ii) the relation between these layers and decentralization are yet not clear for the interviewees, or (iii) they consider that the levels of mistrust or conflict of interest among the participants are so low that concerns and explanations about these layers were not relevant.

It is likely that networks involving a smaller number of participants, and with less diversification of stakeholder types (e.g., only public sector organizations) may reach agreements and decisions on decentralization more easily.

Situations may occur that involve a larger number of participants, a greater diversification of stakeholder types (e.g., public sector, private sector and individuals), with a higher level of mistrust and conflicts of interest among the participants. Under these conditions, the definition of decentralization will require more attention, debate, and efforts to ensure that the level of decentralization would meet the expectations of the stakeholders involved.

Regarding the relation among different types of stakeholders, there are two Cases (C and E) that involve the register of information relevant for the public and private sector, and none of them have decentralization as a motivation, nor as a benefit.

The definition of higher levels of decentralization, which is the key to create trust, would require technical, governance and legal knowledge of the network participants to make the decisions together about the decentralization layers. New initiatives involving higher level of disruption and potentially different types of stakeholders would deal with the trilemma that claims that no blockchain system can simultaneously provide

decentralization, security, and scalability (Li et al., 2021b). This might be a challenge to be analyzed especially in initiatives within the other value propositions (Zutshi et al., 2021).

Then, the comprehension regarding different levels of decentralization and its layers, and its relation to security and scalability is paramount to allow the design of the systems that meet the expectations of the stakeholders involved, and to avoid undesired consequences.

6.3.2 The value of security

The value of security provided by blockchain was identified in all the initiatives of the Cases, in alignment with the motivations to use the technology.

The security was a benefit achieved since the technology offers mechanisms to increase the reliability of data. It is appreciated that the history of transactions can be consulted with the certainty that data was not edited or deleted (Case B). The immutability provided by blockchain is considered crucial when dealing with data among different countries (Case A).

The value of security is created due to the consensus mechanisms, the creation of nodes that preserve the data, the use of cryptography, the history of updates and the identification of participants. This allows availability, integrity, immutability, and traceability of the records, increasing the trust in data (Cases C, D and E). This also enables the creation of a secure infrastructure, which is a foundation and a contribution of the public sector to the private sector, facilitating the interactions among them (Case C).

In the initiative of Case F, security was identified as a benefit, although it is not the main benefit. As explained before, the benefit of decentralization, related to collaboration and federative approach was the most appreciated, and although the mechanism that allows this benefit is in place, it is not in use yet.

Then, the security provided by blockchain was a value identified in all the Cases, and the next subsections are related to public value.

6.3.3 The public value of professionalism and trust

The public value of professionalism and trust was created in different ways by the initiatives of the Cases A, C, D and F:

- The initiative of Case A enabled the recognition of the organizations involved in the development of the solution as innovative. There was national and international recognition, and the initiative was presented in different events and for intergovernmental organizations. This recognition influences the image of the organizations involved, and it demonstrates their capacity to influence the national and international environment, contributing to increase the respect for these institutions and countries.
- In the initiative of Case C, it is considered that blockchain allows the creation of trust in the context of the provision of an infrastructure that enable interactions among public and private sectors.
- It is indicated that the benefit of decentralization enabled the creation of trust among the network participants in the Case A and it has this potential in the Case F.
- In the initiative of Case D, one of the motivations of the organizations to use blockchain was knowledge development, and this expectation was met. Both organizations involved in the creation of the initiative increased their capacity and developed competences to deal with an emergent technology. The collaboration among the organizations was also highlighted as a benefit. The knowledge, experience and new model of collaboration experimented by the teams increased the institutional capacity of the organizations and it would allow them to develop new internal or external products and services.

Then, the public value of professionalism and trust was created in different ways by the initiatives of the Cases, and it is related to the recognition of the capacity of the countries to influence the national and international environment (Case A), the trust enabled from the expected provision of the infrastructure that will allow the interaction among public and private sectors (Case C), the creation of trust as a consequence of the decentralization and collaboration (Cases A) and the knowledge, experience and new model

of collaboration experimented by different organizations from the public sector, which increased their institutional capacity (Case D).

The literature indicates the potential of blockchain to create trust (Hao et al., 2019; Piao et al., 2021; Shuaib et al., 2020; Westerlund et al., 2021), and the initiatives of Cases A, C, and D confirmed the creation of the public value of professionalism and trust.

6.3.4 The public value of internal effectiveness and efficiency

The public value of internal effectiveness and efficiency was created by the initiatives of Cases A, B, D and F. This public value was enabled in situations in which the initiatives replaced procedures that were previously performed with the use of paper, telephone or e-mail (Cases A, B, D), and in a periodicity considered inappropriate (Cases A, F).

The initiatives allowed automation and more agility to perform the processes, since once data is exchanged in blockchain, it is immediately available to the other countries (Case A) or organizations (Cases B, D, F) to consume.

The initiatives also allowed cost efficiencies, in comparison with the adoption of other possible centralized and traditional solutions (Case A) or in comparison with previous systems used (Case F). The initiatives contributed to increasing the quality of internal processes (Case D) and to reducing the incidence of human errors, due to the standardization of communication and data exchange and the simplification of the process (Case B).

Then, efficiency was created by automation, and gains were observed in terms of time and cost. Effectiveness was enabled due to standardization and higher quality of execution of processes and activities.

Then, the empirical research confirmed that the initiatives of the Cases enable the creation of the public value of internal effectiveness and efficiency. The exploration of the initiatives supported the understanding regarding how this public value is created.

6.3.5 The public value of quality of the public services

The public value of quality of public services was created in the context of the initiatives of Cases A, C and E.

The quality of the public service was observed in the context of the service delivered for companies involved with international trade, since the internal agility in data exchange among the countries allowed that certified companies started to take advantage of the benefits in less time (Case A).

This public value was identified in the context of the digitization of the flight logs, that may trigger the reduction or elimination of some procedures in the airline sector, providing agility to activities that involve different stakeholders of the airline ecosystem. Then, these efficiency gains may improve the quality of the services provided by the public sector, affecting the way it interacts with the private sector (Case C).

The quality of the public service was created in the scenario related to Covid-19 exams and vaccination. Before the use of the new solution, much information about clinical exams used to only be under the possession of healthcare institutions. And the information about vaccines usually was delivered for individuals in a paper card. After the implementation of the new system, individuals can access their information about Covid-19 on a mobile application or on the website and share it in two languages. The accessibility to the information was facilitated, improving the experience and convenience of individuals in the context of healthcare services and in situations of international travels (Case E).

Therefore, the beneficiaries of these initiatives are companies and the business environment of the international trade (Case A), individuals dealing with healthcare services (Case E) and the ecosystem of the airline sector, considering the potential of the digitization of flight logs to trigger a revision of related processes (Case C).

In the literature, there is no study related to the value proposition of decentralized data infrastructure and membership management that indicates the creation of the public value of quality of the public services.

Considering the research that are not restricted to this value proposition, quality is vaguely cited by Alexopoulos et al. (2019) and Jaoude and Saade (2019), which consid-

er that the decentralized approach of blockchain and the use of smart contracts would allow governments to improve the quality of services.

Some studies explore quality in the perspective of regulation and compliance (Micheler & Whaley, 2020), impartiality (Ning et al., 2021), and reduction of bureaucracy (Prakash & Gunalan, 2020):

- Micheler and Whaley (2020) consider that blockchain could make regulation more precise and compliance easier, because the regulator would be able to supervise the whole population of regulated entities, benefitting from granular evidence and having access to more accurate and real time information. This is similar to the context of the initiative of Case C.
- Ning et al. (2021) explore quality in the perspective of impartiality and consider that impartiality can be enhanced due to the contribution of blockchain to accuracy, coordination, transparency of the government processes and trust.
- Prakash and Gunalan (2020) consider that the new business model allowed with blockchain enables the reduction of bureaucracy between government and citizens.

Then, while the initiatives of the Cases explore quality of the public services in terms of agility and convenience, the literature debate quality in the perspective of regulation and compliance, impartiality, and reduction of bureaucracy. Then, this empirical research presents the contribution of the initiatives to the quality of the public service in the value proposition of decentralized data infrastructure and membership management.

This topic discussed the value of blockchain and of the public value created by initiatives using the technology. More information is available on the synthesis of this chapter, at its end.

6.4 The resources and capabilities influencing value

In this research, we explore the resources and capabilities influencing the value of blockchain in the context of the public sector, with the aim of answering the research question “RQ3 - What are the resources and capabilities that influence the value crea-

tion of blockchain in the context of the public sector and how does this influence occur?”. The answer is explored in the text below.

As defined in the Theoretical Framework of Chapter 3, the resources and capabilities influencing value in the context of IT, in general, are dynamic capabilities, IT resources and capabilities, and other resources and capabilities. The analysis of the initiatives of the six Cases from Chapter 5 confirmed that these resources and capabilities also influence the value of blockchain in the public sector. Table 23 compares the elements of the Model with the six cases analyzed.

Table 23

Resources and capabilities of the Cases

R&C (Framework)	R&C (Cases)	Cases					
		A	B	C	D	E	F
DC – sensing	DC – sensing		x		x		x
DC - seizing	DC - seizing	x	x		x	x	x
DC - reconfiguring	DC - reconfiguring	x	x		x	x	x
IT R&C	Technical knowledge	x	x	x	x	x	x
Other R&C	Business knowledge	x			x		
	Sponsorship	x	x	x			
	Hype	x		x			

The following subsections discuss the resources and capabilities identified in the cases analyzed:

6.4.1 Dynamic capabilities

a) Sensing

The sensing capability was identified as influencing the value creation of blockchain in the initiatives of the Cases B, D and F. This capability was performed in different ways in the initiatives and probably the organizations have distinct levels of maturity of the activities and process involved with the sensing of the external environment:

- In the context of Case B, before the initiative’s development, Organization B1 had a previous experience with blockchain, in which they created an internal and technical research group with five professionals, that explored the use of distributed ledger in some potential use cases. They developed some proofs of concept

and published a report about it. In this initial contact with the technology, they acquired knowledge and experience that was useful in the context of the creation of the initiative of Case B.

- In the initiative of Case D, the sensing of the environment and of the new opportunity took place in some design thinking workshops that occurred over the course of a few weeks. The workshops were facilitated by an innovation team of Organization D1. In the workshops, business problems of different themes were discussed, as well as the benefits that blockchain could provide, with the understanding that blockchain could support the public procurement process. Potential users were interviewed, to a better understanding of their needs. Then, the functionalities for a minimum viable product (MVP) and for future releases were defined. Waring et al. (2018) indicates that the involvement of stakeholders such as potential users is essential to achieve benefit realization.
- Considering the initiative of Case F, the sensing of the environment and of the opportunity to adopt blockchain was performed by a professional of Organization F1. The professional participated in a congress, and he performed some research about which technology could solve the problem that the organization was facing. In this initiative, sensing involved a more individual and ad hoc analysis. This situation may be changed, since after some time the Organization F1 established a formal innovation process. According to the literature, Kanungo & Jain (2011) identified that the sensing capability is weak in the Directorate of Income Tax (DIT) in a developing country. Coincidentally, Organization F1 is also responsible for income taxation, in another developing country.

Then, it was observed that the sensing of the environment and of the possibility to use blockchain to address a problem or opportunity was performed in different ways in the initiatives. It involved the support of a technical research group (Case B), the support of an innovation team, who conducted the design thinking workshops (Case D) and the support of an individual, which performed some research by himself (Case F). The differences in the approaches for the sensing activity may be related to distinct maturity levels of the organizational processes.

It is interesting to observe that the activities related to sensing were the least cited among the dynamic capabilities. It was not mentioned as influencing the value creation

of blockchain in the initiatives of Cases A, C and E. The following topics explore why sensing may not be cited by the other initiatives:

- In the initiative of Case A, Organization A1 usually participates in a working group with the customs of other countries. In one of the meetings of this working group, it was made a presentation regarding blockchain, and it was proposed to the countries to perform an evaluation about the opportunity to use the technology in the context of information exchange. Then, the collaborator of Organization A1 discussed the chance to use blockchain with another team in the same organization that had already used the technology for other purposes. So, the opportunity to use blockchain in the context of foreign trade was not based on the execution of an internal or systematic process.
- In the initiative of Case C, Organization C1 does not develop software with its own capacity, then it contracted an external organization (a software house) to develop the initiative and they also has a contract with another organization to support and control the software house. In the initiative of Case C, no dynamic capability was identified as influencing value.
- In the initiative of Case E, the team of the organization that developed the solution analyzed cases from different developing and developed countries, and they had meetings with some of them. Sensing may not be considered relevant because the approach to perform the sensing of the opportunity seemed to be less structured, based on conversations, without the use of a specific process.

The literature highlights some causes for the weakly execution of the sensing capability. According to Kanungo & Jain (2011), the causes may be associated with: (i) risk aversion, (ii) lack of urgency in IT decisions, (iii) absence of the need to be responsive to the public, (iv) extreme bureaucratic structure, (v) lack of competent individuals and of organizational process dedicated to sensing, (vii) influence of consultants in decisions. Then, these situations may contribute to making the sensing capability extremely weak. The poor execution of sensing or its postponement might lead organizations to miss the opportunity to solve problems with greater agility and efficiency.

On the other hand, Waring et al. (2018) indicate that organizations that have strong or mature dynamic capabilities in the realization of benefits will have staff whose role is to scan the environment for opportunities and present them to internal committees. These

organizations will have processes supporting decision making. These organizations will also have systems in place to support the analysis of a range of IT. In the study of these authors, they consider that the organization can no longer rely on traditional best practice in IT management, and they need to recognize that success requires the creation of new services and the implementation of innovative organizational forms and business models. According to them, it is necessary for a new style of entrepreneurial managers to sense and shape the future, unshackle the organization, utilizing knowledge to transform organizational structures. This is totally aligned with the arguments of Teece (2007), which considers that well understood best practices that are already widely adopted are not dynamic capabilities and cannot be associated with sustainable enterprise performance. There is an emerging recognition by managers that the foundation for success transcends the simplistic adoption of best practices.

Therefore, the initiatives of the Cases indicated how sensing influenced the value creation of blockchain and this capability was the least cited among the Cases. Considering the cases that identified this capability, it is performed with different approaches and probably different levels of maturity. Some possible causes for the low level of maturity are discussed, as well as the advantages of higher level of maturity.

b) Seizing

The dynamic capability of seizing was identified as influencing the value creation of blockchain in the initiatives of Cases A, B, D, E and F. The following topics explain how the capability contributed to it:

- In the initiative of Case A, the seizing of the opportunity was considered a challenge because different countries were involved, and the coordination of the efforts should respect the autonomy of each of them. It was made an initial effort between two organizations to propose the idea of the new system and present it to the other countries. A preliminary model was produced, explaining how blockchain should solve some problems that the countries were facing. Due to this proposal and explanation, the other countries agreed with the use of blockchain and decided to advance with the work.
- Considering the initiative of Case B, Organization B1 created a prototype to present to the other organizations, in the initial discussions about the new system.

Organization B1 presented how the process for managing the authorization of financial institutions operation could be improved with the use of the technology. This preliminary analysis supported the decision of the other organizations to proceed with the development of the system.

- In the context of the initiative of Case D, the organizations involved in the design thinking workshops decided to establish a cooperation agreement, in which the responsibilities were defined, and the business and technical teams of the organizations were defined and involved. The resources were negotiated, related to knowledge and infrastructure. The seizing of the opportunity involved the inter-organizational commitment and the development of the initial outline and business model of the solution.
- In the initiative of Case E, the team created a proof of concept that demonstrated to the organization that blockchain could be a useful technology to fulfill the requirements they had. Then, it was possible to envisage how the new system would work and the team convinced the decision makers to proceed with the full development of the solution.
- Considering the initiative of Case F, the interaction among Organizations F1 and F2 supported the analysis and decision to develop the new solution and the definition of the ways that the system would deal with the challenges identified by them.

To summarize, the seizing of the opportunity involved the creation of similar means to allow the preliminary evaluation and explanation of the use of the technology, as prototypes and proofs of concept. The seizing activity involves the initial delineation of the system and the creation of commitment. This dynamic capability was considered relevant for these initiatives, and it influenced the value creation of blockchain.

The results found are aligned with the idea that the seizing capability, or matching (Kanungo & Jain, 2011) allows the organization to see how IT matches to the value-adding opportunities that IT creates or reveals. This was exactly what was made in the initiatives of the Cases, when it was created prototypes and proof of concepts.

On the other hand, seizing may involve portfolio analysis, not observed in the initiative of the Cases. The capability of seizing involves, from a strategic perspective, the analysis of priorities and infrastructural assessments, considering the goals of the IT portfolio

(Kanungo & Jain, 2011). None of the initiatives of the Cases mentioned that the seizing capability involved a portfolio analysis.

Regarding the process of portfolio management, Waring et al. (2018) highlight the importance of defining the mechanisms necessary to benefit accomplishment, planning how they will be realized and establishing measures and reviewing processes. They discourage the management of projects in isolation, emphasizing the importance of the portfolio management process, to ensure benefits integration among different initiatives. Therefore, although the initiatives of the cases indicate the importance of seizing, it was not identified a portfolio approach in which the initiatives would be evaluated. Portfolio management practices could have avoided the problem faced by the initiative of Case D, which had their resources displaced, due to the change in management positions and the subsequent lack of sponsorship. Portfolio management may create conditions to evaluate different opportunities and select them based on transparent and specific criteria, involving analytical techniques, reducing the exposure of projects to subjective preferences. This may reduce the risk of discontinuity and waste of resources. The portfolio management process in the context of initiatives which involves different organizations probably involve higher complexity and deserves exploration about how it should be performed to support public value creation.

c) Reconfiguring

The dynamic capability of reconfiguring was identified as influencing the value creation of blockchain in the initiatives of Cases A, B, D, E and F. The following topics explain how the influence occurs:

- In the initiative of Case A, after the countries were convinced to proceed with the development of the system, they started the reconfiguration of resources and processes. A training session was organized, and a technical and governance facilitator was defined by voting. The management process was chosen, the frequency of meetings was established, and it was possible to integrate the efforts of the teams to advance with the solution development.
- Considering the initiative of Case B, a committee assumed the responsibility of governance. The committee supported the decision-making process, and it facilitated the definition of deadlines and the allocation of resources. The role of gov-

ernance was considered relevant, and it promoted collaboration among the organizations participating in the initiative.

- In the initiative of Case D, the organizations involved in the solution development had complementary capabilities and they tried to take advantage of the competences of each organization. They organized regular meetings to monitor the evolution of the initiative and they provided knowledge transfer among the organizations. The collaboration, willingness, commitment, and dedication of the teams of the organizations were considered decisive.
- Regarding the initiative of Case E, the collaboration of the team, their dedication, and commitment were considered relevant, especially dealing with the emergency and unusual situation of Covid-19, in which the availability of data was crucial to support decisions in the national healthcare context.
- In the initiative of Case F, there were two organizations involved in the initiative development and it was the first time of the teams dealing with blockchain. Then, their efforts involved learning by doing, trial and error. The professionals dived into the technology and both organizations participated from the start until the end of the development.

Therefore, the dynamic capability of reconfiguring was identified as influencing the value creation of blockchain. It was highlighted the challenge to integrate the efforts and to allocate resources among different countries and organizations. The collaboration and development of new capabilities were considered appropriate in the initiatives. It was emphasized the importance of some roles and their responsibilities, as the technical and governance facilitator, to support the decisions among the different participants of the initiatives.

This dynamic capability was identified in all initiatives except in the initiative of Case C, regarding the flight logs, in which a company was contracted to develop the solution sponsored by the public agency.

The results are aligned with the literature, which indicates the importance of the reconfiguration capability, to address changing requirements and demands from the internal and external environment (Janssen & Joha, 2007).

Therefore, considering all the three dynamic capabilities, it is worth to mention that according to Waring et al. (2018), there are inter relationships between the dynamic

capabilities and the managerial skills needed to perform each one are quite different. Organizations that would like to achieve success must build and use all of them. In the context of digital transformation, these dynamic capabilities must be represented in the top management group initiating the transformation, as they are unlikely to be found in one individual. The authors highlight that without the appropriate skills to support sensing, seizing, and reconfiguring, benefit realization will be compromised, with the chance to obtain poor results.

Thus, this topic presented the dynamic capabilities that influence the value creation of blockchain in the context of the public sector and how the influence occurs. It was observed that the initiatives of the cases have less maturity in the sensing capability and that even when the three capabilities were performed in different ways and with probably distinct levels of maturity, they were important to influence the value creation of an emerging technology.

6.4.2 IT resources and capabilities

It was identified that technical knowledge influences the value creation of blockchain, and it is explored in the following topic:

a) Technical knowledge

Technical knowledge influenced the value creation of blockchain in the initiatives of all the Cases. The influence occurred even in situations in which the initiatives dealt with technical knowledge with different approaches.

Technical knowledge was strengthened and shared among different countries (Case A) and organizations (Case D, F), promoting intensive collaboration among the participants of the initiative (Case D). Although some countries or organizations could have more knowledge than the others, there was an interest in sharing and aligning the knowledge among the participants (Cases A and D). Technical knowledge was considered crucial to support the selection of the platform to be used and to enable the development of the initiative (Cases A and C).

Technical knowledge was developed in a structured research activity performed prior to the development of the initiative, which was crucial to support decisions, with a clearer understanding about the limitations and characteristics of different platforms (Case B).

There were also situations in which the development of the initiative provided knowledge acquisition, through learning by doing (Cases D, E and F), since some participants did not master the technology, but it was committed to learn it increasingly. It also happened that one organization contracted another to develop all the initiative, without the concern of knowledge acquisition on the part of the contracting party (Case C). On the other hand, there were organizations totally concerned about knowledge acquisition since it would allow them to develop new products and services, increasing the capacity of the public sector to develop new solutions by itself (Case D).

Therefore, even with different approaches to deal with technical knowledge, this was recognized as a relevant resource for the initiatives. This result is aligned with previous studies, that consider the lack of knowledge as a substantial barrier for blockchain implementation in developing countries (Dhagarra et al., 2019; Mishra & Maheshwari, 2021; Nataren & Herran, 2019).

To summarize, the initiatives of the Cases indicated the influence of technical knowledge in the value creation of blockchain. This result is aligned with the literature, which demonstrates that IT resources and capabilities are related to value creation, as presented by the research of Alshaher (2021), Dahiya and Mathew (2016), Pang et al. (2014) and Zhao and Fan (2018).

6.4.3 Other resources and capabilities

This subsection presents the other resources and capabilities that influence the value creation of blockchain, which are business knowledge, sponsorship, and hype, according to the following information:

a) Business knowledge

The initiatives of Cases A and D considered that business knowledge influenced the value creation of blockchain:

- In the initiative of Case A, the business knowledge is related to international trade, information exchange requirements, international agreements, legal conditions, and secrecy issues. The understanding about these procedures and its characteristics influenced the value creation of blockchain since it was possible to define the requirements and the appropriate design to meet the needs.

- In the initiative of Case D, business knowledge (and the technical knowledge, as presented previously) were identified as the most important resource. In this initiative, the business knowledge is related to the understanding about the public procurement process, especially regarding the difficulties in dealing with the price collection.

Therefore, these were the initiatives that highlighted the business knowledge, considering processes that involve different countries (Case A) or different organizations in the same country (Case D).

This result is aligned with previous research, which indicate that the transformation of the public administration by digital technologies is related to process improvements (Ndou, 2004; Twizeyimana & Andersson, 2019). Olnes et al. (2017) highlight the importance of the adaptation of administrative processes to benefit from blockchain. Then, in the initiatives of the Cases and in the literature, an understating about the process that will be automated, improved or disrupted using blockchain is necessary and relevant to influence value creation.

b) Sponsorship

The initiatives of Cases A, B and C identified that sponsorship influenced the value creation of blockchain:

- In the initiative of Case A, sponsorship was considered relevant and Organizations A1 and A2 offered support to the initiative development because they were aware that the use of technology in this initiative represented an initial step to disrupt other processes related to foreign trade or related to other interactions among countries.
- In regard to the initiative of Case B, sponsorship was considered relevant, since the initial discussions about the initiative development started in 2017, when there was a shortage of knowledge about blockchain and its potential, in comparison to 2021, when the interview was performed. Then, the sponsorship of the committee that assumed the governance was relevant as well as the support of each organization involved. The project was considered strategic in the con-

text of the innovation area of the organization that developed the initiative and scarce resources were allocated to it.

- In the initiative of Case C, there was sponsorship from one of the directors of the public agency. This director usually supports innovation, and he offered the political support for the solution development, and he encouraged the rational adoption of the technology, or in other words, the adoption just in the case of fulfillment of requirements.

Therefore, in the context of initiatives A, B and C, sponsorship was identified as influencing value, and the initiatives received support in terms of coordination, resources allocated and political endorsement.

This result is aligned with the literature, which indicates that the lack of top management support and commitment is a barrier for blockchain implementation (Dhagarra et al., 2019). It is important to remember that the initiative of Case D was discontinued due to the lack of top management sponsorship, demonstrating the importance of this element.

c) Hype

It was identified that hype and enthusiasm influence the value creation of blockchain in the initiatives of Cases A and C:

- In the initiative of Case A, it was identified that the hype around blockchain and the consideration that the technology would create many benefits represented an incentive to explore the use of the technology.
- The initiative of Case C considered that the hype and enthusiasm of the team around blockchain created a receptive environment to experiment the technology. Even if a rational analysis was performed about the technology adoption, the hype contributed to increase the interest of the people around the initiative, and it influenced the value creation of blockchain.

In the literature, there is a study that analyzes the influence of hype in blockchain adoption (Koster & Borgman, 2020). According to them, hype had an initial positive influence on blockchain adoption, which subsequently became a negative influence. Hype had a positive influence in getting support, resources and enthusiasm related to a pro-

ject. Then, after some time, the hype forms a barrier, due to some circumstances, such as the confusion between blockchain, bitcoin and cryptocurrencies, and then skepticism arises.

Hype is related to enthusiasm and receptiveness, but its effect on mistaken decisions about blockchain adoption is not clear. Considering that dealing with emerging technology involves inherent risks, one possible way to avoid the negative effect of hype on decisions is to deal with the experiments of the use of the technology with a knowledge management approach, in which an appropriate documentation is generated and disseminated. This is especially important in the cases in which the expectations were not met, so other teams would have the chance to know what went right and wrong and avoid mistaken decisions in the future, as well as prevent the waste of resources of the public sector.

Then, this topic discussed the resources and capabilities influencing the value creation of blockchain. More information about it is available on the next section, regarding the synthesis of this chapter.

6.5 Synthesis of the chapter

The cross-case analysis allows to answer the research questions. Considering the first, “RQ1- Why does the public sector adopt blockchain?” according to the results, the main motivations are security and decentralization, and it was also cited by few cases the motivations of knowledge development, and cost reduction. The motivations are related to expectations to address problems or opportunities. All the expectations were met, and the benefits were achieved, as discussed further down in this section.

To the best of our knowledge, this is the first study that contributes to understand the motivations to use blockchain in the context of the public sector, specifically within the value propositions of decentralized data infrastructure and membership management. Then, it fills in the gap indicated by Konashevych and Poblet (2019). Probably due to the risk aversion typical of the public sector (Goh and Arenas, 2020), decision makers are being conservative with the use of the technology, prioritizing the use of blockchain in situations that involve a reduced number of network participants, or which does not involve many transactions per second, or in the context of simple processes that were

being previously performed manually using paper or e-mails, or with the aim to consider just a small part of a larger process, in situations that involve a low degree of disruption and lower complexity. This may be the first step to acquire more knowledge, experience, confidence, and sponsorship to embrace, in the future, new initiatives that may be more complex and innovative.

The unexpected result regarding transparency, which was not identified as a motivation in the Cases, may be because the problems regarding fraud, counterfeiting and corruption were not the main problems addressed by the six Cases. These problems are related to the motivation of transparency in the research related to education, procurement and land registry (de Souza-Daw & Ross, 2021; Hassija et al., 2021; Pandey, 2018; Satish Babu & Suresh Babu, 2020). It was a surprise that none of the organizations of the Cases are exploring the use of blockchain to increase transparency and reduce fraud and corruption, because the country of the individuals interviewed is not among the 100 less corrupt countries in the world in the ranking of control of corruption (Global Economy, 2022).

Considering the second research question, which is “RQ2- What is the value of blockchain in the context of the public sector and how is value created?”, according to the results, the value created by blockchain is security and decentralization. Considering that IT initiatives in the public sector contribute to the creation of public value, it was identified that professionalism and trust, internal effectiveness and efficiency and quality of the public services were created by the initiatives that are adopting blockchain.

The analysis of value confirmed that the expectations regarding the use of the technology were met. The Theoretical Framework indicated that the value of blockchain also involved transparency, which was not identified in the initiatives of the Cases. Then, neither the motivation of transparency, nor the value of transparency was identified. This benefit may not be identified in the Cases because of the types of initiatives. Transparency is considered a potential benefit in the literature in application areas that mainly involves fraud and corruption, such as public records related to land registry (Satish and Suresh, 2020), identity verification (Malik et al., 2019) and marriage certificates (Kamaruzaman et al., 2018). None of the initiatives of the Cases mentioned issues related to this.

The Framework indicated that IT initiatives may create the public value of participation and engagement. The initiatives of the Cases did not involve the creation of this public value. Participation and engagement is related to the engagement of society in government actions and public discussions, enabling community's empowerment and electronic democracy (Karunasena et al., 2011; Picazo-Vela et al., 2018; Rose et al., 2015; Twizeyimana & Andersson, 2019). There are a few examples of initiatives related to these topics in the literature (Khan et al., 2018; Moura & Gomes, 2017; Mukherjee et al., 2020), but these themes are not concerns of the initiatives of the Cases.

Then, the findings of the empirical study fit into the literature in respect to the value of security and decentralization and the public value of professionalism and trust, internal effectiveness and efficiency and quality of the public services. The unexpected results regarding transparency and participation and engagement may be because the main concerns of the initiatives of the cases are not related to the reduction of fraud and corruption dealing with public registries, or engagement of society in public discussions, or community empowerment and electronic democracy. Further studies could evaluate whether and how initiatives using blockchain may contribute to transparency and to participation and engagement.

As far as we know, this is the first study that explores the value of blockchain in the context of the public sector of South America, considering the value proposition of decentralized data infrastructure and membership management. The research also identifies what is the public value created by initiatives that are using blockchain and how public value is created. The contribution to knowledge is the clarification of the impact of an emerging technology to a segment of the economy that seems to be ignored by research (Pang et al., 2014).

Regarding the third research question, which is "RQ3- What are the resources and capabilities that influence the value creation of blockchain in the context of the public sector and how does this influence occur?", according to the initiatives of the Cases, the resources and capabilities are sensing, seizing, reconfiguring, technical and business knowledge, sponsorship, and hype. The influence occurs as the following:

- The dynamic capability of sensing was performed with different approaches by the organizations, with the support of an innovation team, of a research team, and in an ad hoc way, involving probably different levels of maturity.
- The dynamic capability of seizing involved similar ways to perform the preliminary evaluation of blockchain use, as the creation of prototypes and proofs of concept. Practices of portfolio management were not identified, although considered relevant by the literature.
- In the dynamic capability of reconfiguring, it was highlighted the challenge to integrate efforts and allocate resources among different countries and organizations. The roles of technical and governance facilitator were emphasized as relevant to supporting decisions among different stakeholders and to advance with the work of the initiatives.
- No dynamic capability was identified as influencing value creation in the initiative of Case C. This was an unexpected result. This unique case was the one in which an agency sponsored the development of the initiative by contracting an external company for its development. The agency involved in this case does not develop software with their own capacity and it did not have the concern of knowledge acquisition regarding blockchain. Considering that dynamic capabilities are recognized as a way to influence excellence in new products and to influence performance in the long run (Teece, 2007), the sensing of the environment, the seizing of the opportunity to use blockchain, the reconfiguring of resources to achieve the goal of the initiative are likely not recognized as important capabilities for the success of the agency in the long run.
- Technical knowledge was identified as influencing value creation. The teams of most of the initiatives had some basic knowledge or experience regarding blockchain, but they would like to enhance it. Knowledge was shared among the participants of the same initiatives, creating a collaborative environment among organizations of the public sector. The knowledge acquired supported the organizations in the creation of new products and services, increasing the capacity of the public sector to deal with future challenges.

- Business knowledge was identified as influencing value creation. Its importance is related to the deep understanding of the processes that would be altered, improved or disrupted due to the adoption of blockchain.
- Sponsorship was considered relevant, representing allocation of resources and political support.
- Hype and enthusiasm were considered relevant to create a receptive environment for the use of the blockchain, which influenced value creation, although they were not the main drivers to decide about the technology adoption.

This result confirms the dimensions of the Theoretical Framework, regarding the resources and capabilities influencing the value of IT. Then, the findings of the empirical study fit into the literature of IT and advance knowledge regarding the resources and capabilities influencing the value creation of a specific emerging technology.

To the best of our knowledge, this is the first study that explore the resources and capabilities influencing the value creation of blockchain in the context of the public sector in South America, considering the value proposition of decentralized data infrastructure and membership management. The results contribute to advance knowledge related to previous studies (Adnani, 2014; Goh & Arenas, 2020; Pang et al, 2014; Picazo-Vela et al., 2018). These authors explore the relationship of resources and capabilities and value creation, and the current research specifies and explains this relation when dealing with a specific emerging technology.

Finally, an overview regarding the comparison between the Framework and the evidence collected is provided in Table 24.

Table 24

Theoretical Framework and evidence collected

Dimension	Framework	Initiatives of the cases	Cases					
			A	B	C	D	E	F
Motivations	Decentralization	Decentralization	x	x		x		x
	Security	Security	x	x	x	x	x	x
	Transparency	-						
	-	Knowledge development				x		
	-	Cost reduction						x
Value	Decentralization	Decentralization	x	x		x		x
	Security	Security	x	x	x	x	x	x

	Transparency	-						
	Professionalism and trust	Professionalism and trust	x			x		
	Internal effectiveness and efficiency	Internal effectiveness and efficiency	x	x		x		x
	Quality of the public services	Quality of the public services	x		x		x	
	Participation and Engagement	-						
Resources and capabilities	Sensing	Sensing		x		x		x
	Seizing	Seizing	x	x		x	x	x
	Reconfiguring	Reconfiguring	x	x		x	x	x
	IT resources and capabilities (R&C)	IT R&C (technical knowledge)	x	x	x	x	x	x
	Other resources and capabilities (R&C)	Other R&C (business knowledge)	x			x		
		Other R&C (sponsorship)	x	x	x			
		Other R&C (hype and enthusiasm)	x		x			

This chapter presented the cross-case analysis, to demonstrate the similarities and differences among the cases and to answer the research questions, according to the empirical data collected. The next chapter presents the conclusions of this study.

7 CONCLUSION

7.1 Introduction

This last Chapter summarizes the research and encompasses its major conclusions, theoretical and practical contributions (7.2), the study's limitations (7.3), and the implications and suggestions for further research (7.4).

The literature of strategic management, information systems and digital government, related to the value of blockchain and IT in the context of the public sector, encompasses omissions and situations that are not well clarified yet. The empirical part of this research addresses the following gaps of the literature:

- It is not clear why blockchain should be used in the public sector (Konashevych & Poblet, 2019). Previous studies that state the motivations to use the technology in specific areas of application present ideas and initiatives that are in the initial stages of development (Alnafrah & Mouselli, 2021; Yadav & Kushwaha, 2021), as architectures and prototypes. The motivations to use the technology in initiatives that are fully implemented are not clear, hindering the assessment of the fulfillment of expectations.

- Despite the growing reputation of blockchain, there is a lack of applied cases (Tavares et al., 2020) and a lack of concrete and empirical evaluation of its use (Ali et al., 2021; Al-Megren et al., 2018; Cagigas et al., 2021). It is necessary to move from theoretical analysis to real-world insights (Sanchez, 2019), and move the research from descriptive and theoretical studies to empirical analysis of actual implementations and assessments based on real cases, including a rigorous analysis of the benefits of the technology (Cagigas et al., 2021; Ning et al., 2021). Previous studies that discuss the potential value of the technology rely on ideas and initiatives that are in initial stages of development, as models and frameworks (Alnafrah & Mouselli 2021; Guo et al., 2021; Li et al., 2021), architectures (Yadav & Kushwaha, 2021), and prototypes (Hang et al., 2019). The lack of understanding regarding the benefits of an emerging technology implies the possible waste of public resources, and trial and error that could be prevented.

- Although the technology offers potential to developing countries, there is reduced research in this regard (Zein & Twinomurinzi, 2019) and there is a small number of studies and cases in South America (Moura & Gomes, 2019; Tavares et al., 2020;

Toapanta et al., 2019), which is in Latin America, a continent with high levels of corruption (Casallas et al., 2020). The developing countries are those with more difficulty in defining strategies to obtain and manage resources. Understanding the impact of an emerging technology is relevant to improve the efficiency of resource utilization.

- The literature regarding the value of IT indicates the expected public value created in the context of the public sector (Bannister & Connolly, 2014; Twizeyimana & Andersson, 2019). However, it is not yet clear what is the contribution of blockchain initiatives in this regard. There is indication of the potential of blockchain initiatives to create some types of public value (Alexopoulos et al., 2019; Cagigas et al., 2021; Denny et al., 2017; Hao et al., 2019; Jaoude & Saade, 2019; Olnes and Jansen, 2018; Rukanova et al., 2021). Just one study analyzes the public value of blockchain, but it considers only one initiative that is in the process of acquiring maturity (Tavares et al., 2020). Therefore, empirical studies involving more initiatives are necessary for clarification.

- Previous studies that evaluate the influence of IT in the context of the public sector rely on dynamic capabilities (Kanungo & Jain, 2011; Waring et al., 2018), IT resources and capabilities (Abdullah et al., 2020; Dahiya & Mathew, 2016; Goh and Arenas, 2020; Pang et al., 2019; Zhao & Fan, 2018) and other resources and capabilities (Abdullah et al., 2020; Chan et al., 2011; Makasi et al., 2021; Pedersen, 2017; Picazo-Vela et al., 2018; Zhao & Fan, 2021). It is not clear what are the resources and capabilities that influence the value creation of blockchain and how this influence occurs in the context of the public sector. Therefore, the research questions that address these gaps are the following:

- RQ1: Why does the public sector adopt blockchain?
- RQ2: What is the value of blockchain in the context of the public sector and how is value created?
- RQ3: What are the resources and capabilities that influence the value creation of blockchain in the context of the public sector and how does this influence occur?

The research questions consider the term blockchain, and the literature indicates that the definition of blockchain is not yet established, and there is a discussion about the qualification of a system as a blockchain (Konashevych & Poblet, 2021). The combination of different prior technologies enabled the creation of the technology behind bitcoin, which is considered as a public and permissionless blockchain. There are other technol-

ologies with different characteristics, as private and permissioned, that are also considered as blockchain for some authors (Rukanova et al., 2021), while others refer to them as distributed ledger technologies (DLTs).

Considering the lack of a clear definition about the technology, the term blockchain is used in this research encompassing the different combinations of the characteristics of private or public versus permissionless or permissioned (Olnes & Jansen, 2018). According to Zutshi et al. (2021), these blockchains and distributed ledger technologies have different characteristics and offer distinct value propositions, that vary in terms of degree of disruption and complexity of implementation.

After the literature analysis, a Theoretical framework was proposed, considering the gaps identified and the research questions. Regarding the methodology, this research is exploratory and explanatory, and it adopts a multiple case study approach. The unit of analysis is represented by initiatives that use blockchain in the context of the public sector.

Regarding data collection, a case study protocol was created, to support primary data collection through interviews. The Cases explore six initiatives for data sharing or exchange related to foreign trade, regulators of the financial sector, civil aviation, public procurement, healthcare, and tax identification data. It was performed 16 interviews in total, with 14 individuals, including business and technical leaders, team members and final user.

In the data analysis, thematic analysis was conducted, with a deductive approach, NVivo was used, and a database was created. The transcription of the interviews was coded in nodes, using the dimensions of the Theoretical Framework and new nodes were created, when necessary.

The initiatives of the six cases analyzed and the Theoretical Framework created refer to the value propositions of decentralized data infrastructure and membership management. These value propositions are considered as the least disruptive and with the lowest complexity of implementation, in comparison to the other value propositions of blockchain (Zutshi et al., 2021). Therefore, considering this brief explanation, the research questions are all related to the value propositions cited, and the answers are discussed in the following subsections:

7.1.1 Why does the public sector adopt blockchain?

Existing literature had not yet made clear why the public sector adopts blockchain (Konashevych & Poblet, 2019). By studying initiatives that are in more mature development stages, this research enriches this knowledge, exploring the motivations to use the technology and its value. According to the evidence collected, the motivations of the public sector to adopt blockchain are security and decentralization. Other less cited motivations are knowledge development and cost reduction. The motivations to use the technology represent expectations to address problems or opportunities faced by the organizations and all of them were met, which means that the associated benefits were achieved.

According to the results, the organizations of the public sector are exploring the use of the technology to support simple activities related to data exchange, that were being previously executed using paper, e-mails, or telephone calls. Blockchain has been used mainly to allow interactions among a reduced number of network participants, in situations that do not require many transactions per second in its majority. The technology has been adopted to support just a part of some larger processes, with the intention of expanding its use in case of achieving the expected results. The motivations to adopt blockchain are associated with the need to use a system without centralized control, avoiding hierarchies, enabling a federative relationship among different countries or organizations. All these conditions are associated with security, data integrity and immutability. These are the main motivations. Adding to this, there are the motivations related to costs reduction in data exchange and related to the expectation to learn more about the technology, creating the capabilities necessary for the development of future products and services.

The results confirm that blockchain has been used in situations that involve a low degree of disruption and lower complexity of implementation (Zutshi et al., 2021) and this cautious approach of decision makers may be related to the risk aversion typical of the public sector (Goh and Arenas, 2020) or to the lack of knowledge in dealing with cases that might involve higher disruption and complexity (Dhagarra et al., 2019; Mishra & Maheshwari, 2021; Nataren & Herran, 2019).

The current initiatives of the Cases may represent the first step to acquire more knowledge, experience, sponsorship, and confidence to embrace new initiatives in the future that might be more innovative. Then, it may represent the initial move to explore the other value propositions of the technology, related to crypto economic models (Coffie & Saint, 2021), analytics and automation (Gomez Rivera & Tosh, 2019) and decentralized governance (Zutshi et al., 2021).

7.1.2 What is the value of blockchain initiatives?

The evidence collected confirms that blockchain creates the value or benefit of security and decentralization. This result addresses the lack of concrete and empirical evaluation of the use of blockchain (Ali et al., 2021; Al-Megren et al., 2018; Cagigas et al., 2021). This research allows the discovery of real-world insights (Sanchez, 2019), since it involved empirical analysis of actual implementations and assessments based on real cases (Cagigas et al., 2021; Ning et al., 2021), addressing the gaps previously identified.

Security is enabled due to the mechanisms that increase the reliability of data, with the certainty that data was not inappropriately edited or deleted, allowing the consultation of the history of transactions. The immutability provided by blockchain is considered crucial, especially when dealing with different countries. Security is obtained due to the consensus mechanisms, the existence of nodes that preserve the data, the use of cryptography, the history of updates and the identification of participants. This allows availability, integrity, immutability, and traceability of the records, increasing the trust in data. This also facilitates the creation of a secure infrastructure, in which the public sector may provide a foundation to its interaction with the private sector. Then, while previous research indicates just the potential value of security, relying on initiatives in early stage of development (Pandey, 2018), this research confirms this benefit and explains how it is created.

The other benefit identified is decentralization. Decentralization is enabled by the definition of rules that are agreed upon by the participants and implemented in the initiatives, without a central control or hierarchy among the participants. In the context of countries, decentralization allows the replication in the digital environment of the type of relation that exists among them in the real world, considering their sovereignty, and

the avoidance of hierarchy, facilitating negotiations among them. Decentralization is also valuable in the interactions among different organizations of the public sector, allowing independence and interconnection at the same time. Decentralization enables collaboration among the organizations and maintains the federated characteristics of their relationship. Then, while previous studies cited just the potential benefit of decentralization in initiatives in early stages of development (Pradana et al., 2018), this research confirms this benefit, based on empirical evidence from multiple cases analysis that are mostly fully implemented and in use. Therefore, the main benefits of blockchain for the public sector, according to initiatives involving countries of South America, are security and decentralization.

This research also analyzed another aspect of value creation in the context of the public sector. Considering that the impact of IT in this sector involves the creation of public value (Rose et al., 2015), it was explored what is the public value created by the initiatives that are using blockchain. This was not clear in the literature, and the results of this research confirm that the initiatives that are using blockchain are enabling the public value of professionalism and trust, internal effectiveness and efficiency and quality of the public service.

Regarding the public value of professionalism and trust, it was created by the acquired capacity of the organizations to deal with blockchain, contributing to increasing the respect for them. This capacity is related to the knowledge, innovation and new models of collaboration experimented by the different organizations from the public sector. The capacity acquired would allow them to develop new internal or external products and services. In one of the initiatives, the organizations involved in its development had the recognition of their competence to influence the national and international environment.

This public value was also enabled by the creation of trust, due to decentralization and security, and in the context of the provision of an infrastructure that may enable interactions among public and private sectors. The literature indicates just the potential of blockchain to create trust (Hao et al., 2019; Piao et al., 2021; Shuaib et al., 2020; Westerland et al., 2021), and the results of this research confirm the creation of the public value of professionalism and trust (Karunasena et al., 2011; Rose et al., 2015).

Regarding internal effectiveness and efficiency, the results confirm the creation of this public value, which was enabled in situations in which the initiatives replaced simple procedures of data exchange that were previously performed with the use of paper, telephone calls or e-mail, in a periodicity considered inappropriate. The initiatives allowed automation and more agility to perform the processes. The initiatives also enabled cost efficiencies, in comparison with the adoption of other possible centralized solutions or in comparison with a previous system used by the organizations. The initiatives contributed to increase the quality of internal processes and to reduce the incidence of human errors, due to the standardization of communication and the simplification of processes. Therefore, efficiency gains in terms of time and cost were created by automation and simplification. Effectiveness was enabled due to standardization and due to the higher quality of the execution of internal processes. Then, while the literature indicates just the potential value of the initiatives using blockchain to create this public value, based on experiments (Leite et al., 2020), this empirical research confirms the creation of the public value of internal effectiveness and efficiency and explains how value is created.

Regarding the public value of quality of the public services, the results confirm that it is created in situations in which the internal efficiency and effectiveness in data exchange among countries or organizations benefited the final user involved, enabling more agility in the services provided for individuals or organizations. This was observed in the services related to foreign trade and it is expected in the aviation services. The quality of the public service was also observed in situations in which the accessibility of healthcare data by individuals was facilitated, due to digitization and data availability. Then, the public value of internal effectiveness and efficiency enables the improvement of the quality of the services provided by the public sector, affecting the way it interacts with individuals and organizations. In the literature analyzed, related to the value proposition of decentralized data infrastructure and membership management, no study explores how this public value is created. Therefore, this research contributes to this understanding.

7.1.3 What are the resources and capabilities influencing value creation?

The value creation of blockchain is influenced by resources and capabilities, and this research identifies them and explains how the influence occurs. The results contribute to advance knowledge related to previous studies (Adnani, 2014; Goh & Arenas, 2020; Pang et al, 2014; Picazo-Vela et al., 2018). These authors explore the relationship of resources and capabilities and the value creation of IT, and the current research specifies and explains this relation when dealing with a particular emerging technology.

The dynamic capabilities of sensing, seizing and reconfiguring influence the value creation of blockchain, contributing to advance knowledge regarding the complementarity and impact of these elements in value creation (Kanungo & Jain, 2011). There are different approaches of the organizations in dealing with dynamic capabilities, as with the support of innovation team, research team and in an ad hoc way. This suggests different levels of maturity in dealing with the dynamic capabilities, and the maturity in this context is a challenge, since dynamic capabilities respond to triggers from the external and internal environment and it is renewed regularly (Waring et al., 2018).

Regarding IT resources and capabilities, the results confirm its influence in the value creation of blockchain, and the highlight is the technical knowledge of the teams involved in the initiative development. The influence of technical knowledge involved its sharing among different countries and organizations, promoting collaboration among the participants of the initiatives. In some cases, the professionals have just a basic knowledge and during the development they were learning by doing, enhancing it. This result demonstrates the importance of collaboration to support knowledge development, and attention was drawn to the fact that technical knowledge is yet rare to find and expensive. This is aligned with previous studies, that indicate the lack of knowledge as a substantial barrier for blockchain implementation in developing countries (Dhagarra et al., 2019; Mishra & Maheshwari, 2021; Nataren & Herran, 2019).

Regarding the other resources and capabilities, it was identified that the business knowledge, sponsorship and hype and enthusiasm influence the value creation of blockchain. Business knowledge is related to the deep understanding regarding the process or activity that would be modified, improved or disrupted with the use of blockchain. This result is aligned with previous research, which indicate that the transformation of the public administration by digital technologies is related to process improvements (Ndou,

2004; Twizeyimana & Andersson, 2019). And the importance of the adaptation of administrative processes to benefit from blockchain has already been indicated (Olne et al., 2017). Then, the results confirm that a deep understating about a process that would be improved or disrupted by blockchain is necessary and relevant to influence value creation.

Sponsorship was identified as influencing the value creation of blockchain. Sponsorship was obtained due to the understanding that the use of the technology represented an initial step to disrupt other processes. Sponsorship was enabled by executives or a committee that assumed the governance and supported the decisions among different organizations. Sponsorship represented support in terms of coordination, resources allocated and political endorsement. This result is aligned with the literature, which indicates that the lack of top management support and commitment is a barrier for blockchain implementation (Dhagarra et al., 2019), and this was exactly what happened regarding one initiative that had its continuity interrupted.

Hype and enthusiasm involve the consideration by the stakeholders of an initiative that the technology would create many benefits. This represented an incentive to explore the use of blockchain, enabling a receptive environment to experiment the technology.

7.2 Theoretical and practical implications

7.2.1 Theoretical implications

This study offers a novel approach by analyzing the impact of an emerging technology in a sector that usually receives little attention by researchers (Pang et al., 2014). To the best of our knowledge, this is the first research that explores and reveals the motivations to use blockchain in the public sector, according to the value proposition of decentralized data infrastructure and membership management, considering initiatives that involve developing countries. The motivations represent expectations, and its analysis broadens the understanding of the value created by the technology and why it is been used.

The evidence regarding the value of blockchain in the context of the public sector contributes to the advance of knowledge, since there was a lack of a rigorous analysis of the

benefits of blockchain, considering an empirical examination of actual implementations and assessments based on real cases (Cagigas et al., 2021; Ning et al., 2021).

Regarding public value, while the literature of IT explores its influence in public value creation (Bannister & Connolly, 2014; Chatfield & Reddick, 2018; Twizeyimana & Andersson, 2019), the literature of blockchain indicates just its potential to create benefits related to public value (Alexopoulos et al., 2019; Cagigas et al., 2021; Denny et al., 2017; Hao et al., 2019; Jaoude & Saade, 2019; Olnes and Jansen, 2018; Rukanova et al., 2021), or it explores the public value in one initiative that is in the process of acquiring maturity (Tavares et al., 2020). Thus, this research confirms that the initiatives that are using blockchain create public value, advancing knowledge about the impact of initiatives that are using this specific technology.

This study deepens and innovates in presenting two perspectives of value creation, the contribution of a specific emerging technology to generate benefits for the public sector, and the analysis of the broader impact of the initiatives that use blockchain. Previous studies that consider public value creation do not make this distinction, considering IT in general (Goh and Arenas, 2020; Pang et al., 2014).

As far as we know, this is the first study that explores the value of blockchain in the context of the public sector in South America within the value proposition of decentralized data infrastructure and membership management. The study addresses the gap related to the understanding of the potential of blockchain in the context of developing countries (Zein & Twinomurinzi, 2019).

To the best of our knowledge, this is the first study that explore the resources and capabilities influencing the value creation of blockchain in the context of the public sector in South America, considering the value propositions of decentralized data infrastructure and membership management. The results are aligned with previous studies regarding IT (Adnani, 2014; Goh & Arenas, 2020; Pang et al., 2014; Picazo-Vela et al., 2018), and it adds knowledge regarding this specific emerging technology. While these authors explore the relationship between resources or capabilities with value creation of IT in general, this research focuses on a specific IT, creating conditions for an in-depth understanding of its exclusive impact.

7.2.2 Practical implications

A relevant contribution of the research is the understanding of the impact of an emerging technology to a segment of the economy that seems to be ignored by research, which is the public sector (Pang et al., 2014), even if the worldwide IT spending of the public sector reached approximately half a trillion USD in 2021 (Gartner, 2022). This amount is very expressive and is higher than the gross domestic product of approximately 180 countries in 2021 (World Bank, 2021). The exclusive analysis of initiatives involving developing countries, which are those with more difficulty to define strategies to obtain and to manage resources, can contribute to avoid unnecessary expenses and to comprehend how to leverage the use of the technology.

The study clarifies why and how the public sector is using blockchain and what are the results obtained. The results may be useful to public sector decision makers that are thinking about the adoption of the technology but are uncertain about the real benefits. The understanding of the real value of this emerging technology might support better decisions, avoiding wrong expectations, trial and error, and the waste of public resources.

The main implications and recommendations for practice are the following:

- The acknowledgement of the value created by blockchain technology in initiatives that have the motivations of security and decentralization, facilitating decisions that may involve the creation of initiatives with similar expectations.
- The understanding of the public value enabled by initiatives that are using blockchain, supporting the definition of business models that considers the definition of the impact of the initiatives of the public sector on society.
- The need to create indicators related to the benefits achieved, preferably considering indicators of quality or results of the processes before and after the use of blockchain, when it is possible. The creation of measures to evaluate public value is a recognized challenge that may be controversial (Makasi et al., 2021), but considering the expressive investments of the public sector in IT, the disclosure of the indicators is paramount for accountability.
- The recognition of the importance of the dynamic capabilities of sensing, seizing, and reconfiguring, since there is evidence that they support the value creation of blockchain in the context of the public sector. Public sector organizations

may rely on different professionals to execute the capabilities, since there are differences among the skills required to perform them. Orientations or processes may be defined with periodical revision and systems may be adopted to support the execution of the dynamic capabilities.

- The importance of strengthening the dynamic capability of sensing since there is evidence of its role in value creation. The weak execution of this dynamic capability can postpone the value creation that would be achieved in less time if the external environment analysis was properly performed.
- The awareness regarding the role of the seizing capability and the possible use of portfolio management to support the selection of new initiatives. Portfolio management is based on transparent criteria, involving multiple stakeholders, to avoid unreasonable decisions and to reduce the risk of discontinuity of initiatives, as a result of changing in management positions.

7.3 Research limitations

Some of the limitations of this research are that the initiatives are associated with the same value propositions; there was a difficulty to find initiatives in advanced stages of development and it was not possible to interview all the expected organizations or professionals involved in the development of the initiatives of the Cases. The limitations are explained as follows:

- The research is restricted to the value propositions of decentralized data infrastructure and membership management (Zutshi et al., 2021) and all the cases involve private and permissioned networks. This was not a criterion for selection of the initiatives of the Cases, but it was expected, and what happened was that all the cases have these characteristics. Then, other initiatives involving different value propositions and typologies would create additional value that was not explored in this research.
- Another limitation of the research was the difficulty in finding initiatives that are fully in use, since one of the initiatives had no continuity for the time being and another initiative was selected to participate in the study before its entrance into the production environment (it was not yet fully developed and in use in the

real-world scenario). It would be better to avoid initiatives with these characteristics, to ensure the collection of evidence based only on initiatives in use for some time, for a more precise understanding of the benefits achieved.

- Unfortunately, it was not possible to interview individuals of all the organizations involved in the development of the initiatives of some cases and neither it was possible to interview all the professionals that it was expected, because of different internal reasons of the organizations. The complementarity and triangulation of data from more sources of evidence would increase the quality of the study and it would enrich the research results.

7.4 Implications and suggestions for further research

There are some specific issues that could be clarified by future research, and they are explored in the following topics:

- Considering the first research limitation of the previous subsection, future studies could analyze the motivations to use blockchain, the value created by the technology and the resources and capabilities influencing value in developed countries, to compare with the results of this research and understand similarities and differences of developing countries. So, it would consider the same value propositions addressed in this study. Further research could also analyze the value creation of blockchain in the context of the other value propositions indicated by Zutshi et al. (2021), although it might not be easy to find initiatives in advanced stages of development, but this is a matter of time.
- Future studies could analyze what are the characteristics of the dynamic capabilities that would allow higher value creation of initiatives using emerging technologies in the public sector. Although the results of this research confirm the influence of dynamic capabilities in value creation, dynamic capabilities are performed with different approaches in the initiatives. The literature regarding IT, the public sector and dynamic capabilities needs more investigation about how to differentiate a rich from a poor way to execute dynamic capabilities and how this influence value creation. Some studies identify situations in which dynamic capabilities are weakly performed (Kanungo & Jain, 2011) and studies that con-

sider the need to develop a more mature approach to deal with DC (Waring et al., 2018). There is a recognition of the challenge to develop dynamic capabilities, since it does not involve just the training of staff, rather it is a matter of helping them to innovate (Waring et al., 2018). So, future studies could address this issue.

- Further research could evaluate whether and how blockchain initiatives contribute to the value creation of transparency and to the public value of participation and engagement once these values were not highlighted by the initiatives of the Cases and the literature indicates these potential benefits. More research is needed to explain whether and how these types of benefits are enabled.
- Further studies could perform a technical evaluation of the role of other distributed systems to provide decentralization and security, conducting a systematic comparison with the use of different blockchains or distributed ledger systems (e.g., public and permissionless, private and permissioned). Then, it would be possible to clarify the differences between them and provide indication regarding in what situations each one is more recommended.

The clarification of these issues would support the advance of theory regarding information systems and digital government, shining a light on the value creation of blockchain in the context of the public sector. It would also support the theory regarding strategic management and the relation between resources, dynamic capabilities and value creation of IT in the public sector.

In conclusion and about the wider influence of this research, some reflections are placed. The literature of IT encompasses some studies that explore the failure of projects and initiatives in the public sector (Brown, 2002; Dada, 2017), indicating that most IT projects in this sector fail (Ashraf et al., 2010), pointing that this problem has persisted for decades (Goldfinch, 2007) and stating that the situation is even worse in developing countries (Ashraf et al., 2010). Why, after all, despite such a significant public sector investments in IT, do initiatives fail so badly? There are some varied answers that involve high complexity and enthusiasm (Goldfinch, 2007), among others. This research fits into the context of these problems with three purposes: (i) to raise awareness of researchers about the importance of advancing knowledge in this area, contributing to the understanding of the mechanisms of success and failure and how to leverage or

avoid them, (ii) to draw the attention of the public sector managers to the importance of using transparent decision criteria and of making well-founded decisions about the management of resources and capabilities that would enable the creation of public value demanded by society through emerging technologies, and (iii) to shed light about the need to increase communication and collaboration between researchers and public sector managers to strengthen innovation and amplify its positive impact, with a strategic approach. As far as private and permissioned blockchains or DLT are concerned, this research is an initial contribution to these bolder purposes cited.

REFERENCES

- Abdullah, N. H. N., Harjito, A., Said, J. (2020). The role of strategic management accounting on heterogeneity of human capital, information technology capabilities and value creation. *International Journal of Innovation, Creativity and Change*, 10(11), 652-673.
- Adel, A. (2020). Integrative Framework for Blockchain Implementation: Uniting Organizational, Business and Engineering Factors. *Computer Science & Information Technology Conference Proceedings*.
- Al-abri, R., Shaikh, A., Goldsmith, L. T. (2019). Designing of a Framework for Electronic Voting Systems using Blockchain Technology. *International Business Information Management Conference*, 34.
- Al Barghuthi, N. B., Hamdan, I., Al Suwaidi, S., Lootah, A., Al Amoudi, B., Al Shamsi, O., Al Aryani, S. (2019). An Analytical View on Political Voting System using Blockchain Technology-UAE Case Study. *IEEE Access*.
- Al Barghuthi, N. B., Ncube, C., Said, H. (2019). State of Art of the Effectiveness in Adopting Blockchain Technology-UAE Survey Study. *Sixth HCT Information Technology Trends (ITT), IEEE*.
- Alexopoulos, C., Charalabidis, Y., Androutsopoulou, A., Loutsaris, M. A., Lachana, Z. (2019). Benefits and Obstacles of Blockchain Applications in e-Government. *Proceedings of the 52nd Hawaii International Conference on System Sciences*.
- Ali, O., Jaradat, A., Kulakli, A., Abuhlimeh, A. (2021). A Comparative Study: Blockchain Technology Utilization Benefits, Challenges and Functionalities. *IEEE Access*. DOI: 10.1109/ACCESS.2021.3050241
- Alketbi, A., Nasir, Q., Talib, M. A. (2018). Blockchain for government services - Use cases, security benefits and challenges. *IEEE Learning and Technology Conference (L&T)*. DOI: 10.1109/LT.2018.8368494
- Al-Megren, S., Alsalamah, S., Altoaimy, L., Alsalamah, H., Soltanisehat, L., Almutairi, E., Pentland, A. (2018). Blockchain Use Cases in Digital Sectors: A Review of the Literature. *IEEE Conference on Internet of Things, Green Computing and Communications, Cyber, Physical and Social Computing, Smart Data, Blockchain, Computer and Information Technology*. DOI: 10.1109/Cybermatics_2018.2018.00242
- Alnafrah, I., Mouselli, S. (2021). Revitalizing blockchain technology potentials for smooth academic records management and verification in low-income countries. *International Journal of Educational Development*, 85. <https://doi.org/10.1016/j.ijedudev.2021.102460>
- Alshaher, A. (2021). IT capabilities as a fundamental of electronic government system success in developing countries from users' perspectives. *Transforming Government: People, Process and Policy*, 15, 129-149.
- Amelin, R., Arkhipov, V., Channov, S., Dobrobaba, M., Naumov, V. (2019). Prospects of Blockchain-Based Information Systems for the Protection of Intellectual

- Property. *International Conference on Digital Transformation and Global Society*, 327-337. https://doi.org/10.1007/978-3-030-37858-5_27
- Amend, J., Kaiser, J., Uhlig, L., Urbach, N., Volter, F. (2021). What Do We Really Need? A Systematic Literature Review of the Requirements for Blockchain-based E-government Services. *16th International Conference on Wirtschaftsinformatik*.
- Amit, R., Schoemaker, P. J. H. (1993). Strategic assets and organizational rent. *Strategic Management Journal*, 14, 33-46.
- Aranda, D. A., Fernandez, L. M. M., Stantchev, V. (2019). Integration of Internet of Things (IoT) and Blockchain to increase humanitarian aid supply. *International Conference on Transportation Information and Safety*, 5.
- Aristidou, C., Marcou, E. (2019). Blockchain standards and government applications. *Journal of ICT*, 7(3), 287-312. DOI: 10.13052/jicts2245-800X.736
- Ashraf, J., Khattak, N. S., Zaidi, A. M. (2010). Why do public sector IT projects fail. *International Conference on Informatics and Systems (INFOS)*, 1-6.
- Balasubramanian, S., Shukla, V., Sethi, J. S., Islam, N., Saloum, R. (2021). A readiness assessment framework for Blockchain adoption: A healthcare case study. *Technological Forecasting & Social Change*, 165, 1-16, <https://doi.org/10.1016/j.techfore.2020.120536>
- Baranwal, P. R. (2020). Blockchain Based Full Privacy Preserving Public Procurement. *International Conference on Blockchain*.
- Barney, J. (1991). Firm resources and sustainable competitive advantage. *Journal of Management*, 17(1), 99-120.
- Barney, J. (2001). Resource-based theories of competitive advantage: A ten-year retrospective on the resource-based view. *Journal of Management*, 27, 643-650.
- Barney, J. B., Corte, V., D., Sciarelli, M., Arikian, A. (2012). The role of resource-based theory in strategic management studies: managerial implications and hints for research. In G. B. Dagnino (Ed.), *Handbook of research on competitive strategy*. Northampton, Massachusetts.
- Barney, J. B., Jr., D. J. K., Wright, M. (2011). The Future of Resource-Based Theory: Revitalization or Decline? *Journal of Management*, 37, 1299-1315. DOI: 10.1177/0149206310391805
- Barney, J., Wright, M., Jr., D. J. K. (2001). The resource-based view of the firm: ten years after 1991. *Journal of Management*, 27, 625-641.
- Barney, J. B. (2017). The evolutionary roots of resource-based theory. In C. E. Helfat (Ed.), *The SMS Blackwell Handbook of organizational capabilities*.
- Bannister, F., Connolly, R. (2014). ICT, public values and transformative government: A framework and programme for research. *Government Information Quarterly*, 31, 119-128.
- Batubara, F.R., Ubacht, J., Janssen, M. (2018). Challenges of blockchain technology adoption for e-government: A systematic literature review. *ACM International Conference Proceeding Series*.

- Beck, R., Muller Bloch, C. (2017). Blockchain as Radical Innovation: A Framework for Engaging with Distributed Ledgers. *Proceedings of the 50th Hawaii International Conference on System Sciences*.
- Berryhill, J., T. Bourgery and A. Hanson (2018), "Blockchains Unchained: Blockchain Technology and its Use in the Public Sector", *OECD Working Papers on Public Governance*, 28, OECD Publishing, Paris. <http://dx.doi.org/10.1787/3c32c429-en>
- Bitcoin (2023). What is bitcoin? <https://bitcoin.org/en/>
- Britchenko, I., Cherniavska, T. (2019). Blockchain technology in the fiscal process of Ukraine optimization. *Economic Studies*, 28(5), 134-147.
- Brown, M., M., Brudney. J. (1998). Public sector information technology initiatives: Implications for programs of public administration. *Administration and Society*, 30(4), 421-442.
- Brown, T. (2002). Modernization or Failure? IT Development Projects in the UK Public Sector. *Financial Accountability & Management*, 17(4), 363-381. <https://doi.org/10.1111/1468-0408.00139>
- Cagigas, D., Clifton, J., Diaz-Fuentes, D., Fernandez-Gutierrez, M. (2021). Blockchain for Public Services: A Systematic Literature Review. *IEEE Access*, 9. 10.1109/ACCESS.2021.3052019
- Chan, C. M. L., Hackney, R., Pan, S. L., Chou, T. (2011). Managing e-Government system implementation: a resource enactment perspective. *European Journal of Information Systems*, 20, 529-541.
- Cao, X., Xu, H., Ma, Y., Xu, B., Qi, J. (2019). Research on a blockchain-based medical data management model. *International Conference on Health Information Science*, 35-44, https://doi.org/10.1007/978-3-030-32962-4_4
- Casallas, J. A. T., Lovelle, J. M. C., Molano, J. I. R. (2020). Smart Contracts with Blockchain in the Public Sector. *International Journal of Interactive Multimedia and Artificial Intelligence*, 6(3). DOI: 10.9781/ijimai.2020.07.005
- Chatfield, A. T., Reddick, C. G. (2018). Customer agility and responsiveness through big data analytics for public value creation: A case study of Houston 311 on-demand services. *Government Information Quarterly*, 35, 336-347.
- Chen, W., Xu, Z., Shi, S., Zhao, Y., Zhao, J. (2018). A survey of blockchain applications in different domains. *ACM International Conference Proceeding Series*, 17-21.
- Chohan, S. R., Hu, G. (2020). Success Factors Influencing Citizens' Adoption of IoT Service Orchestration for Public Value Creation in Smart Government. *IEEE Access*. DOI: 10.1109/ACCESS.2020.3036054
- Cisneros, B., Ye, J., Park, C. H., Kim, Y. (2021). CoviReader: Using IOTA and QR Code Technology to Control Epidemic Diseases across the US. *IEEE Annual Computing and Communication Workshop and Conference*. DOI: 10.1109/CCWC51732.2021.9376093

- Clarke, V., Braun, V. (2017). Thematic analysis. *The Journal of Positive Psychology*, 12:3, 297-298, DOI: 10.1080/17439760.2016.1262613
- Coffie, I., Saint, M. (2021). Digitizing Physical Assets on Blockchain 2.0: A Smart Contract Approach to Land Transfer and Registry. *International Conference on e-Infrastructure and e-Services for Developing Countries*, 234-252, https://doi.org/10.1007/978-3-030-70572-5_15
- Collomosse, J., Bui, T., Brown, A., Sheridan, J., Green, A., Bell, M., Fawcett, J., Higgins, J., Thereaux, O. (2018). ARCHANGEL: Trusted Archives of Digital Public Documents. *Proceedings of the ACM Symposium on Document Engineering*, 1-4, <https://doi.org/10.1145/3209280.3229120>
- Consensys (n.d.). Getting started with Consensys Quorum. <https://consensys.net/quorum/products/guides/getting-started-with-consensys-quorum/>
- Cunningham, D. J., Ascher, M. T., Viola, D., Visintainer, P. F. (2007). Baseline assessment of public health informatics competencies in two Hudson Valley health departments. *Public Health Reports*, 122, 302-310.
- Çaldag, M. T., Gokalp, E. (2020). Exploring Critical Success Factors for Blockchain-based Intelligent Transportation Systems. *Emerging Science Journal*, 4, 27-44. DOI: <http://dx.doi.org/10.28991/esj-2020-SP1-03>
- Dada, D. (2017). The Failure of E-Government in Developing Countries: A Literature Review. *The electronic Journal of Information Systems in Developing Countries*, 26(1), 1-10. <https://doi.org/10.1002/j.1681-4835.2006.tb00176.x>
- Dahiya, D., Mathew, S. K. (2016). IT assets, IT infrastructure performance and IT capability: a framework for e-government. *Transforming Government: People, Process and Policy*, 3, 411-433. DOI: 10.1108/TG-07-2015-0031
- Demir, M., Turetken, O., Ferworn, A. (2020). Blockchain-based transparent disaster relief delivery assurance. *IEEE International Systems Conference (SysCon)*. DOI: 10.1109/SysCon47679.2020.9275915
- Denny, D. M. T., Paulo, R. F., De Castro, D. (2017). Blockchain and agenda 2030. *Revista Brasileira de Políticas Públicas*, 122.
- de Souza-Daw, T., Ross, R. (2021). Fraud in higher education: a system for detection and prevention. *Journal of Engineering, Design and Technology*. DOI: 10.1108/JEDT-12-2020-0504
- Dhagarra, D., Goswami, M., Sarma, P. R. S., Choudhury, A. (2019). Big Data and blockchain supported conceptual model for enhanced healthcare coverage: *The Indian context*. *Business Process Management Journal*, 25(7). DOI: 10.1108/BPMJ-06-2018-0164
- Dhinakaran, K., Britto Hrudaya Raj, P. M., Vinod, D. (2021). A Secure Electronic Voting System Using Blockchain Technology. *Proceedings of the Second International Conference on Information Management and Machine Intelligence, Lecture Notes in Networks and Systems*, 166. https://doi.org/10.1007/978-981-15-9689-6_34

- Dubey, R., Gunasekaran, A., Bryde, D. J., Dwivedi, Y. K., Papadopoulos, T. (2020). Blockchain technology for enhancing swift-trust, collaboration, and resilience within a humanitarian supply chain setting. *International Journal of Production Research*, 58(11), 3381-3398. DOI: 10.1080/00207543.2020.1722860
- Eisenhardt, K. M., Martin, J. A. (2000). Dynamic capabilities: what are they? *Strategic Management Journal*, 21, 1105-1121.
- Elisa, N., Yang, L., Li, H., Chao, F., Naik, N. (2019). Consortium blockchain for security and privacy-preserving in E-government Systems. *Proceedings of the 19th International Conference on Electronic Business*, 99-107.
- Enwerem, U. C., Chukwudebe, G. A. (2021). Regulation and Standardization of Blockchain Technology for Improved Benefit Realization. *International Conference on Emerging Applications and Technologies for Industry 4.0*, 240-253. DOI:10.1007/978-3-030-80216-5_18
- Ezzine, I., Benhlila, L. (2020). Technology against COVID-19: A blockchain-based framework for data quality. *2020 6th IEEE Congress on Information Science and Technology (CiSt)*. DOI: 10.1109/CIST49399.2021.9357200
- Franco, P. (2014). Understanding Bitcoin: Cryptography, Engineering and Economics. Wiley. DOI: 10.1002/9781119019138
- Frizzo-Barker, J., Chow-White, P. A., Adams, P. R. Ha, D., Green, S. (2020). Blockchain as a disruptive technology for business: A systematic review. *International Journal of Information Management*, 51, DOI: <https://doi.org/10.1016/j.ijinfomgt.2019.10.014>
- Gao, Y., Pan, Q., Liu, Y., Lin, H., Chen, Y., Wen, Q. (2021). The Notarial Office in E-government: A Blockchain-Based Solution. *IEEE Access*.
- Garcia-Font, V. (2020). Social Block: An architecture for decentralized user-centric data management applications for communications in smart cities. *Journal of Parallel and Distributed Computing*, 145, 13-23, <https://doi.org/10.1016/j.jpdc.2020.06.004>
- Gartner (2022). Gartner Forecasts Worldwide Government IT Spending to Grow 5% in 2022. <https://www.gartner.com/en/newsroom/press-releases/2022-06-13-ww-govt-it-spending-forecast-2022>
- Geneiatakis, D., Soupionis, Y., Steri, G., Kounelis, I., Neisse, R., Nai-Fovino, I. (2020). Blockchain Performance Analysis for Supporting Cross-Border E-Government Services. *IEEE Transactions on Engineering Management*, 67(4). DOI: 10.1109/TEM.2020.2979325.
- Gil-García, J. R., Pardo, T. A. (2005). E-government success factors: Mapping practical tools to theoretical foundations. *Government Information Quarterly*, 22, 187-216.
- Goh, J. M., Arenas, A. E. (2020). IT value creation in public sector: how IT-enabled capabilities mitigate tradeoffs in public organizations. *European Journal of Information Systems*, 29(1), 25-43. <https://doi.org/10.1080/0960085X.2019.1708821>

- Goldfinch, S. (2007). Pessimism, Computer Failure, and Information Systems Development in the Public Sector. *Public Administration Review*, 67(5), 917-929. <https://doi.org/10.1111/j.1540-6210.2007.00778.x>
- Gomez, C., Perez-Blanco, F. J., Vara, J. M., Castro, V., Marcos, E. (2021). Design and development of smart contracts for e-government through value and business process modeling. *Proceedings of the 54th Hawaii International Conference on System Sciences*.
- Gomez Rivera, A. O., Tosh, D. K. (2019). Towards security and privacy of SCADA systems through decentralized architecture. *International Conference on Computational Science and Computational Intelligence (CSCI)*, 1224-1229. DOI 10.1109/CSCI49370.2019.00230
- Guo, Q., He, Q. C., Chen, Y. J., Huang, W. (2021). Poverty mitigation via solar panel adoption: Smart contracts and targeted subsidy design. *Omega*, 102. <https://doi.org/10.1016/j.omega.2020.102367>
- Hang, L., Choi, E., Kim, D. H. (2019). A Novel EMR Integrity Management Based on a Medical Blockchain Platform in Hospital. *Electronics*, 8(467), 1-27. DOI: 10.3390/electronics8040467
- Hao, Y., Piao, C., Zhao, Y., Jiang, X. (2019). Privacy Preserving Government Data Sharing Based on Hyperledger Blockchain. *International Conference on e-Business Engineering*. https://doi.org/10.1007/978-3-030-34986-8_27
- Hardwick, F. S., Akram, R. N., Markantonakis, K. (2018). Fair and Transparent Blockchain based Tendering Framework - A Step Towards Open Governance. *17th IEEE International Conference on Trust, Security and Privacy in Computing and Communications/ 12th IEEE International Conference on Big Data Science And Engineering*. DOI: 10.1109/TrustCom/BigDataSE.2018.00185
- Hassija, V., Chamola, V., Krishna, D. N. G., Kumar, N., Guizani, M. (2021). A Blockchain and Edge-Computing-Based Secure Framework for Government Tender Allocation. *Internet of Things Journal*, 8(4).
- Hughes, L., Dwivedy, Y. K., Misra, S. K., Rana, N. P., Raghavan, V., Akella, V. (2019). Blockchain research, practice, and policy: Applications, benefits, limitations, emerging research themes and research agenda. *International Journal of Information Management*, 49, 114-129. DOI: <https://doi.org/10.1016/j.ijinfomgt.2019.02.005>
- Hu, G., Pan, W. Lu, M., Wang, J. (2009). The widely shared definition of e-Government: An exploratory study. *The Electronic Library*, 27(6), 968 – 985.
- Hyperledger Fabric (2022). Read the Docs. <https://hyperledger-fabric.readthedocs.io/en/latest/ledger/ledger.html>
- Iyer, S., Thakur, S., Dixit, M., Katkam, R., Agrawal, A., Kazi, F. (2019). Blockchain and Anomaly Detection based Monitoring System for Enforcing Wastewater Reuse. *International Conference on Computing and Networking Technology (ICCNT)*. DOI: 10.1109/ICCNT45670.2019.8944586

- Jaffer, S. A., Pandey, S., Mehta, R., Bhavathankar, P. (2020). Blockchain based direct benefit transfer system for subsidy delivery. *International Conference for Emerging Technology (INCET)*.
- Jamil, F., Ahmad, S., Iqbal, N., Kim, D. (2020). Towards a Remote Monitoring of Patient Vital Signs Based on IoT-Based Blockchain Integrity Management Platforms in Smart Hospitals. *Sensors*, 20. DOI:10.3390/s20082195
- Janssen, M., Joha, A. (2007). Understanding IT governance for the operation of shared services in public service networks. *International Journal of Networking and Virtual Organizations*, 4, 20-34.
- Janssen, M., Weerakkody, V., Ismagilova, E., Sivarajah, U., Irani, Z. (2020). A framework for analyzing blockchain technology adoption: Integrating institutional, market and technical factors. *International Journal of Information Management*, 50, 302-309.
- Jaoude, J. A., Saade, R. G. (2019). Blockchain Applications - Usage in Different Domains. *IEEE Access*. DOI: 10.1109/ACCESS.2019.2902501
- Kadam, R., Vidhani, V., Bane, A., Valecha, B., Giri, N. (2020). Land records system using hybrid blockchain. *IEEE International Conference on Convergence to Digital World – Quo Vadis (ICCDW 2020)*. DOI: 10.1109/ICCDW45521.2020.9318693
- Kamaruzaman, N. E., Yassin, I. M., Zabidi, A., Zaman, F. H. K., Rizman, Z. I., Baharom, R., Wahab, N. A. (2018). Blockchain technology for Islamic marriage certificate. *International Journal of Engineering & Technology*, 7(4), 193-197.
- Kamau, G., Wausi, A. (2015). Evaluating the Public Value of e-Government Services. *IST-Africa 2015 Conference Proceedings*.
- Kanungo, S., Jain, V. (2011). Analyzing IT-enabled Effectiveness in Government Sector: A RBV and Dynamic Capability Perspective. *The Database for Advances in Information Systems*, 42, 38-62.
- Karunasena, K., Deng, H., Singh, M. (2011). Measuring the public value of e-government: a case study from Sri Lanka. *Transforming Government: People, Process and Policy*, 5(1), 81-99.
- Kassahun, A. E., Molla, A. (2011). BPR Complementary Competence for Developing Economy Public Sector: A Construct and Measurement Instrument. *Pacific Asia Conference on Information Systems (PACIS)*, 92.
- Kaur, M., Murtaza, M., Habbal, M. (2020). Post study of Blockchain in smart health environment. *5th International Conference on Innovative Technologies in Intelligent Systems and Industrial Applications (CITISIA)*. DOI: 10.1109/CITISIA50690.2020.9371819
- Khan, K. M., Arshad, J., Khan, M. M. (2018). Secure Digital Voting System Based on Blockchain Technology. *International Journal of Electronic Government Research (IJEGR)*, 14(1). DOI: 10.4018/IJEGR.2018010103
- Khan, N., Lee, D., Baek, C., Park, C. (2020). Converging Technologies for Safety Planning and Inspection Information System of Portable Firefighting Equipment. *IEEE Access*. DOI: 10.1109/ACCESS.2020.3039512

- Kiger, M., Varpio, L. (2020). Thematic analysis of qualitative data: AMEE Guide No. 131, *Medical Teacher*. DOI: 10.1080/0142159X.2020.1755030
- Konashevych, O. (2020). Constraints and benefits of the blockchain use for real estate and property rights. *Journal of Property, Planning and Environmental Law*, 12(2). DOI: 10.1108/JPEL-12-2019-0061
- Konashevych, O., Poblet, M. (2018). Is Blockchain Hashing an Effective Method for Electronic Governance? *Legal Knowledge and Information Systems*. doi:10.3233/978-1-61499-935-5-195
- Konashevych, O., Poblet, M. (2019). Blockchain anchoring of public registries: Options and challenges. *Proceedings of the 12th International Conference on Theory and Practice of Electronic Governance (ICEGOV2019)*. <https://doi.org/10.1145/3326365.3326406>
- Koster, F., Borgman, H. P. (2020). New Kid on the block! Understanding blockchain adoption in the public sector. *Proceedings of the 53rd Hawaii International Conference on System Sciences*. <https://hdl.handle.net/10125/63958>
- Koulizakis, I., Loukis, E. (2020). A development framework for blockchain technologies in digital government. *Proceedings of the 13th International Conference on Theory and Practice of Electronic Governance*. <https://doi.org/10.1145/3428502.3428519>
- Krishnan, S., Tan, B., C., C., Pan, S. L. (2010). Process model of customer-centric e-government enabled service transformation: Insights from MINDEF's portal implementation experience. *IFIP International Federation for Information Processing 2010*, 334, 187-200.
- Krogsboll, M., Borre, L. H., Slaats, T., Debois, S. (2020). Smart Contracts for Government Processes: Case Study and Prototype Implementation. *International Conference on Financial Cryptography and Data Security*, 676-684. https://doi.org/10.1007/978-3-030-51280-4_36
- Kumar, K., Sharma, A. (2019). E-voting in India using blockchain and its modus operandi. *Journal of Computational and Theoretical Nanoscience*, 16, 3774-3777. DOI: 10.1166/jctn.2019.8249
- Kundu, D. (2019). Blockchain and Trust in a Smart City. *Environment and Urbanization ASIA*, 10(1), 31-43. DOI: 10.1177/0975425319832392
- Labazova, O. (2019). Towards a Framework for Evaluation of Blockchain Implementations. *International Conference on Information Systems (ICIS)*.
- Leite, G. S., Albuquerque, A. B., Pinheiro, P. R. (2020). Process automation and blockchain in intelligence and investigation units: An approach. *Applied Science*, 10(3677). DOI: 10.3390/app10113677
- Li, L., Du, K., Xin, S., Zhang, W. (2017). Creating value through IT-enabled integration in public organizations: A case study of a prefectural Chinese Center for Disease Control and Prevention. *International Journal of Information Management*, 37 (1), 1575-1580.

- Li, W., Wang, L., Li, Y., Liu, B. (2021a). A blockchain-based emissions trading system for the road transport sector: policy design and evaluation. *Climate Policy*. <https://doi.org/10.1080/14693062.2020.1851641>
- Li, S., Yu, M., Yang, C., Avestimehr, A. S., Kannan, S., Viswanath, P. (2021b). Poly-Shard: Coded Sharding Achieves Linearly Scaling Efficiency and Security Simultaneously. *IEEE Transactions on Information Forensics and Security*, 16, 249-261. DOI: 10.1109/TIFS.2020.3009610
- Luna-Reyes, L., Juiz, C., Gutierrez-Martinez, I., Duhamel, F. B. (2020). Exploring the relationships between dynamic capabilities and IT governance: Implications for local governments. *Transforming Government: People, Process and Policy*, 14, 149-169. DOI: 10.1108/TG-09-2019-0092
- Makadok, R. (2001). Toward a synthesis of the resource-based and dynamic capability views of rent creation. *Strategic Management Journal*, 22, 387-401.
- Makasi, T., Tate, M., Desouza, K. C., Nili, A. (2021). Value-Based Guiding Principles for Managing Cognitive Computing Systems in the Public Sector. *Public Performance & Management Review*, 44(4), 929-959. <https://doi.org/10.1080/15309576.2021.1879883>
- Malik, G., Parasrampur, K., Reddy, S. P., Shah, S. (2019). Blockchain Based Identity Verification Model. *International Conference on Vision Towards Emerging Trends in Communication and Networking (ViTECoN)*.
- Manoj, M. K., Srivastava, G., Somayaji, S. R. K., Gadekallu, T. R., Maddikunta, P. K. R., Bhattacharya, S. (2020). An Incentive Based Approach for COVID-19 planning using Blockchain Technology. *IEEE Globecom Workshops*. DOI: 10.1109/GCWkshps50303.2020.9367469
- Martins, T. C. M., Zambalde, A. L., Grutzmann, A., Bermejo, P. H. S., Almeida, E. L., Nascimento, T. B. P. (2019). Value Innovation in the Public Sector: Concept, Determining Factors and Framework, *Springer Nature Switzerland AG 2019*, 163–175. https://doi.org/10.1007/978-3-030-27523-5_12.
- Mata, F. J., Fuerst, W. L., Barney, J. B. (1995). Information technology and sustained competitive advantage: a resource-based analysis. *Management Information Systems Research Center, MIS Quarterly*, 19, 487-505.
- Meijer, D., Ubacht, J. (2018). The governance of blockchain systems from an institutional perspective, a matter of trust or control? *Proceedings of the 19th Annual International Conference on Digital Government Research: Governance in the Data Age*. <https://doi.org/10.1145/3209281.3209321>
- Melville, N., Kraemer, K., Gurbaxani, V. (2004). Review: Information technology and organizational performance: an integrative model of IT business value. *Mis Quarterly*, 28(2), 283-322.
- Micheler, E., Whaley, A. (2020). Regulatory Technology: Replacing Law with Computer Code. *European Business Organization Law Review*, 21, 349–377. <https://doi.org/10.1007/s40804-019-00151-1>
- Mintah, K., Baako, K. T., Kavaarpuo, G., Otchere, G. K. (2020). Skin lands in Ghana and application of blockchain technology for acquisition and title registration.

Journal of Property, Planning and Environmental Law. DOI: 10.1108/JPPPEL-12-2019-0062

- Mishra, H., Maheshwari, P. (2021). Blockchain in Indian Public Distribution System: a conceptual framework to prevent leakage of the supplies and its enablers and disablers. *Journal of Global Operations and Strategic Sourcing*. DOI: 10.1108/JGOSS-07-2020-0044
- Montgomery, H. (2022). Decentralization in the enterprise space: Why open source is essential for blockchain. *IEEE Blockchain Americas*.
- Moura, T., Gomes, A. (2017). Blockchain Voting and its effects on Election Transparency and Voter Confidence. *Proceedings of the 18th Annual International Conference on Digital Government Research*. DOI: <http://dx.doi.org/10.1145/3085228.3085263>
- Mukhametov, D. (2020). Self-organization of Network Communities via Blockchain Technology: Reputation Systems and Limits of Digital Democracy. *Systems of Signal Synchronization, Generating and Processing in Telecommunications (SYNCHROINFO)*.
- Mukherjee, P. P., Boshra, A. A., Ashraf, M. M., Biswas, M. (2020). A Hyper-ledger Fabric Framework as a Service for Improved Quality E-voting System. *IEEE Region 10 Symposium (TENSYP)*.
- Musoke, A. A. Dushimimana, P., Saint, M. (2021). Identity Inclusion: A Digital National Identification for All. *SmartCity360° 2020: Science and Technologies for Smart Cities*, 511-525. https://doi.org/10.1007/978-3-030-76063-2_34
- Nabatchi, T. (2011). Exploring the Public Values Universe: Understanding Values in Public Administration. *Public Management Research Conference*.
- Natarén, C., Herran, A. (2019). Restoring trust in Mexican government. Preliminary assessment of DLT implementation. *Proceedings of the 2019 International Conference on Blockchain Technology*.
- Ndou, V. D. (2004). e-Government for developing countries: opportunities and challenges. *The Electronic Journal on Information Systems in Developing Countries*. 18(1), 1-24.
- Ning, X., Ramirez, R., Khuntia, J. (2021). Blockchain-enabled government efficiency and impartiality: using blockchain for targeted poverty alleviation in a city in China. *Information Technology for Development*, 27(3), 599-616. DOI: 10.1080/02681102.2021.1925619
- Norstrom, L., Lindman, J. (2020). Exploring Blockchain Municipal Use Cases. *Americas Conference on Information Systems (AMCIS)*. https://aisel.aisnet.org/amcis2020/org_transformation_is/org_transformation_is/24
- OECD (2018). Blockchain and its Use in the Public Sector. Observatory of Public Sector Innovation. Retrieved from <https://www.oecd.org/fr/gov/administration-innovante/oecd-guide-to-blockchain-technology-and-its-use-in-the-public-sector.htm> on September 05, 2019.

- Ojo, A., Adebayo, S. (2017). Blockchain as a next generation government information infrastructure: A review of initiatives in D5 countries. *Public Administration and Information Technology*, 32, 283-298.
- Olnes, S. (2016). Beyond Bitcoin enabling smart government using blockchain technology. *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, 253-264.
- Olnes, S., Jansen A. (2018). Blockchain Technology as Infrastructure in Public Sector - an Analytical Framework. *Proceedings of the 19th Annual International Conference on Digital Government Research: Governance in the Data Age*. <https://doi.org/10.1145/3209281.3209293>
- Olnes, S., Ubacht, J., Janssen, M. (2017). Blockchain in government: Benefits and implications of distributed ledger technology for information sharing. *Government Information Quarterly*, 34, 355-364.
- Olnes, S., Ubacht, J., Janssen, A. (2017). Blockchain technology as a support infrastructure in e-Government. *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, 215-227.
- Pablo, A. L., Reay, T., Dewald, J. R., Casebeer, A. L. (2007). Identifying, Enabling and Managing Dynamic Capabilities in the Public Sector. *Journal of Management Studies*, 44(5), 687-708.
- Pandey, P. (2018). Can blockchain spark off the reincarnation of India's living dead? *IEEE International Conference on Innovation and Intelligence for Informatics, Computing, and Technologies (3ICT)*, 1-8. <https://doi.org/10.1109/3ICT.2018.8855731>
- Pang, M-S., Lee, G., DeLeone, W. H. (2014). IT resources, organizational capabilities, and value creation in public-sector organizations: a public-value management perspective. *Journal of Information Technology*, 29, 187-205.
- Paul, J., Criado, A. R. (2020). The art of writing literature review: What do we know and what do we need to know? *International Business Review*, 29, DOI: 10.1016/j.ibusrev.2020.101717
- Paul, J., Lim, W. M., O' Cass, A., Hao, A. W., Bresciani, S. (2021). Scientific procedures and rationales for systematic literature reviews (SPAR-4-SLR). *International Journal of Consumer Industry*, 45, 1-16. DOI: 10.1111/ijcs.12695
- Pedersen, K. (2017). Realizing e-government benefits with minimal capabilities. *Transforming Government: People, Process and Policy*, 2, 262-285. DOI: 10.1108/TG-11-2016-0083
- Piao, C., Hao, Y., Yan, J., Jiang, X. (2021). Privacy preserving in blockchain-based government data sharing: A Service-On-Chain (SOC) approach. *Information Processing and Management*, 58. <https://doi.org/10.1016/j.ipm.2021.102651>
- Picazo-Vela, S., Gutierrez-Martinez, I., Duhamel, F., Luna, D. E., Luna-Reyes, L., F. (2018). Value of inter-organizational collaboration in digital government projects. *Public Management Review*, 20(5), 691-708. <https://doi.org/10.1080/14719037.2017.1305702>.

- Piening, E. P. (2013). Dynamic capabilities in public organizations: A literature review and research agenda. *Public Management Review*, 15(2), 209-245.
- Powell, T. C., Dent-Micallef, A. (1997). Information technology as competitive advantage: the role of human, business, and technology resources. *Strategic Management Journal*, 18, 375-405.
- Pradana, A., Sing, G. O., Kumar, Y. J., Mohammed, A. A. (2018). Blockchain Traffic Offence Demerit Points Smart Contracts: Proof of Work. *International Journal of Advanced Computer Science and Applications*, 9(11).
- Prakash, S., Gunalan, I. (2020). A new business model for digital governance of public records using blockchain. *Proceedings of the 13th International Conference on Theory and Practice of Electronic Governance*. <https://doi.org/10.1145/3428502.3428518>
- Pu, S. Y., Lam, J. S. L. (2021). Blockchain adoptions in the maritime industry: a conceptual framework. *Maritime Policy & Management*, 48(6), 777-794. DOI: 10.1080/03088839.2020.1825855
- Qian, J. P., Ruiz-Garcia, L., Fan, B., Villalba, J. I. R., McCarthy, U., Zhang, B., Yu, Q., Wu, W. (2020). Food traceability system from governmental, corporate, and consumer perspectives in the European Union and China: A comparative review. *Trends in Food Science & Technology*, 99, 402-412. <https://doi.org/10.1016/j.tifs.2020.03.025>
- Rana, N. P., Dwivedi, Y. K., Hughes, D. L. (2021). Analysis of challenges for blockchain adoption within the Indian public sector: an interpretive structural modelling approach. *Information Technology and People*. DOI: 10.1108/ITP-07-2020-0460
- Risius, M., Spohrer, K. (2017). A Blockchain Research Framework What We (don't) Know, Where We Go from Here, and How We Will Get There. *Business and Information Systems Engineering*, 59(6), 385-409. DOI: 10.1007/s12599-017-0506-0
- Rose, J., Persson, J. S., Heeager, L. T., Irani, Z. (2015). Managing e-Government: value positions and relationships, *Information Systems Journal*, 25, 531-571. DOI: 10.1111/isj.12052
- Rukanova, B., Ubacht J., Engelenburg, S. V., Tan, Y., Geurts, M., Sies, M., Molenhuis, M., Slegt, M. (2021). Realizing value from voluntary business-government information sharing through blockchain-enabled infrastructures: The case of importing tires to the Netherlands using TradeLens. *International Conference on Digital Government Research*. <https://doi.org/10.1145/3463677.3463704>
- Saho, N. J. G., Ezin, E. C. (2021). Developing a Digital Healthcare Book based on the Blockchain Technology. *International Symposium on Electrical, Electronics and Information Engineering*, 617-622. <https://doi.org/10.1145/3459104.3459203>
- Sánchez, S. N. (2019). The implementation of decentralized ledger technologies for public procurement: Blockchain-based Smart Public Contracts. *European Procurement & Public Private Partnership Law Review*, 14(3), 180-196. <https://www.jstor.org/stable/26895828>

- Satish Babu, B. V., Suresh Babu, K. (2020). Materializing blockchain technology to maintain digital ledger of land records. *Proceedings of the Third International Conference on Computational Intelligence and Informatics*, 201-212. DOI: 10.1007/978-981-15-1480-7_16
- Scholl, H. J., Bolivar, M. P. R. (2019). Regulation as both enabler of technology use and global competitive tool: The Gibraltar case. *Government Information Quarterly*, 36, 601-613. <https://doi.org/10.1016/j.giq.2019.05.003>
- Scott, M., DeLone, W., Golden, W. (2016). Measuring eGovernment success: a public value approach. *European Journal of Information Systems*, 25, 187-208. <https://doi.org/10.1057/ejis.2015.11>.
- Sekaran, U., Bougie, R. (2013). *Research Methods for Business*. United Kingdom: John Wiley & Sons LDA.
- Semenets, H., Yakobchuk, V., Plotnikova, M. (2018). Family homesteads settlements as the subjects of the public management in rural territories. *Management Theory and Studies for Rural Business and Infrastructure Development*, 40(4).
- Sethibe, T., Campbell, J., McDonald, C. (2007). IT Governance in Public and Private Sector Organizations: Examining the Differences and Defining Future Research Directions. *ACIS 2007 Proceedings*, 118. <https://aisel.aisnet.org/acis2007/118/>
- Shen, B., Cheng, M., Dong, C., Xiao, Y. (2021). Battling counterfeit masks during the COVID-19 outbreak: Quality inspection vs. blockchain adoption. *International Journal of Production Research*. DOI: 10.1080/00207543.2021.1961038
- Shih, D., Shih, P., Wu, T. (2018). An infrastructure of multi-pollutant air quality deterioration early warning system in spark platform. *IEEE International Conference on Cloud Computing and Big Data Analysis*.
- Shuaib, M., Daud, S. M., Alam, S., Khan, W. Z. (2020). Blockchain-based framework for secure and reliable land registry system. *Telecommunication, Computing, Electronics and Control*, 18(5), 2560-2571. DOI: 10.12928/TELKOMNIKA.v18i5.15787
- Singh, H. S., Palan, D. R., Shinde, R., Doshi, M. (2020). Health monitoring and analysis using IPFS and blockchain. *IEEE International Conference on Convergence to Digital World*. DOI: 10.1109/ICCDW45521.2020.931865
- Somayaji, S. R. K., Alazab, M., Manoj, M. K., Bucchiarone, A., Chowdhary, L., C., Gadekallu, T., R. (2020). A Framework for Prediction and Storage of Battery Life in IoT Devices using DNN and Blockchain. *IEEE Globecom Workshops*. DOI: 10.1109/GCWkshps50303.2020.9367413
- Song, L., Wang, X., Wei, P., Lu, Z., Wang, X., Merveille, N. (2021). Blockchain-Based Flexible Double-Chain Architecture and Performance Optimization for Better Sustainability in Agriculture. *Computers, Materials & Continua*. DOI: 10.32604/cmc.2021.016954
- Sorongan, E., Hidayati, Q. (2020). Integration of eucs variables into delone and mclean models for E-government evaluation: Conceptual models. *Scientific Journal of Information System Technology*, 6(1), 32-42. <https://doi.org/10.26594/register.v6i1.1608>

- Sotoudehnia, M. (2021). 'Making blockchain real': regulatory discourses of blockchains as a smart, civic service. *Regional Studies*. DOI: 10.1080/00343404.2021.1882671
- Srinivasan, R. (2008). Sources, characteristics and effects of emerging technologies: Research opportunities in innovation. *Industrial Marketing Management*, 37(6), 633-640.
- Stake, R. E. (2006). Multiple case study analysis. The Guilford Press. New York.
- Standish Group (2015). Chaos report 2015. https://www.standishgroup.com/sample_research_files/CHAOSReport2015-Final.pdf
- Tavares, E., C., Meirelles, F. S., Tavares, E. C., Schunk, L., Cunha, M. A. (2019). Blockchain in the Green Treasure: Different Investment Objectives. *Twenty-fifth Americas Conference on Information Systems*.
- Tavares, E. C., Meirelles, F. D., Cunha, M. A., Schunk, L. M. (2021). Blockchain in the Amazon: creating public value and promoting sustainability. *Information Technology for Development*, 27(3), 579-598. DOI: 10.1080/02681102.2020.1848772
- Teece, D. J., Pisano, G., Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, 18(7), 509-533.
- Teece, D. J. (2007). Explicating dynamic capabilities: the nature and micro foundations of (sustainable) enterprise performance. *Strategic Management Journal*, 28, 1319-1350.
- Templier, M., Paré, G. (2015). A Framework for Guiding and Evaluating Literature Reviews. *Communications of the Association for Information Systems*, 37, 6, DOI: 10.17705/1CAIS.03706
- The Global Economy (2022). Control of corruption - Country rankings. https://www.theglobaleconomy.com/rankings/wb_corruption/
- Thompson, D. V., Rust, R. T., Rhoda, J. (2005). The business value of e-government for small firms. *International Journal of Service Industry Management*, 16(4), 385-407.
- Thosar, A., Harne, M., Sarode, A., Kaur, P. (2020). Land Registry Management using Blockchain. *International Conference on Smart Innovations in Design, Environment, Management, Planning and Computing*. DOI: 10.1109/ICSIDEMPC49020.2020.9299614
- Toapanta, S. M. T., Monteverde, A. A. C., Rojas, J. G. O., Gallegos, L. E. M. (2019). Proposal of ledger technology to apply to a public organization in Ecuador. *Advances in Science, Technology and Engineering Systems Journal*, 4(3), 251-259.
- Toufaily, E., Zalan, T., Dhaou, S. B. (2021). A framework of blockchain technology adoption: An investigation of challenges and expected value. *Information and Management*, 58, 1-17.

- Tseng, J., Liao, Y., Chong, B., Liao, S. (2018). Governance on the drug supply chain via gcoin blockchain. *International Journal of Environmental Research and Public Health*, 15(1055). DOI: 10.3390/ijerph15061055
- Tshering, G., Gao, S. (2020). Understanding security in the government's use of blockchain technology with value focused thinking approach. *Journal of Enterprise Information Management*, 33(3), 519-540.
- Twizeyimana, J. D., Andersson, A. (2019). The public value of E-Government – A literature review. *Government Information Quarterly*, 36, 167-178.
- Vaismoradi, M., Jones, J., Turunen, H., Snelgrove, S. (2015). Theme development in qualitative content analysis and thematic analysis. *Journal of Nursing Education and Practice*, 6(5). 100-110. <http://dx.doi.org/10.5430/jnep.v6n5p100>
- Vaismoradi, M., Snelgrove, S. (2019). Theme in qualitative content analysis and thematic analysis. *Forum Qualitative Social Research*, 20(3). <https://doi.org/10.17169/fqs-20.3.3376>
- Vanany, I., Rakhmawati, N. A., Sukoso, S., Soon, J. (2020). Indonesian Halal Food Integrity: Blockchain Platform. *International Conference on Computer Engineering, Network, and Intelligent Multimedia*.
- Xu, C., Yahn, H., Yu, Y., Li, Z. (2019). Trusted and Flexible Electronic Certificate Catalog Sharing System Based on Consortium Blockchain. *International Conference on Computer and Communications*.
- Yadav, A. S., Kushwaha, D. S. (2021). Blockchain-based digitization of land record through trust value-based consensus algorithm. *Peer-to-Peer Networking and Applications*, 14, 3540–3558. <https://doi.org/10.1007/s12083-021-01207-1>
- Yin, R. K. (2012). Applications of case study research, Third edition. SAGE Publications, Inc. California.
- Yin, R. K. (2009). Case study research: design and methods, Fourth edition. SAGE Publications, Inc. California.
- Yin, R. K. (2014). Case study research: design and methods, Fifth edition. SAGE Publications, Inc. California.
- Yin, R. K. (2018). Case study research and applications: Design and methods. Sixth edition. SAGE Publications, California.
- Yli-Huumo, J., Ko, D., Choi, S., Park, S., Smolander, K. (2016). Where Is Current Research on Blockchain Technology? A Systematic Review. *Plos One*, 11(10). DOI: ARTNe016347710.1371/journal.pone.0163477
- Walsh, C., O'reilly, P., Gleasure, R., McAvoy, J., O'Leary, K. (2020). Understanding manager resistance to blockchain systems. *European Management Journal*.
- Wang, F., De Filippi, P. (2020). Self-Sovereign Identity in a Globalized World: Credentials-Based Identity Systems as a Driver for Economic Inclusion. *Hypothesis and Theory*, 2(28). DOI: 10.3389/fbloc.2019.00028
- Wang, Y., Huang, S., Yu, X. (2021). An Oil and Gas Big Data Sharing Model Based on Blockchain Technology. *International Conference on Green Energy and Sustainable Development*. DOI: 10.1088/1755-1315/651/3/032105

- Warkentin, M., Orgeron, C. (2020). Using the security triad to assess blockchain technology in the public sector applications. *International Journal of Information Management*, 52.
- Waring, T., Casey, R., Robson, A. (2018). Benefits realization from IT-enabled innovation: A capability challenge for NHS English acute hospital trusts? *Information Technology and People*, 31(3), 618-645. DOI: 10.1108/ITP-06-2015-0151
- Warren, S., Treat, D. (2019). Building Value with Blockchain Technology: How to Evaluate Blockchain's Benefits. World Economic Forum.
- Wattegama, D., Silva, P. S., Jayathilake, C. R., Elapatha, K., Abeywardena, K., Kuruwitaarachchi, N. (2021). "iSAY": Blockchain-based Intelligent Polling System for Legislative Assistance. *International Journal of Advanced Computer Science and Applications*, 12(1).
- Westerlund, M., Nene, S., Leminen, S., Rajahonka, M. (2021). An Exploration of Blockchain-based Traceability in Food Supply Chains: On the Benefits of Distributed Digital Records from Farm to Fork. *Technology Innovation Management Review*, 11(6).
- Winter, S. G. (2003). Understanding dynamic capabilities. *Strategic Management Journal*, 24, 991-995.
- World Bank (2022). Gross domestic product 2021. <https://databank.worldbank.org/data/download/GDP.pdf>
- Zein, R. M., Twinomurinzi, H. (2019). Towards Blockchain Technology to Support Digital Government. *International Conference on Electronic Government and the Information Systems Perspective*, 207–220. DOI: 10.1007/978-3-030-27523-5_15
- Zhao, Y., Fan, B. (2018). Exploring open government data capacity of government agency: Based on the resource-based theory. *Government Information Quarterly*, 35. 1-12, <https://doi.org/10.1016/j.giq.2018.01.002>
- Zhao, Y., Fan, B. (2021). Effect of an agency's resources on the implementation of open government data. *Information and Management*, 58, 1-12. <https://doi.org/10.1016/j.im.2021.103465>.
- Zhang, L., Gao, Y., Chen, J., Wang, X., Huang, Z., Wei, D. (2019a). Research on remote sensing data sharing model based on blockchain technology. *International Conference on Blockchain Technology and Application*. <https://doi.org/10.1145/3376044.3376047>
- Zhang, Y., Xu, X., Liu, A., Lu, Q., Xu, L., Tao, F. (2019b). Blockchain-Based Trust Mechanism for IoT-Based Smart Manufacturing System. *IEEE Transactions on Computational Social Systems*. DOI: 10.1109/TCSS.2019.2918467
- Zhang, Y., Liu, Y., Jiong, Z., Zhang, X., Li, B., Chen, E. (2021). Development and assessment of blockchain-IoT-based traceability system for frozen aquatic product. *Journal of Food Process Engineering*, 44(5). <https://doi.org/10.1111/jfpe.13669>
- Zheng, D., Chen, J., Huang, L., Zhang, C. (2013). E-government adoption in public administration organizations: integrating institutional theory perspective and re-

source-based view. *European Journal of Information Systems*, 22, 221-234.
DOI: 10.1057/ejis.2012.28

Zutshi, A., Grilo, A., Nodehi, T. (2021). The value proposition of blockchain technologies and its impact on Digital Platforms. *Computers & Industrial Engineering*, 155. <https://doi.org/10.1016/j.cie.2021.107187>