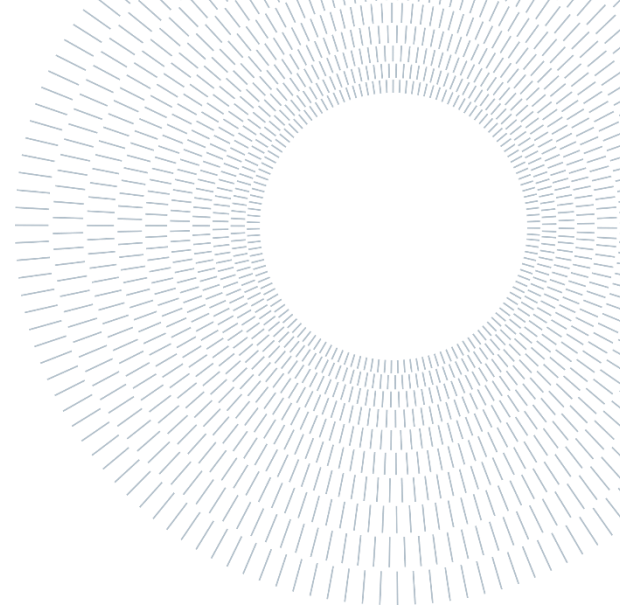




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EXECUTIVE SUMMARY OF THE THESIS

## Blockchain in the public sector: an international census and a case study of public administration collaboration

TESI MAGISTRALE IN MANAGEMENT ENGINEERING – INGEGNERIA GESTIONALE

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### 1. Introduction

Governments are moving toward e-Government to improve and modernize their business models and organizational structures while strengthening their relationship with citizens, businesses, and other non-state players. Consequently, the adoption of emerging advanced technologies to ensure citizens' faster, secure, and transparent access to public services is no longer a luxury but rather a modern-era requirement (Saxena et al., 2022).

One of them is blockchain technology, which belongs to the Distributed Ledger Technology family. Blockchain technology eliminates the need for intermediaries replacing them with a network of digital users who work together to verify transactions and maintain the ledger's integrity. As a result, each member of the blockchain network has a copy of the ledger, making anyone on the network able to verify historical transaction logs and ensure their validity (Supriyadi et al., 2021).

Blockchain adoption in the public sector provides accessible and transparent information to citizens and promotes the integration of resources among different public organizations by means of transferring data more easily and safely (Hou, 2017).

In the dissertation, the relationships between blockchain technology and the public sector are explored. To do so a census and a case study analysis were conducted to explore and expand this topic.

### 2. Literature review

The systematic literature review provided a comprehensive overview of the existing studies related to blockchain adoption in the public sector.

After analysing the Scopus database through the research query, the final number of papers analysed was 29. The selected papers were classified based on perspective, methodology, year, and relevance to the literature review. Besides, it was considered the content of the study

and some useful metadata. Most studies are exploratory (72%), and mainly focused on case studies and other qualitative research. The fact that neither explanatory nor empirical research has been found highlights the novelty of the topic under examination.

The scientific literature on blockchain adoption in the public sector, with literature related to e-Government and blockchain technical features, was examined and several concepts were found, namely the problem of governance, the lack of blockchain common standards, general guidelines for implementation, applications-related topics and potential benefits and challenges derived from blockchain adoption.

The gaps in academic literature were identified:

- Literature lacks a comprehensive framework to classify blockchain applications in the public sector.
- Potential areas of application, such as governance design and the blockchain impact on public administration (PA) collaboration are not properly covered.
- The potential impact of blockchain platforms used by public administrations and citizens is not reviewed.

From the literature gaps, the research questions (RQs) the dissertation aims to address were developed.

**Research question 1.** *What is the current situation of blockchain technology in the international public sector domain? How to classify potential applications implemented by public administrations around the world?*

**Research question 2.** *How does governance design influence public administration collaboration on a blockchain platform?*

### 3. Research methodology

Given the qualitative purpose of the research, a theory-building approach was chosen. Specifically, a census was developed to answer the first descriptive RQ. The second RQ refers to the exploration of how public administration relationships and governance are organized in a blockchain platform project. To answer this

question a case study was conducted and analysed through the theoretical lenses of collaboration (Gulati et al., 2012) and governance (Lumineau et al., 2021).

### 4. Empirical analysis

To answer the first research question, empirical research was conducted by building a census based on international ongoing projects gathered through secondary sources (i.e. websites). Then, cross-field and inter-field analyses were performed to gain information about the evolution trends of blockchain technology adoption in the public sector and to understand the connections between the different dimensions. As a result, a project analysed in the census was considered as a case study to further investigate the most interesting trends that emerged.

In detail, 367 projects ranging from 2017 to 2022 were collected. Each of the initiatives gathered was analysed based on some dimensions, namely, process impacted, government application area, maturity level (announcement, proof of concept, operative), timing, expected benefits, stakeholders interactions (B2B, B2G, B2C), geographical distribution, actors involved, and types of blockchain adopted. Finally, a cross-data analysis was made between these dimensions and the main findings were:

- From 2020 to 2022, blockchain adoption in the public sector shifted from an initial phase of hype to a more mature stage. This is due to the increase in the number of projects in concrete experimentation and already operative.
- Central PA is at the forefront of promoting these initiatives, which require a high level of interaction with citizens. Multi-actor projects (i.e. developed by consortiums) are increasingly taking place, even though they are only a small part of the total.
- The solutions primarily involve notarizing existing public processes for the sake of improving verifiability, efficiency, transparency, security and immutability.
- The most common areas of application are general public services (e.g. data management, identity management, e-Voting), economic affairs (e.g. supply

chain management), healthcare, and education.

## 5. Case study

The case study chose to answer the second RQ focuses on the Italian Blockchain Services Infrastructure (IBSI). IBSI is an ongoing project with the goal of creating the first Italian blockchain network between public administrations on which to design initiatives that improve the relationship between PAs and citizens.

The lack of multi-actor blockchain projects implemented in PAs emerged from the census, and the literature gaps identified made IBSI a particularly suitable case study to be analysed. Indeed, this project, examined in the census, has been chosen because it offers a comprehensive overview of a plethora of public administrations working together to design a blockchain platform that can be leveraged to develop use cases and deliver better public services to citizens.

Even though the case study was based on a single context, it provided a variety of perspectives on the collaboration units of analysis highlighting the collaborative processes among PAs and citizens involved in the project (Gulati et al., 2012) and the underlying governance that supports them (Lumineau et al., 2021).

Regarding data collection, different sources of information were examined to gather data about the selected use case, with semi-structured interviews being the major contributor. A questions protocol was used as a general guide for conducting the interviews, without forcing any kind of answer and granting flexibility to follow up interesting or unexpected responses.

Table 1 summarizes the key data of the eight informants and the dates of the interviews. A second round of interviews was conducted to gain further insights into the concepts that emerged. However, only four of the eight initial informants were interviewed a second time due to availability reasons.

Table 1: List of interviews

Inter view number	Public administration	Role	1 <sup>st</sup> inter view date	2 <sup>nd</sup> inter view date
1	Infratel	Project manager	13/2 /23	8/3/ 23
2	Poste Italiane	Project manager	15/2 /23	8/3/ 23
3	Poste Italiane	ICT innovation strategist	15/2 /23	
4	INAIL	Project manager	16/2 /23	
5	ACI Informati ca	Project manager	17/2 /23	8/3/ 23
6	Politecnic o di Milano	Researcher	20/2 /23	
7	Politecnic o di Milano	Researcher	21/2 /23	
8	Regione Lombardi a	Project manager	21/2 /23	14/3 /23

The data gathered from interviews, project documentation, and secondary sources (i.e. websites) were then analysed through an open coding approach. Codes were grouped according to their homogeneity to build high-order categories, which were then organized to define aggregate dimensions. Then, the data gathered were analysed by triangulating them with the literature review, resulting in the design of the data structure. The data structure, presented in Figure 1, illustrates the graphical representation of the relations between different data levels showing the progression from raw data to key concepts (Gioia et al., 2012).

Finally, the development of the final model was based on comparing emerging concepts with interviews and existing literature and then repeating this process. This phase ended when interviews and secondary sources did not add anything relevant to the model developed.

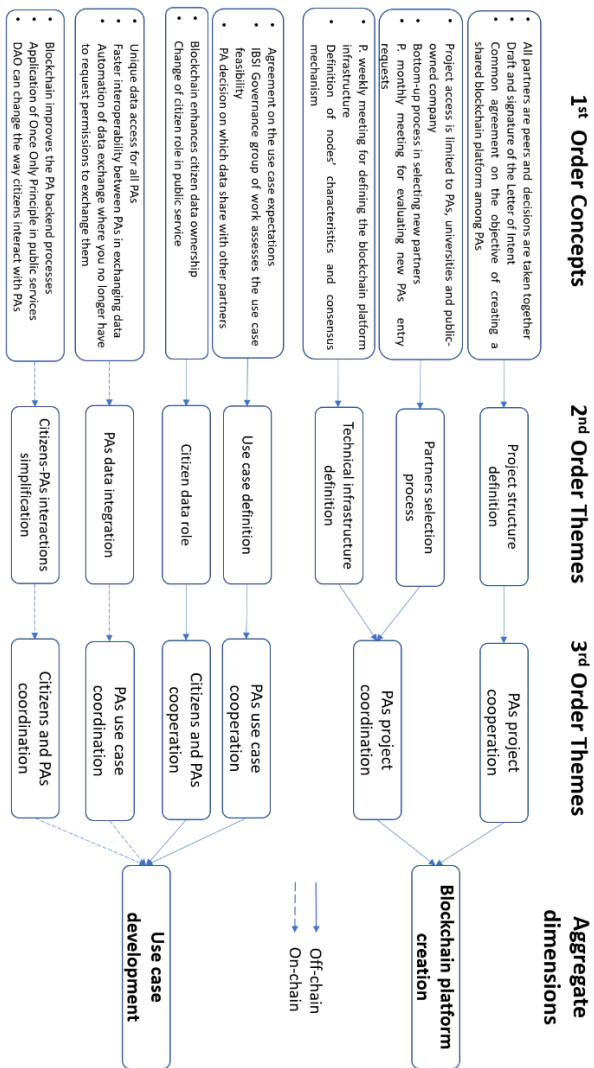


Figure 1: Data structure

## 6. Discussion

The final model describes the processes involved in creating and using a blockchain platform specifically designed for public administrations, which may prove valuable to PAs and practitioners. It considers the distinct roles played by both PA and citizen actors involved in the project, highlighting the collaborations among them. Moreover, based on the findings of Lumineau et al. (2021), the model emphasizes the various types of governance present in the project, underlining where blockchain technology effectively impacts collaborations between actors.

The following paragraphs provide an overview of the different layers of analysis and the related propositions used to arrive at the definition of the final model.

### 6.1. Blockchain platform creation

In the first phase of the project, public administrations gathered to collaborate on the definition and implementation of the optimal blockchain platform infrastructure. The objectives of the platform, first informally discussed among public administrations, are then formalized in a letter of intent. This contract norms the relationships between the partners (considering them as all peers), the decision-making activities and the characteristics a partner should have to join the project. However, the letter of intent can be considered a mere formality since it is a contract that does not include any penalties. The simplicity of this contract is justified by the fact that the public sector is a non-competitive environment where public administrations tend to collaborate and trust by their nature. This differs from Lumineau et al. (2021) research domain, as they considered a context where trust was a goal to achieve and not a feature already present between the actors involved. Then, the optimal blockchain platform’s architecture and technical standards have been designed. These led to the definition of proposition number 1:

**Proposition 1.** *Blockchain is not a necessary component in the creation of a blockchain platform since all the relationships between PAs occur off-chain.*

### 6.2. Use case development

Once the blockchain platform is up and running, PAs can discuss which use cases will be developed upon it. When an initial agreement is reached, it is formalized through a contract. Citizens do not directly participate in the definition of use case targets; however, this step influences citizens’ interactions with public administrations. Indeed, if transversal use cases such as SSI or DAO were implemented, the citizen’s role would shift from a mere user of public services to an active role where he becomes the owner and regulator of his data.

The use of blockchain among PAs in the development of the use case forces interactions between them, as all actors work on the same infrastructure using the same data. This results in a single data access point from which PAs can draw the necessary data for the use case development. In this way, interoperability

between PAs is enhanced as they can share data more easily and quickly, making data exchange automatic.

This phase underlines the impact that blockchain introduction has on the relationships between PAs and citizens, offering a social viewpoint rather than an economical one as described by Lumineau et al. (2021). This concept is summarized in proposition number 2:

**Proposition 2.** *Blockchain promotes interactions between PAs and citizens, highlighting the social perspective of blockchain adoption.*

### 6.3. Collaboration perspective

To consider the collaborative aspect of the project, the relationships between actors in the two identified project phases were analysed through the lens of cooperation and coordination (Gulati et al., 2012).

Cooperation in the blockchain platform creation phase occurs at the stage of discussion of project objectives between partners and their formalization in the letter of intent. After the definition and formalization of the project objectives, partners coordinate joint actions to achieve them. In particular, partners evaluate the requests to join the project and discuss what is the optimal blockchain architecture and how to maintain it.

Cooperation in the use case development phase is related to the definition of which actors are involved in the initiative, the public processes that need to be changed and the value for the citizen. In this phase, coordination is based on blockchain and involves both citizens and PAs. The latter experience greater interoperability in the exchange of data for developing the use case, while citizens can be more involved in government activities. This is due to the increased transparency of public processes brought by blockchain.

In conclusion, it is possible to frame cooperation as the discussion and agreement process of objectives definition, which occurs off-chain. In contrast, coordination is the process which involves multiple actors to achieve the expected outputs.

Proposition 3 explains where blockchain impacts collaboration:

**Proposition 3.** *Cooperation takes place off-chain, while blockchain enhances coordination in the use cases development.*

### 6.4. Governance perspective

An additional layer of analysis was conducted to understand the types of governance that foster collaboration in the project. Based on Lumineau et al. (2021) findings, three governance models are present in the project: contractual, relational and blockchain.

Since blockchain is not involved in the creation of a blockchain platform, only contractual and relational governance occurs. The letter of intent is the contract between partners defining the commitment to the project. However, since it is a project fostered by PAs that tend to collaborate and trust each other and because the letter does not contain any penalties in case of misbehaviour of the parts, a clear separation between these two governance models is hard to find.

The same combination of contractual and relational governance takes place in the cooperation part of use case development. The step of dialogue and formalization of use case objectives takes place off-chain and is still based on traditional governance. Blockchain governance coordinates partners in the development of the use case. The technology permits to have a common shared infrastructure where all the data are gathered in one place, increasing the alignment of activities between PAs. Blockchain governance also impacts the coordination among citizens and PAs as the use of blockchain creates novel ways citizens can experience better public services. Proposition 4 presents an overview of how governance design influences collaboration on a blockchain platform:

**Proposition 4.** *Blockchain governance does not impact cooperation processes which are based on traditional governance, but it is practical for coordinating the development of use cases.*

This proposition is partially in contrast to Lumineau et al. (2021) findings as they stated that

blockchain governance both impacts cooperation and coordination.

To conclude, the results of the study are reported in a final model, shown in Figure 2. This model presents the two distinct phases of the project highlighting the processes of cooperation (in light blue) and coordination (green) and the type of governance that enables them. Specifically, contractual and relational governance are presented with a continuous line while blockchain governance has a dashed line.

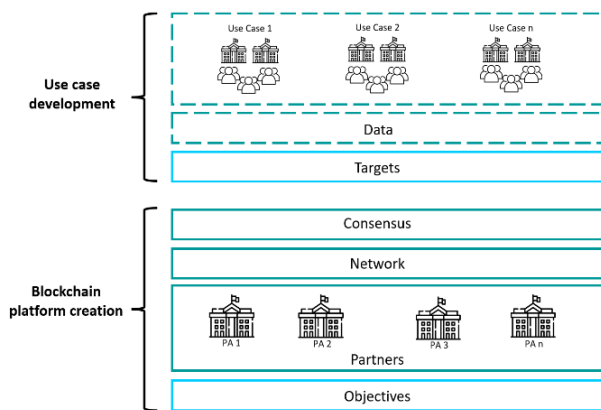


Figure 2: Final model

## 7. Conclusion

This dissertation offers a social perspective left unexplored by Lumineau et al. (2021) by providing a model that sheds light on how and where blockchain governance effectively impacts collaboration in the public domain. Practitioners can use this framework to develop similar projects and to identify the governance models that are most suited to delivering transparent and accessible services to citizens.

### 7.1. Limitations and future research

The qualitative nature and the choice of a single case study limited the generalizability of the findings. Future research could further investigate this topic on a double level: deepen the specific context analysed by the case study by considering other similar projects (e.g. EBSI), and expand the research by considering relationships with other actors (e.g. private companies).

Moreover, due to the novelty of the topic of interest, quantitative data on the observed phenomenon is lacking, thus influencing the development of statistical and mathematical models to test the findings.

Finally, future studies could use this research as a starting point, expanding and integrating the dissertation's results to identify how blockchain technology impacts relationships in the public context.

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