Designing an Integrated Data Exchange (IDE) system in context: A case study of Santiago, Chile.

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Abstract

Abstract: Cities are collecting increasingly large amounts of data. Cities can use this data to improve their understanding and response to complex urban issues. In order to leverage the value of data, cities need to build governance and management systems that integrate multiple sources, facilitating the use of the data collected. These systems, also called IDEs (Landsbergen, Girth, & Westover-Muñoz, 2022), serve as platforms to enable other smart city activities. Designing these platforms is challenging as it involves developing a socio-technical system that accounts for their particular reality. This study identifies the contextual characteristics that must be considered when designing an IDE. For this purpose, I use a case study approach, including data collected from interviews and document analysis. Preliminary results show the relevance of leadership, institutional, and cultural factors that can affect the predisposition towards or against risk and bridging the gaps in technical capabilities to effectively engage stakeholders early in the design process.

Keywords

Integrated Data Exchange IDE, smart city, data integration.

1. Introduction

Data has become an essential element for the implementation of smart city initiatives (Hashem, et al., 2016), particularly for integrating cities digitalization strategies with other pressing issues (Bribi & Krogstie, 2020). However, the growth in smart cities initiatives has followed a strategy on data that can be seen as more organic than strategic (Dameri & Rosenthal-Sabroux, 2014; Rodriguez-Bolivar, et al., 2020).

Most often, cities have engaged in specific projects with specific data intended to solve particular problems. The path dependencies generated through this project approach, however, result in cities managing and using data as 'information islands', rather than in an integrated way (Brutti et al., 2019, Gupta, et al., 2020). This organic approach limits the opportunities to create a more sustainable and resilient community by leveraging new and multiple data sources and their resulting insights (Bribi, 2019; Bribi & Krogstie, 2020).

An "Integrated Data Exchange" (IDE) is a governance system for the assembly, curation, analysis, and provisioning of social, demographic, and transportation data for multiple smart city projects (Landsbergen, Girth & Westover-Munoz, 2022). An IDE adds value beyond a data platform by making data useful and used and by enabling other ancillary functions such as citizen engagement, civic and technology-based entrepreneurship, and sense-making to be tightly connected to the data governance design (Angelidou, et al., 2018).

However, cities do not have a way to systematically design IDEs to fully engage with the complexity of urban systems. Cities around the world have started to implement data platforms (Barns, 2018) to manage the data of their smart city projects. These diverse experiences represent an opportunity to learn from these early attempts at what works. However, it is difficult for cities to use these experiences, as

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they may vary for other reasons, such as having less mature digital infrastructure, weaker institutions, or fewer resources available (Offenhuber, 2019). To learn from these experiences, cities need to understand how different designs reflect their specific needs and conditions.

This study aims to identify the contextual characteristics that can influence how an IDE is designed. These contextual characteristics may be the institutional structure, the goals and priorities of the smart city, and the baseline of the socio-technical capabilities of the ecosystem. To answer this question, I use a single case study approach, collecting and analyzing primary and secondary sources of information. This study focuses on the case of Sé Santiago, the smart city program for the city of Santiago, Chile. This approach allows for gaining a deeper understanding of the multiple factors playing out in the design of an IDE in a real-world setting.

Identifying the factors that can influence the design of an IDE facilitates the comprehension and application of other cities' experiences when designing and implementing similar systems. By understanding how these broad contextual characteristics can impact the design of the IDE, practitioners can look at the case studies in academic and non-academic literature and identify practices that may apply and/or translate to their reality. Moreover, this study is part of a larger research endeavor that includes comparing the design of IDEs in cities around the world to synthesize their configurations and expanding the IDE conceptual framework to include the typical questions and alternatives to be explored during the design process.

2. Conceptual framework

2.1. Integrated Data Exchange (IDE)

The framework developed by Landsbergen, Girth, and Westover-Munoz, identifies the main functions of an IDE, and their relationship with different governance approaches. From the authors' perspective, IDEs are more than mere data repositories or marketplaces for app developers. An IDE can be understood in the context of the often-discussed concept of the "platform," which is the base that facilitates a "whole ecosystem of participation" (O'Reilly, 2010). As a digital platform, an IDE is a "sociotechnical assemblage encompassing the technical elements (of software and hardware) and associated organizational processes and standards" (Reuver et al., 2018, p. 126).

An IDE adds value by making data useful for organizations and the community and by enabling other ancillary functions, such as citizen engagement, civic and technology-based entrepreneurship, and sensemaking, to be tightly connected to the data governance design (Angelidou et al., 2018). While ancillary, they still need to be integrated. These "functions" are an IDE's main activities and the framework's basic component. The most basic IDE includes the processes and infrastructure to exchange data among the projects in a smart city, which means receiving data collected by entities inside and outside the city government, integrating it with data coming in from other sources, and then providing some of that data back to projects. Smart city "projects" are socio-technological solutions to address problems or opportunities in the city. They are not managed within the IDE. Projects are connected to the IDE as they produce and consume data, but they are managed independently.

The functions identified functions in three domains: political, operational, and funding. These domains are discussed in terms of their relationship with the long-term sustainability of the IDE. Within these domains, they describe seven different functions. First, they identify a function of guidance and oversight for the political domain. The challenge of designing this type of platform is sometimes reduced to mere technical challenges (March, 2018). This perspective causes cities to approach the management of this integrated platform from a technocratic perspective. The role assumed by many governmental agencies involved in managing an IDE is monitoring its operations and its compliance with the technical requirements of the platform. Thus, data management projects that are being implemented by the private sector have little, if any, political oversight (Cardullo & Kitchin, 2019).

However, oversight is critical as it ensures that a vision is defined in collaboration with the relevant stakeholders, and effectively implemented (Gupta, Panagiotopoulos & Bowen, 2020). A smart city is not only a governmental initiative but also a marketplace (Anthopoulos, 2015). In a smart city, private partners use the city to develop a whole production process, from development and innovation to consumption (Clark, 2019). The power these players gain by having access to resources, networks, and data can create an advantage for current partners and prevent the entry of other competitors in the future

(Clark, 2020). However, the potential effects of private partners holding excessive power to control the market make government sponsorship, oversight, and intervention in smart city projects crucial to check the power of corporate players (Joshi, Saxena & Godbole, 2016).

Second, the operational domain captures functions referred as the more direct purpose of the IDE. These functions correspond to the activities carried out by or with the support of the IDE. The authors list civic technology, citizen participation, sense-making, day-to-day operations, and innovation among these functions. These functions include both the technical operation of the IDE, as well as other activities carried out by other initiatives within the smart city and enabled by the resources and capabilities of the IDE.

In the operational domain, the challenges are multiple. On the one hand for an IDE needs to be able to operate in a complex environment, combining data with different standards and providing a platform for the development of applications and services (Bellini et al., 2018). When designing an IDE, managers must consider platform reliability, efficiency, scalability, reuse, and security, among others (Lv et al., 2018; Chamoso et al., 2020). Design challenges may be related to IDE growth, maintenance, and interoperability (Del Esposte et al., 2019). While on the other hand an IDE generates value by effectively connecting with existing projects or identifying new opportunities to leverage data in these areas. As a platform, the IDE provides resources that help or enable the engagement of multiple actors in the context of and with data. The design of an IDE must be relevant to ensure that the initiative capabilities required to execute these functions are available. These capabilities are not only technical; they also require attending to the smart city environment's social and political constraints and opportunities.

Third, and finally, the authors identify funding as a critical function to ensure mid- and long-term financial sustainability. The existing literature on smart cities has not addressed this question in depth, with most analyses providing either a list of potential sources of funding and financing for individual projects (Galati, 2018; Kavta & Yadav, 2017) or focusing on specific smart city project areas, such as transportation (Hamilton & Zhu, 2017; Mishra, 2019). However, the literature does not discuss funding and financing strategies for transversal or enabling initiatives, such as the IDE, or the way that IDEs functions are performed can positively or negatively affect access to funding.

2.2. IDE design

This study seeks to understand what are the contextual characteristics that impact the design of an IDE. The IDE is immersed in the context of a city or region and thus influenced in its design and operations by the different characteristics of the smart city and, more broadly, the institutional, cultural, and technological context of the city. The literature on digital platforms has identified multiple elements that can be impactful for the design and operations of an IDE, such as diversity of domains (De Reuver et. al., 2018), fragmented governance (Kitchin & Moore-Cherry, 2021; Coletta et al., 2019; Paul & Paul, 2012; Manda & Backhouse, 2016), the buy-in of different stakeholders (Jakku et al. 2019; Anttiroiko et al., 2014), as well as potential privacy, security, and equity issues, among others (Komninos et al., 2019; Kitchin, 2016; Campisi et al., 2021).

2.2.1. Focus or domain of the smart city.

Multiple definitions of smart city can be found in the literature (Dameri, 2013; Gil-García, Pardo & Nam, 2015; Kummitha & Crutzen, 2017). Elements such as technology, human capital, and governance have been identified both independently and in conjunction as the distinctive characteristics of a smart city (Meijer & Rodriguez-Bolivar, 2016). Although these dimensions are not mutually exclusive (Nam & Pardo, 2011), researchers and practitioners tend to focus on one dimension more strongly than others in the study and implementation of smart cities.

The tension between technology and community-oriented smart city initiatives has always been present in the literature (Cardullo, Di Feliciantonio & Kitchin, 2019). Critiques of smart city conceptualizations that heavily focus on technological solutions argue that looking at problems from a technology frame distracts us from the roots of many urban issues (Green, 2019; Yigitcanlar, 2021).

Despite the debate, technocratic views of smart cities do not seem to be in retreat, and smart cities and the industry around them continue to produce technological solutions and products (Clark, 2020)

Based on this debate, the concept of the smart city has been used to describe two domains: initiatives focused on areas like energy, mobility, or logistics, in which technology is particularly relevant, and others focused on education, culture, or social inclusion, where technology is not necessarily central (Praharaj & Han, 2019; Neirotti et al., 2014). The focus of a smart city initiative determines its goals and priorities. For example, an initiative focused on economic development would have a greater emphasis on innovation and entrepreneurship, while one focused on community engagement would be more intensive in establishing participation mechanisms.

Additionally, the focus of the smart city also determines what type of data will be collected and managed in an IDE. De Reuver et. al. (2018) this has been identified as the horizontal scope of the smart city. For these authors, the challenge is in understanding how the intertwinement of digital platforms, with systems and institutions, in different domains can affect the outcomes.

2.2.2. Scope or level of fragmentation.

The fragmentation of multiple jurisdictions is challenging for the governance of smart cities (Kitchin & Moore-Cherry, 2021; Coletta et al., 2019). A metropolitan city or region can span multiple jurisdictions at different levels, and each one of them may see a very uneven implementation of the smart city initiative. In fragmented regions, insufficient leadership and coordination can affect deploying technologies that require a scale to work, such as the IDE. The issue with fragmented and multi-tiered jurisdictions has been identified as a key challenge for achieving integration and interoperability in developing countries (Paul & Paul, 2012; Manda & Backhouse, 2016)

An initiative with a regional scope will likely involve more diverse partners in overlapping jurisdictions than an initiative centered in one municipality. The mechanisms available to reach a consensus and coordinate the implementation of goals and values will be critical for the design of an IDE. In this case, special attention to the oversight function is necessary.

2.2.3. Operations of the smart city.

How each smart city initiative operates also translates to the operations of the corresponding IDE. In the context of urban sharing platforms, governments can play multiple roles. Local governments can regulate the activity of private organizations or NGOs, can be the provider of the services included in the sharing platform, including the services that this platform support, or can act as enablers by coordinating stakeholders and providing some capabilities to the ecosystem (Zvolska, et al., 2019). Depending on their smart city strategy and the characteristics of the ecosystem, a city could choose any of these approaches. Initiatives that operate in a centralized manner can use or build the capacities and infrastructure for a central partner to host an IDE. In the case of a decentralized scheme, the entity that can host the IDE remains an open question. Smart city initiatives may consider creating a new entity, relying on governmental organizations, or partnering with a private entity or NGO, among other options, to operate an IDE.

In the process of sharing and using public and private data through an IDE, local governments can face different issues, such as data privacy, security, and equity issues (Komninos et al., 2019; Kitchin, 2016; Campisi et al., 2021). The different approaches to the operations of the smart city and to the operations of the IDE will give the city different levels of control over the design, monitoring, and oversight of the platform, allowing it to better manage potential risks (Laufs et al., 2020)

2.2.4. Governance of the smart city.

Governance encompasses such institutional elements as rules, procedures, and values, as well as the multiple organizations involved in the formulation and pursuit of collective goals (Peters & Pierre, 2012). The relevance of governance in the design of an IDE is twofold. First, the governance of a smart

city impacts how an IDE is designed and who the actors who directly participate in this system are. Smart cities aim to coordinate and harness the capabilities of multiple stakeholders. This type of "smart governance" has been identified as an essential part of the smart city paradigm (. In this context, an IDE represents both an opportunity to "facilitate creative collaboration and contribute to the increase in and utilization of systemic intelligence" (Anttiroiko et al., 2014, p. 327) and a challenge to set adequate governance rules to ensure the stakeholders' trust and buy-in.

Second, an IDE needs to have its own rules and procedures for data governance. Jakku et al. (2019) identify the lack of trust and deficient transparency regarding data ownership and use as barriers to engage in data sharing in the smart city context. Having data-sharing agreements, governing legal principles, and data standards can enhance the trust of the actors and their willingness to collaborate.

3. Methodology

3.1. Site selection

This research will use a single case study to identify important contextual characteristics that impact the design of the IDE. Given this goal, the selected case must either be designing an IDE or have recently gone through that process. In this context, Sé Santiago (Santiago, Chile) was selected as the case to be studied in this study. Sé Santiago is a public-private initiative that started formally in 2017 and is an interesting and unique opportunity. Like many smart cities, Sé Santiago uses a public-private approach to govern an initiative focused on generating sustainable economic development. Moreover, this case represents a unique opportunity. Sé Santiago is currently designing an IDE, which is very timely; they have granted us access to study this case, and in coordinating this study, we have built a trusting relationship. All of this contributes to gaining a deep understanding of the case.

Sé Santiago aims to articulate technological solutions in mobility, public safety, and the environment. For these purposes, it has developed a ten-year roadmap divided into three main stages: positioning (2017-2019), consolidation (2020-2022), and institutionalization (2023-2025)[2]. During the first three years, Sé Santiago focused on technological entrepreneurship and innovation, implementing over 100 projects in areas like electric and autonomous vehicles, the circular economy, and water management. To manage the data flowing from and to those projects, designing an integrated platform became necessary.

Sé Santiago's "Smart data ciudad" project was conceived to solve the emergent challenges in data management for the smart city initiative. However, as of today, beyond the acknowledgment of the need and opportunity, "smart data" is still not organized in a smart way. During 2022, the Metropolitan Regional Government took the lead in designing and implementing a platform similar to the one Se Santiago was planning. The system, called "Gestion integrada regional asistida" or "GIRA", incorporates other initiatives proposed by different stakeholders, including the smart city, universities, and the private sector, into one integrated project. What initially was the "Smart data Ciudad" transformed into the "Smart data ciudadano," which intends to collect and analyze social media and other crowdsourced data from citizens to improve the responsiveness of local governments.

The project for designing and implementing the GIRA counts four main components. The "Smart Data ciudadano", described previously, the "Centro integrado de gestion regional", which is a platform for the integration, analysis, and monitoring, and the "Data Metropolitana Geoespacial", an interoperable platform to collect and display geographic data, and the design of a governance and management processes that can cover these three systems. The director of the project is a faculty in one of the biggest research universities in Santiago, and in Chile, the Pontificia Universidad Catolica[3].

The selected case does not seek to represent every smart city but to reveal elements that can be relevant to consider by other cities designing an IDE. In this sense, and for the analysis of this case to be useful for other managers facing similar challenges, the case will be described and analyzed, attending to the characteristics of this smart city initiative.

[2] www.sesantiago.cl/somos/

[3] arquitectura.uc.cl/proyectos/noticias/7339-roberto-moris-sera-director-de-proyecto-del-gore.html

3.2. Data collection

Documents: Documents that pertain to the strategic definitions and governance arrangements of both smart city initiatives will be collected. Examples of documents include roadmaps, strategic plans, and reports. These documents will be collected using publicly available sources and requesting them from the entities implementing each smart city. See Table 1 for a detail of the documents analyzed.

Interviews: Interviews are key to collecting data directly from the relevant stakeholders of Santiago's data ecosystem, including nonprofit organizations, academia, public technological institutes, businesses involved in smart city projects, and governmental institutions, among others. Using a convenience sample, we have identified the individuals who can speak to both the strategic and technical aspects of their data endeavors. The semi-structured interview protocol captures the stakeholders' interests, their relationships with other actors in the data ecosystem, and the gaps or opportunities for collaboration. See Table 1 for details.

Table 1
Table title

Interview groups	Interviews conducted	Document categories	Documents analyzed
Project	5	Project working document	15
Central government	4	Academic articles	5
Local government	3	Consulting reports	7
NGO	6	Policies, Laws, and Law Discussion	8
Academia	3	News articles and opinion	5

3.3. Data analysis

The analytical strategy for the case study will be descriptive. Details about the case and its contextual characteristics relevant to understand its nature will be described. The data collected will be coded in two rounds, with an eclectic coding approach (Saldaña, 2016) in the first round, including structural and descriptive coding. The case will be described and analyzed, attending to the elements of the smart city relevant to the design of digital platforms identified in section 2.2 “IDE design.” These are focus or domain, scope or level of fragmentation, operations of the smart city, and governance of the smart city.

4. Preliminary results and discussion

As stated in the previous section, these results are preliminary, as they only represent a part of the interviews and documents collected. The data collection and analysis are expected to conclude in May 2023.

4.1. Focus or domain of the smart city.

As discussed in the case description, this research focused initially on Sé Santiago's initiative to create an integrated platform for the smart city initiative they were leading. However, given the evolution of this platform into only a component of the GIRA, this study also shifted to look at this new platform more broadly. Originally, Se Santiago and their projects focused heavily on economic development. The projects were intended to stimulate tech entrepreneurship in areas that could contribute to the city's development, such as sustainability, and transportation efficiency, among others. The Smart data Ciudad also included a component to enable citizens' participation, but its main focus was to merge data from territories with data collected in the implementation of their projects, to improve decision-making in local governments.

Once Sé Santiago's version of the IDE was adopted into the GIRA. The focus of Sé Santiago's initiative shifted to focus mainly on the component of citizen participation. This change was driven in part by the emergence of private entities providing services to local governments to collect and analyze data provided by citizens to improve decision-making. From interviews with stakeholders outside of the project team, there was the impression that these data were then the property of the private company that collected rather than a public good available for the city to use. This, in part motivates the creation of a freely available application that can crowdsource data to capture citizens' more pressing issues and provide citizens with information to better reach the government and local governments with the information required to improve their responsiveness.

On the other hand, the GIRA has a strong public safety orientation. Although the unit leading the initiative within the regional government is under the department of industry and development, the opportunity that triggers the initiative has a focus on transportation and public safety. The monitoring of the city through a "control room" was a function hosted by the central government in the ministry of transportation and telecommunications. In 2021, the law changed the competencies of the regional government and made its main authority, the governor, an elected official. These changes contemplated a transition of some functions from the central to the regional levels, being the monitoring of the city one of them. This, together with the vision of the current governor, Claudio Orrego, were the main motivators for the GIRA, as today is being designed.

4.2. Scope or level of fragmentation

Chile is a unitary country, meaning that most of the governing power is centralized in the national government, which includes a legislature, a judicial system, and the executive. Both the executive and judicial systems include instances of administrative decentralization. This means that some functions are exclusively delegated to local governments or agencies. In the Chilean context, the decentralization process has been slow and mostly focused on transferring administrative functions from the center to the regional and municipal levels (Dazarola, 2019). This means regional and municipal levels do not have great control over fiscal and political matters.

As mentioned in the previous section, a series of changes in the Law and Constitution transformed the regional government into a more autonomous entity. Before this transformation, regional governments were only an extension of the central government; their authorities were appointed by the president, and their responsibility was to support the implementation of policies emanating from the executive. In that function, regional governments were seen basically as a „granting organization“; municipalities and other organizations would present projects to be funded by the regional funds (FNDR and FIC-R). In 2021, the changes in the law started being implemented. This allowed governors, the maximum authority of the regional government, to be elected by popular vote and mandated the central government start transferring some of its functions.

These changes presented regional governments with tremendous institutional and organizational challenges. Santiago’s Regional Government identified a need to change its identity from a “bank” or “granting organization” to a programmatic and policy-making entity. This was one of the motivations for the GIRA projects, as it would provide the regional government with valuable input and leverage to orient the action of other actors in the regional ecosystem. Only two years have transcurred since these changes took place, and changing the identity of the regional government is proving more challenging than expected. Interviewees at the municipal level still characterize their relationship with the regional government as project-based; collaborating means being granted funds to implement their projects.

Sé Santiago's operates in this context; its scope is regional, including most of the 52 local governments in the metropolitan area. Its governance works as an alliance that brings together diverse actors from the public and private sectors, academia, and community organizations to define its strategic priorities. The smart city initiative operates outside the government and is currently led by a nonprofit organization (País Digital). Most of its financial support comes from regional-level government (CORFO and Regional government). For the implementation of projects, the funding entities require partners, both public and private, to invest resources and share the implementation risk. The IDE, in this case, the GIRA, includes the projects carried out by the smart city initiative, as well as other projects supported by the regional government.

The broad scope of the smart city represents a challenge to the development of a shared vision and an implementation plan that involves all the different stakeholders. There are very significant disparities in terms of the capabilities and priorities of the actors in different sectors. For example, from the side of the public sector, there are at least three levels of government involved, municipalities, regional, and national government. Looking only at municipalities is possible to see that there are various levels of development in terms of innovation and digitalization. This disparity cannot be explained by a unique reason but instead reflects the diverse realities of this level of government. Studies at the national level identify that municipalities leading the processes of digital transformation are not necessarily the wealthier ones. Surprisingly there seems to be no clear explanation as to why some municipalities have been able to achieve a higher level of services online, easily accessible websites, and a higher level of security, among other factors, while others are lagging. Interviewees that have worked with municipalities seem to agree that the main factor is their innovation mindset as well as the entrepreneurial character of at least part of their teams. Municipalities that have made innovation an explicit priority from the top as well as public servants motivated to solve specific problems in new ways have achieved a higher level of development in this area. However anecdotal, this implies that those municipalities see innovation not as an additional activity but as an enabler for them to provide better services.

Interviewees from the central government and private sector pointed out that the strength of Se Santiago was in their connection with the private sector rather than in their leadership for all the stakeholders, including government, academia, and non-profit. In this sense, the leadership assumed by the regional government and the university involved in the GIRA, intends to supplement Se Santiago's ability to persuade and coordinate the different levels of government involved in the project.

Given the incentives of the newly elected regional government and the processes to transition certain responsibilities from the central to the regional level, at this time, the relationship with the agencies and political entities at the national government seems to be more developed. In comparison, the relationship with municipalities is merely theoretical. Most interviewees connected to the project recognize the relevance of involving local governments in the project, as they will be critical to use the capabilities of the center for decision-making. However, these actors have not been systematically involved in the early stage of the design of the GIRA. Rather, they are identified as key stakeholders and expected to be involved in the future when their platform is more fleshed out.

4.3. Operations of the smart city.

The approach taken in this case is more centralized. Institutionally, the GIRA will live in the regional government. The Regional government will collect the data from multiple sources, including self-developed apps and data provided by local governments. Since the involvement with the local governments has not been systematic, from the interviews is difficult to conclude how is the regional government planning to give access to the data to the different municipalities. In some cases, some people involved in the project seem to think that the data will not be directly accessed by the municipalities. Rather, the regional government will process it in an undetermined way and use the numbers or reports to persuade municipalities to into a certain path of action.

The centralization of the IDE is consistent with the institutional structure of the government. Although municipalities are autonomous from the national government and have some unique mandates provided in the law, in practice, this attempt at decentralization has not been entirely successful. Although municipalities can elect their own major and council and develop their own policies and programs, most of them have been dependent on the central and regional governments to access financial resources through grants (FIC and FNDR[4]). On the other hand, the regional government only in 2020 changed from being a political extension of the national government to being independently elected. Currently, as they work through transitioning some functions from the national government, they seem to be acting as a central government on a smaller scale.

The platform will be hosted by a private company. The decision of which company to work with has been made by the regional government, attending to the definitions that the project team has made

[4] www.gobiernosantiago.cl/fic/

in the last year. This decision will ultimately determine what are the technical standards that the other entities will have to follow to participate in the system. These decisions are aligned with the vision of the interviewees from the private sector. From their perspective, the government should not concentrate its efforts on thinking of the technical definition of the platform but rather find ways to bring all the stakeholders together, persuade them to participate, and achieve the biggest impact.

Given the disparities in capabilities at the local level, interviewees from the project clearly identify the need to find ways to bridge that gap. There are no concrete plans as to how to do it. An interviewee mentions that they expect to create a community among different municipalities so they can learn from each other while at the same time reducing the financial costs of developing analytical and technical skills.

4.4. Governance of the smart city.

One common theme across the different sectors interviewed was the lack of clear leadership from someone with the ability to convocate the stakeholders, define a common language and coordinate the efforts to avoid duplication and waste. There is no agreement as to which entity should or could be able to assume that role. Some interviewees pointed out that academics had the depth of knowledge to articulate the efforts; others mentioned Se Santiago, while others thought this had to come from a more central authority, either the national or the regional government.

This lack of clarity has led in some cases to fragmented efforts, while in others to hesitancy to participate in collaboration or sharing data. Some interviewees indicated that not having a unified vision or interpretation of what are the regulations, standards, and limits to the ability of actors increases the level of risk that each one of them would need to internalize if engaging in data sharing. Assuming that risk implies not only a management decision but also a political decision. The political authority will need to assume the costs if something does not work, if someone is hurt, or if entities determine their interpretation of the regulation was not correct. Interviewees seem to think that this has been a factor stopping data integration or even the most basic collaboration at every level of government. Some even refer to the "fear of Contraloria[5]" or fear of being audited.

In the last five years, there has been an effort toward creating or updating regulations specific to privacy protection in the context of big data and algorithmic decision-making and pushing for greater digitalization of public services and public administration. Some of these efforts have a long history of being proposed, discussed, abandoned, and withdrawn from congress. In the last couple of years, given the progress of technology, the needs derived from the last pandemic, and the cases of data breaches shaping public opinion, have created a window of opportunity for these regulations to be prioritized. However, laws such as the Law of Digital Transformation of the State[6] or the Sensitive or personal data protection law[7] have not yet been implemented, with the latest still under discussion in Congress.

Despite the limited progress in the implementation of these new regulations, stakeholders highlight the processes that their mere discussion has started. In terms of privacy, some big companies are already starting to design their system to comply with a higher standard of safety, looking at the international experience as a reference while the specifics of Chilean legislation are defined. In the same way, the upcoming deadline for the implementation of the law of digital transformation has given tools to the central government to push for issues of digitalization and interoperability in the agenda, as well as garner political support to provide the resources required to achieve these goals.

5. Conclusion.

In relationship with the design of IDE, four themes emerge as important context information. First, some agency or entity needs to assume the role of leadership within the network of data generators. The design of an IDE takes place in a multi-actor setting. The characteristics of the different actors, such as

[5] *"The Office of the Comptroller General of the Republic (CGR) is a supreme audit institution of the State Administration and autonomous with respect to the Executive Branch and other public bodies. It controls the legality of administrative acts and safeguards the correct use of public funds".* www.contraloria.cl/web/cgr-ingles

[6] digital.gob.cl/

[7] www.camara.cl/legislacion/ProyectosDeLey/tramitacion.aspx?prmID=11661&prmBoletin=11144-07

size, affect how much leverage they have to impact the design of the platform (Reuver et al., 2018). In the case of Santiago, interviewees also highlighted the differences in capabilities across the different levels of government and within the local governments. These institutional frameworks hinder, at the same time, the ability of local governments to independently decide and advocate for their design choices while obstructing the ability of national-level agencies to mandate local governments to adopt a certain system.

In this context, interviewees identify the lack of leadership as a barrier to designing an IDE that responds to the interests of all the relevant actors. This leadership should not only be some entity able to champion and persuade other stakeholders of the relevance of the issue of data integration and interoperability, but also it should have the knowledge to define a common language, the political capital to push for legislation or standards if necessary, and the management capabilities to coordinate disparate efforts carried out by the stakeholders.

Second, attention needs to be paid to the institutional and cultural factors that play into the predisposition of the different stakeholders towards innovation and risk. In the Chilean case, organizations are constantly audited by CGR; local governments depend financially on resources from the national and regional governments, and they continue having a highly bureaucratic administration with reduced implementation capabilities. In this context, actors can be reticent to collaborate to share data across different government levels when there is no legal mandate, specific budget allocations, and clear guidance from the controlling agencies.

Third, identifying and addressing the gaps in the socio-technical capabilities of the relevant stakeholders can be done at different stages of the design or implementation of the IDE. However, the earlier these issues are addressed, the more likely these entities are able to buy in and effectively participate in making design choices, ultimately affecting the impact of the IDE once implemented. Involving the stakeholders early on also depends on the capacity and resources of the entity leading the initiative, as well as the existence of entities that can mediate that relationship.

6. References

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