Article

JIM
ISSN: 2183-0606
(CC BY 3.0)

Vol. 11, 3 (2023)
p. 30-53
AM: Sep/2023
SM: Apr/2023

Citizen-Centric Personal Data Storage in The Public Sector: An Exploration of Opportunities, Challenges, and Preconditions

Laurens Vandercruysse[1], Ruben D'Hauwers[2], and August Bourgeus[3]

[1]imec-SMIT, Vrije Universiteit Brussel. Pleinlaan 9 – 1050 Brussels, Belgium. | *laurens.vandercruysse@vub.be*
[2]imec-SMIT, Vrije Universiteit Brussel. Pleinlaan 9 – 1050 Brussels, Belgium. | *ruben.dhauwers@vub.be*
[3]imec-SMIT, Vrije Universiteit Brussel. Pleinlaan 9 – 1050 Brussels, Belgium. | *august.bourgeus@vub.be*

Abstract

Public sector organizations are driven to re-imagine personal data management practices. Among others, responsible personal data management is primordial to foster innovations such as ethical artificial intelligence. Notably, the Flemish government aims to set up a Solid-enabled PDS-based data platform, which is to serve as the foundation of (personal) data sharing ecosystems that respect EU fundamental rights 'by design.' Of course, a critical success factor for this novel Flemish data platform is the broad adoption of citizen-centric data storage by public organizations in the region. This article constitutes an exploration of opportunities, challenges, and preconditions for the Flemish public sector through 13 expert interviews. Our findings show that citizen-centric personal data storage is expected to optimize intra-public sector data use, enable proactive public service provision, and foster trust. Challenges relate to a lack of human and financial resources, and data literacy/ inclusivity issues. For continued public sector engagement in PDS-based data ecosystems, preconditions in terms of moderation of ecosystem openness and data sharing reciprocity, as well as clustering of sub-ecosystems by use-cases, are to be considered.

Keywords: Public Sector, Management, Innovation, Personal Data, Data protection, Data Sharing, Information Technology.

Cite paper as: Vandercruysse, L., D'Hauwers, R., (2023). Citizen-Centric Personal Data Storage in The Public Sector: An Exploration of Opportunities, Challenges, and Preconditions, *Journal of Innovation Management*, 11(3), 30-53.; DOI: https://doi.org/10.24840/2183-0606_011.003_0002

1 Introduction

Recent times have marked an explosion in the production and availability of personal data. This increasing volume of data is being processed by a wide variety of societal actors. Where this data was initially frequently collected and used in an ad hoc manner, two concurrent trends now force actors to rethink data management practices.

First, there is a growing demand from the part of citizens to get more transparency concerning what happens with their data (SolidLab, 2022). Both the General Data Protection Regulation (GDPR) and a series of widely publicized data breaches can be considered important awareness-raising tools in that regard. Moreover, the data subject rights included in the GDPR also afford citizens a level of insight into, and control over, personal data processing, safeguarded by law (Regulation (EU) 2016/679, 2016). Second, (regulatory) initiatives are being set up to unlock the societal value of widely sharing data in data ecosystems, or data spaces (European Commission,

2022a). These data spaces can then function as resources for boosting digital and ecological transitions (European Commission, 2022a), in line with e.g. the United Nations Sustainable Development Goals (UN SDGs) (European Commission, 2023; United Nations. 2023a), as well as, and through, fostering (ethical) artificial intelligence (European Commission, 2020a). Of course, a firm precondition for being able to profit maximally from this revamped data economic system is having clear and performant data management, which allows data to flow in and out of the organizational realm (quasi) seamlessly.

These trends, and the resulting pressures to re-imagine how to deal with personal data, are especially acute for public sector organizations because of their specific role in society. Citizen expectations vis-à-vis the public sector often differ from those resting on private actors (Ranchordas & Goanta, 2020), as public organizations exist for the common good. Relatedly, the UN SDGs constitute a high-level development framework, including safeguarding strong fundamental right protections (United Nations. 2023a), which is to guide UN members' actions. Furthermore, when it comes to complying with the law as well as acting in a manner that is congruent with initiatives at different levels of government, public organizations are arguably attributed an example-setting role.

In this context, a particular type of technology, i.e. personal data stores (PDSs), is often mentioned as a facilitator for both offering citizens improved transparency and agency over their personal data, and unlocking the full value of personal data through optimized sharing and use (Fallatah, Barhamgi & Perera, 2023). However, empirical research into the feasibility of employing citizen-centric data storage in the public sphere is scarce.

Through a series of 13 expert interviews, this article will conduct a case study of the public sector in Flanders, Belgium. The Flemish region is a particularly well-suited object for this research, as the Flemish government has recently committed ample resources to offer all its citizens a PDS based on Solid specifications (Digital Flanders, 2022). A core driver for the provision of these PDSs is the idea that these can form the backbone of a data platform based on Solid technology, which will enable the development of public, private, and public-private (personal) data sharing ecosystems. These human-centric data ecosystems are a necessary foundation for the (further) development of ethical artificial intelligence (AI) (Gill and Germann, 2022), as also laid out in the EU strategy for AI (European Commission, 2022a; European Commission, 2020a). A critical success factor for both the service of offering PDSs to citizens as well as the Solid-enabled PDS-based data platform and derived data sharing ecosystems, is the broad support and adoption of this citizen-centric way of data storage by (public) organizations in the region. This article maps specific opportunities, challenges, and preconditions for PDS-adoption in the Flemish public sector.

Insights into public sector drivers and obstacles when it comes to the adoption of PDSs, can inform practitioners and policy makers aiming to develop sustainable citizen-centric data ecosystems. Additionally, our results can constitute a building block for more analytical research into stakeholder dynamics in emerging personal data ecosystems as well as into governance modes of decentral technologies.

The rest of the paper was conceived as follows: Section II offers the necessary background, Section III comprises the methodology, Section IV presents our results, Section V discusses wider research implications, and Section VI offers a conclusion.

2 Background

Never has more personal data been produced than in recent years. People digitally log their thoughts, while their behaviors are being monitored, and their latent preferences are inferred. In an attempt to remain (competitively) relevant, societal actors are increasingly capturing, using, and exchanging these data. As a result, personal data management, in a broad sense, has become a prime field for competition (Birch, Cochrane & Ward, 2021).

The current state of handling personal data has come under scrutiny because of several notable data breaches and data protection law infringements. Data is often stored on proprietary centralized servers (De Filippi, 2016), and treated as intellectual property. However, unlike actual intellectual property assets, personal data cannot be patented or trademarked in the EU, and is subject to the wishes of other rights' holders (Custers & Malgieri, 2022), i.e. data subjects. Since de jure protection of these data assets is not possible, data controllers revert to de facto protection by building walls and protected silos.

This siloed data ecosystem results in a locked-in central position for incumbent data controllers (Nixdorf, 2019). These data controllers regularly view personal data collection as an extractive process, not unakin to mining raw materials (Sadowski, 2019), where the resource is to be gathered, stored, and monetized for the sole benefit of the extractor. Consequently, few data are shared (for the good of society), and the benefits derived from the explosion of data volumes are distributed unevenly (Sadowski, 2019). Information asymmetries, and resulting power asymmetries, are especially pronounced when contrasting large multinational data controllers, on the one hand, and data subjects (Lynskey, 2019), as well as small and medium-sized organizations, on the other hand. Also at the societal level, the sketched barriers to the beneficial flow of personal data are an inhibiting factor. Pertinent examples include limited data available for effective monitoring of UN SDG progress as well as development of ethical AI-systems in line with responsible data principles (Gill and Germann, 2022; Principles for Digital Development, 2022; Proden et al., 2022).

2.1 Leveling the playing field

In response to the growing concerns over the power of large data-controlling internet technology companies, the European Commission has launched a series of data-related (regulatory) initiatives aimed at leveling the data playing field in the European Union.

First, the General Data Protection Regulation (GDPR), which entered into applicability in 2018, hammers on transparency and accountability when processing personal data. It basically sets out the ground rules for companies when collecting and handling personal data, and attributes accountability along the processing chain if these rules are not respected. In essence, GDPR differentiates between three key roles in the context of personal data processing: (i) the data controller, the actor determining the purposes and means, (ii) the data processor, the actor which processes data for a data controller, and (iii) the data subject, the natural person to which the data relates (Regulation (EU) 2016/679, 2016). GDPR protects the fundamental right to data protection of data subjects and as such illegitimates data practices that are instituted without due regard for the rights and freedoms of natural persons (Regulation (EU) 2016/679, 2016). The regulation also explicitly affords data subjects a list of rights that can be exercised faced to data controllers, e.g. the right to access their personal data and the right to be forgotten (Regulation (EU) 2016/679, 2016). Personal data can be processed on a variety of processing grounds, including but not limited to 'consent', 'contract' and 'public interest' (Regulation (EU) 2016/679, 2016). As a horizontal regulation, the GDPR denotes the legal framework across sectors in the whole of the EU. It is important to note that principle-based developments regarding data protection are not unique to the EU-context. On a global scale, the UN SDGs even reference

strong fundamental rights protections, among which the rights to data protection and privacy, explicitly in SDG 16 (United Nations, 2023b). Responsible innovation tenets such as avoiding harm and doing good (Buhmann & Fieseler, 2021; Owen, Bessant & Heintz, 2013) – especially emphases on fairness (see e.g. European Data Protection Supervisor, 2020) – are also influential beyond EU-borders.

Second, beyond setting the limits in terms of data collection and use, the European Commission is also putting regulations into place to facilitate the flow of data. Two regulations are particularly relevant: the Data Governance Act, which puts in place trust and infrastructure components to allow for increased availability of personal data flowing in the public sector specifically (Regulation (EU) 2022/868, 2022), and the proposed Data Act (European Commission, 2022c), which creates a set of third-party data access policies that are to break open (private sector) data silos. These two flagship regulations are complemented by upcoming regulation to ensure a level of interoperability of certain cross-border public sector IT systems, i.e. the Interoperable Europe Act (European Commission, 2022b), as well as existing regulation on optimizing the intra-government reuse of personal information, i.e. the Single Digital Gateway Regulation (Regulation (EU) 2018/1724, 2018).

Together, the set of general ground rules when dealing with personal data, and the initiatives aimed at increasing the volumes of personal data exchange, should form the backbone of a number of 'data spaces.' These data spaces can best be defined as EU single markets for data stratified by thematic areas ranging from agriculture to finance (European Commission, 2022a). The spaces are to unlock value from broad data sharing, also by and with small and medium-sized organizations, while respecting EU fundamental rights (European Commission, 2022a). In essence, these data spaces would constitute a key input to the development of ethical AI. This AI, which would be trained on 'ethically sourced' data, could then aid in transitioning the EU digitally as well as ecologically (European Commission, 2022a; European Commission, 2020a). Similar data pooling initiatives following congruent responsible data innovation principles could aid in monitoring UN SDG progress (Nilashi et al., 2023), as well as – arguably – faster attainment of these goals.

2.2 Collective action

For the success of a paradigm shift in processing personal data, one cannot just rely on top-down measures; collective action imposes itself. The long run sustainability of data spaces as well as the actual level of data subject empowerment and data power redistribution that takes place, will depend on the widespread adoption of technical solutions to put into practice the principles proposed by the presented underlying regulatory initiatives.

Translating abstract legal principles into practical technical tools is not trivial. Moreover, tools able to combine citizen empowerment, on the one hand, with facilitating data flows, on the other hand, are rare. However, personal data stores (PDSs) arguably do embrace both citizen-centricity and increased data use (Fallatah, Barhamgi & Perera, 2023). PDSs can be defined as "*storage devices and services that allow individuals to store their personal digital data for a wide range of purposes*" (Mariani, Styven & Teulon, p. 2, 2021). A PDS is thus a citizen-centric data storage solution, the idea is that the individual can decide with whom and/ or with which applications their personal data is shared. This approach contrasts with current practices in that personal data is often stored by, and with, application providers. PDSs are claimed to offer increased data flow transparency (Fallatah, Barhamgi & Perera, 2023), which in turn should foster (continued) trust in the data economy. Evidently, the utility of using a PDS increases with the number of application providers that allows personal data to be ported from and to the PDS.

Therefore, a critical success factor for a PDS-based data ecosystem is the broad adoption of PDS enabling practices by a wide variety of organizations. This organizational adoption process can be considered a collective action problem because first movers cede control over the personal data which they control without (necessarily) getting access to (a lot of) personal data in return. However, if many organizations do enable the use of PDS for their service provision, over time the extent of access to valuable personal data from the perspective of the individual organization might increase. Overcoming this conundrum is primordial to unleash the full potential of citizen-centric data storage.

In essence, there are several theories for organizational adoption of technology. First, the diffusion of innovations theory which emphasizes communication and social system aspects when viewing these processes (Rogers, 1983). Second, the resource-based view holds that (rigidness of) inter-organizational differences in available resources explain variability in technology adoption (Barney, 1991; Zheng et al., 2013). Third, the fit-viability model developed by Tjan (2001) look as at adoption strategies as ideally fitting better with the organization as-is and providing the largest benefit and/or lowest cost. Last, the technology-organization-environment framework which views adoption of technology by an organization as depending on factors (i) inherently linked to the technology, (ii) the organization at hand, and (iii) the external environment (Tornatzky & Fleischer, 1990). Applications of these theories in recent extant literature cover contexts ranging from blockchain in banking (Kulkarni & Patil, 2020) to radiofrequency ablation based on ultrasound when treating thyroid nodules (Kuo, McManus & Lee, 2022).

To apply any of the theoretical frameworks, one needs a broad scope understanding of a variety of challenges and opportunities technology adoption would bring to the organizational situation. However, for citizen-centric data storage solutions, such as PDSs, even an exploration of adoption motivations and drawbacks is missing. This is remarkable since PDSs are a prominent form of privacy-enhancing technology that have been around for quite a while. Moreover, changing societal perceptions and expectations of the data economy as well as concurrent emerging (regulatory) initiatives, make such research especially timely. A possible explanation lays in PDSs typically being viewed as bottom-up instruments at the fringes of current data practices (Bodó et al., 2021), and research tended to take the perspective of the end-user (e.g. Mariani, Styven & Teulon (2021)).

2.3 The Flemish Top-Down Solid-enabled PDS push

Since collective action is required to make an impact on the division of power in the data sphere (Lehtiniemi & Ruckenstein, 2019), government is arguably uniquely well-placed to initiate as well as enforce changing policies and practices. In line with this train of thought, as mentioned, the Flemish Government is committed to the development of a data platform based on Solid-enabled PDSs. This data platform would form the foundation for the development of public, private, and public-private data sharing ecosystems, and would offer citizens transparency and control over the processing of their personal data by design (Digital Flanders, 2022).

The central role of Solid in this government-driven data ecosystem push calls for a characterization of Solid. In essence, Solid is a technical specification, an evolving standard, that can be leveraged to set up PDSs (Solid, 2023). These PDSs include features for identity management, access control, and communication (Pandit, 2022). The central idea of Solid is to decouple data and applications, with an eye on removing data from central servers and bringing it under the control of the data subject. To make interactions between the decentralized PDSs, i.e. the data storage, and applications run smoothly, Solid applications utilize standard, open and interoperable data formats and protocols (Solid Project, 2023).

Research on the Flemish PDS case is emerging. Buyle et al. (2020) illustrate the potential utility of using Solid-enabled PDSs for a selection of specific use-cases in Flanders. Van Damme et al. (2022) derive a bottom-up research agenda for this specific context along social, network, legal, and technical axes, while Verstraete, Verbrugge and Colle (2022) derive business roles in Solid-enabled ecosystems validated on a Flemish use-case.

This article performs a case study focused on public sector organizations of the sketched top-down push to enter a PDS-based data ecosystem. We focus on the public sector, because citizen-centricity is widely perceived as core to public value (Hujran, Abu-Shanab & Aljaafreh, 2020), and, at the same time, public sector (data) management is comparatively resource-constraint, and IT-maturity is often limited (Bergström et al., 2021; Campmas, Iacob & Simonelli, 2022). This combination should shed an interesting light on (the balancing of) drivers as well as obstacles for citizen-centric data storage. The Flemish case is unique in the scale of the roll-out of the PDS technology. Moreover, it is rare that innovative technologies are being steered so explicitly by the public sector. Exploration of this case can provide much-needed insights into the potential and limitations of the public sector acting as a central agent in decentral data ecosystems. Our aim is to map specific adoption drivers, obstacles, and preconditions for PDSs in the public sector.

3 Methodology

Considering the explorative nature of the research, we made use of the frame of grounded theory. The application of the theory through a series of semi-structured interviews allowed for uncovering drivers and obstacles related to the adoption of Solid-enabled PDSs in the public sector in Flanders in an inductive manner. Grounded theory is especially suitable to answer research questions on innovative or novel phenomena in particular, new contexts (Glaser & Strauss, 1967). Semi-structured interviews allow for inter-interview comparison as well as the construction of generalizable insight, while leaving sufficient room to gauge, and delve deeper into, case-specific observations (Bogner, Littig & Menz, 2009).

To safeguard the validity of the research, we set out to collect data from all layers of

the public sector in Flanders. In total, the 50 largest local governments, the 71 Flemish government entities, and the 14 federal government organizations were approached. Just under 10% of the contacted organizations were prepared to sit for an interview. The main stated reasons for not participating in the research were lack of organizational ICT maturity, and limited use of personal data for core tasks.

In the end, a series of 13 semi-structured expert interviews were conducted with representatives of various government entities. Figure 1 shows the distribution of the interviews across different levels of government.

The semi-structured interviews adhered to the methodological guidance of Bogner, Littig, and Menz (2009). Interview questions probed (i) control and transparency in data processing, (ii) data sharing in a public context, (iii) implementation of Solid-enabled PDSs, and (iv) governance of the Solid-enabled PDS-based ecosystem. Analysis of the interviews followed the pattern of grounded theory (Wiesche et al., 2017): Initial open coding, was followed by the development of axial codes, and finally selective coding occurred to arrive at an overarching framework. Each interview took about 1 hour. Interviews were not recorded, but researcher notes were submitted to the interviewee(s) for correction/completion. Quotes in the results section reflect these notes, and thus do not necessarily constitute a perfect verbatim record.

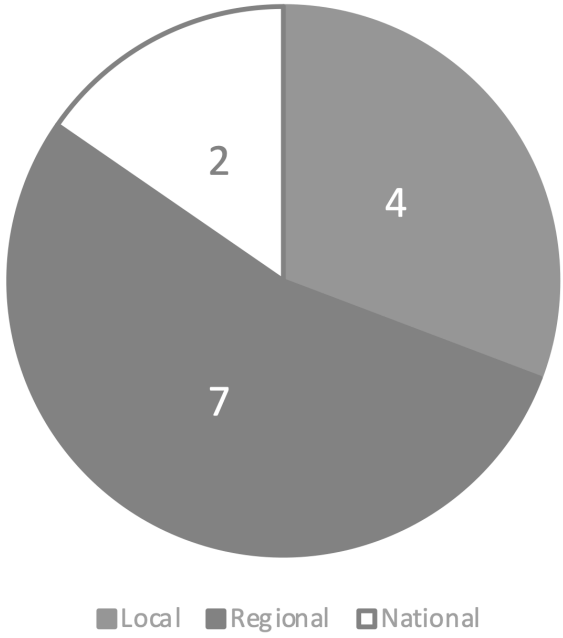


Figure 1. Interview distribution

4 Results

The analysis of the 13 expert interviews led to the construction of a framework based on three core elements, namely (i) intra-organizational drivers for Solid-enabled PDS adoption, (ii) intra-organizational barriers for Solid-enabled PDS adoption, and (iii) Solid-enabled PDS-based ecosystem preconditions. The two former elements concern the inner workings of the public organizations, while the latter focuses on the ecosystem requirements from the point of view of the Flemish public sector. Our results will be presented following this framework structure.

We begin this section with an overview of the drivers for the adoption of citizen-centric data solutions, then proceed to address the barriers, and finally discuss the PDS-based data ecosystem preconditions.

4.1 Drivers for public organizations

Based on the interviews, three drivers for public organizations to adopt Solid-enabled PDSs can be distinguished. First, moving from personal data management in central databases to management of personal data through personal pods can ensure that data that is already known within government is better and more consistently utilized. Second, the creation of a single central place where all necessary information about an individual data subject can always be retrieved, and any useful additional data can be easily accessed, can make public service provision faster and, if desired, more proactive. Third, interviewees indicate that giving citizens more transparency and control over what data is shared for what purpose, when, and with whom, would likely increase citizens' trust in government (data) practices. These three drivers are tackled in depth in what follows.

Better use of currently available government data

The government already holds a considerable volume of data relating to its citizens. Recently there have been several European regulatory initiatives, e.g. the Open Data Directive (Directive

(EU) 2019/1024, 2019) and the Data Governance Act (Regulation (EU) 2022/868, 2022), that aim to unlock value by increasing the speed and extent of sharing of that personal data with a variety of societal actors.

Nonetheless, it is important to not only focus on the international and/or public-private exchange of personal data, but to also realize that there is considerable room for improvement concerning the exchange of data within government. The 'only once' principle, that states that a citizen should present a piece of data to the government only once, and that the government should then retrieve that piece of data internally rather than asking the citizen for the same data a second time (European Commission, 2020b), is still a preoccupation of the European Commission (European Commission, 2020b), and was recently also given a basis in European law with the Single Digital Gateway Regulation (Regulation (EU) 2018/1724, 2018).

However, in practice, the implementation of the 'only once' principle is still far beyond the grasp of many public organizations (interview 7, 8/12/2022, personal communication). A common difficulty in applying 'only once' was pointed out by a local government representative: "*We have a lot of data from citizens in different places, but it is difficult to do the management of that data. For example, there will likely be Excel files with personal data in places where we would rather not have them stored*" (interview 3, 2/12/2022, personal communication). It was also succinctly stated as: "*Today, we sometimes discover that we have certain data in our possession by chance*" (interview 9, 19/12/2022, personal communication).

Citizen-centric data storage through Solid-enabled PDSs is perceived by several interviewees as a tool to make personal data management in the government context more effective. In particular, the centralization of the data under a specific data subject can be seen as a determining factor in this sense: "*For educational staff members, we dispose of some data to be able to pay out the salary. It might be interesting to 'stick' certain data to individual teachers by putting it in their PDS, so that these teachers can then decide when they change schools whether a new school receives those data immediately, for example*" (interview 10, 20/12/2022, personal communication). The 'sticking' of data to individuals, in some contexts - here mainly local governments - can also simplify intra-government data sharing: "*The way cities and municipalities are structured - e.g., in autonomous corporations and NPOs - makes it challenging to exchange data. We always have to start by figuring out if certain organization may or may not have that particular data. If the decision whether to share data could be done via the PDSs, that would be useful*" (interview 4, 9/12/2022, personal communication).

Decoupling personal data and applications would also allow for the analysis and reuse of data that is now considered proprietary by the (private) application manager or (software) service provider. Three of the interviewees explicitly mentioned the relevance of data management being conducted by an external private party as an obstacle to optimal data use in the government context (interview 3, 2/12/2022, personal communication; interview 4, 9/12/2022, personal communication; interview 10, 20/12/2022, personal communication). An insightful example was put forward by an expert from a local administration, "*We also have a City app. If someone makes an appointment at the city (hall) or files a report or complaint on a particular topic, we would very much like to know who we are exchanging with. Now those contact data actually remain with the creator of the app, and it might be better for us if the identity management were to go through the PDS as well because then we can get access to that data as well*" (interview 3, 2/12/2022, personal communication).

Faster, more proactive public services

In addition to making better use of data that is already available, citizen-centric data storage also offers prospects for obtaining more data on citizens more quickly. Government agencies currently strictly observe the data minimization principle, more so since many personal data processing operations are done under the legal basis of public interest. The adoption of Solid-enabled PDSs could serve as a tool to unlock just a little more data, enabling a more proactive form of service delivery. Data processed in the public interest could then be supplemented with personal data that could be useful to speed up or personalize public services.

The centralization of data storage under the control of citizens creates a single source in terms of retrieving personal data. Having a single connection point offers advantages for actors in the public sector: "*Another driver is having a connection point for different types of data, where today we always have to spend time searching*" (interview 9, 19/12/2022, personal communication). Moreover, it would also allow public organizations to always work with the most recent data, and it would minimize the duration between the change of a data point and its adaptation in all possible applications to which that data serves as an input. During an interview, it was concisely stated as, "*The data that the citizen already has, that he or she can get that data to us faster*" (interview 8, 5/12/2022, personal communication).

There are also references in quite a few interviews to the lack of authentic sources for certain types of data. It is mentioned that Solid-enabled PDSs show potential in providing certain additional, verified data quickly, speeding up service delivery. A first example can be situated in the realm of fast-changing data: "*We have the problem that email addresses can come from many different sources, but all of those sources are not authentic sources. In essence, that creates an overload of data, data that is no longer information*" (Interview 9, 19/12/2022, personal communication). Another interviewee highlighted data that is only partly digitized or currently not digitized at all: "*I can imagine that Solid-enabled PDSs would be a solution for some of the issues we run into, for example, to know of the existence of and get access to documents such as court judgments*" (Interview 13, 25/01/2023, personal communication). Evidently, if a citizen could provide these types of personal data immediately via a PDS rather than through emailing back-and-forth with various government administrations, this could improve the speed and responsiveness of public service delivery.

One of the most prominent use cases for PDSs in the public sector is automatic assignment of rights. The combination of having a single connection point for personal data and having the certainty that certain data are correct, allows public organizations - if these are granted access to the necessary data - to proactively adapt services to the wishes and/or needs of the citizen (interview 3, 2/12/2022, personal communication; interview 4, 9/12/2022, personal communication). An example can be found in the sphere of granting (financial) aid: "*Solid-enabled PDSs can also be interesting for the city's core business, for example, to grant premiums and subsidies*" (interview 3, 2/12/2022, personal communication). However, the aid that is granted does not have to be financial, automatic assignment of rights could also avoid certain unpleasant situations, such as "*not needing a deaf person to constantly identify themselves as such, it should be possible for us to see that those people have special needs and then just adjust the services*" (interview 7, 8/12/2022, personal communication).

Trust

Beyond the purely functional drivers, there is also a more fundamental reason why public actors are exploring the adoption of Solid-enabled PDSs: to regain, maintain, and strengthen, trust in public sector data management.

Recent data breaches at various (local) governments placed data security at the forefront for citizens (interview 6, 13/12/2022, personal communication). Several interviewees see the change in personal data management championed by Solid-enabled PDSs as a way to build trust with citizens on two fronts: (i) by providing transparency, and (ii) by giving back control.

First, the use of Solid-enabled PDSs ensures that citizens know who is accessing what data about them, when, and why. This is a form of transparency that until today few public organizations offer, but many seek (interview 6, 13/12/2022, personal communication). Even if data are not processed under the legal basis of 'consent,' transparency provided by PDSs would still add value: "*Also, the open availability that Solid-enabled PDSs offer, provides very useful transparency. Taking into account that, with a view to automatically assign rights, certain things will have to be processed either way, insight can still be given into what has happened*" (interview 9, 19/12/2022, personal communication).

Second, Solid-enabled PDSs ensure that, for certain data, citizens can decide for themselves whether and to what extent to respond to data access requests. This form of agency over one's own data (interview 3, 2/12/2022, personal communication), can also boost the level of trust in government data processing. It should be noted that some of the actions citizens can take regarding (accessing) their data are safeguarded by the General Data Protection Regulation (GDPR), and that, in that sense, Solid-enabled PDSs can support the implementation of those legal requirements (interview 5, 12/12/2022, personal communication). It was also cited by one interviewee that managing one's own Solid-enabled PDS is somewhat similar to managing - and thus also sharing or not sharing - a kind of digital identity oneself, and that too was linked to strengthening trust (interview 11, 21/12/2022, personal communication).

Table 1 summarizes the key elements from this section on drivers for Solid-enabled PDS adoption in the public sector.

Table 1. Schematic overview of drivers for Solid-enabled PDS adoption in public sector.

Drivers for public organizations	
Better use of currently available government data	Implementation of 'only once' principle
	Facilitation of multilateral data sharing
	Access to data held by app administrators/ (software) service providers
Faster, more proactive public services	Accelerating data sourcing through unique linkage point personal data
	Supplement authentic sources
	Facilitation of automatic assignment of rights
Trust	Offer transparency
	Offer control

4.2 Challenges for public organizations

Solid-enabled PDS adoption is not without its challenges for the surveyed public sector actors. Three major obstacles crystallize from the interviews. First, public organizations operate in a context of limited financial and human resources. There are doubts whether adoption of Solid-enabled PDSs can lead to sufficient additional revenue and/ or cost reduction to make up for the initial investment cost. Second, Solid-enabled PDSs inherently come with a significant impact on data management within the organization. The flip side of greater control for citizens over what data can be shared with whom and when, is that the organization must cede part of that control.

Interviewees mainly question the ease of obtaining data they need to perform their (lawful) duties, and the need for/ feasibility of a sufficient level of congruence between approaches at different levels of government to roll out Solid-enabled PDSs in a meaningful way. Finally, if there were to be broad adoption of Solid-enabled PDSs in the public sector, the technology must be available to and usable by people with very different data literacies. inclusivity is a preoccupation of many public sector actors, and the interviews reveal a certain skepticism toward making Solid-enabled PDSs inclusive.

Other priorities

In the public sector, certain constraints exist in terms of available financial and human resources. It should also be noted that in this context a change of IT system often has to be paid for with generally allocated resources that must also finance the provision of core public services (interview 6, 13/12/2022, personal communication; interview 9, 19/12/2022, personal communication). As a result, the adoption of Solid-enabled PDSs would constitute a cost for which resources would have to be shifted, and thus adoption is subject to a balancing of priorities which has to be made internally ex ante.

PDS adoption costs are divided by interviewees into start-up resources on the one hand: "*An obstacle is the IT budget. And even if there were budget, we lack the necessary IT people*" (interview 10, 20/12/2022, personal communication), and, on the other hand, the price of using the data that will be stored in the Solid-enabled PDS once the ecosystem is up-and-running: "*What will it cost [to access the data]? If the cost and added value are balanced, then we will use it*" (interview 7, 8/12/2022, personal communication). Specific to the step enabling PDS use, there is also the initial technical challenge in terms of migration or integration with existing systems (interview 7, 8/12/2022, personal communication), and the reliance on current software providers in that setting (interview 11, 21/12/2022, personal communication).

Revenue potential also plays a role in determining (investment) priorities. The interviews show that many public organizations see only limited opportunities for the broad sharing (possibly in return for payment) of personal data: "*It's highly regulated what we can or cannot share*" (interview 6, 13/12/2022, personal communication). Solid-enabled PDSs were referred to as a possible facilitator for making data available to the private sector. In this context, it concerned data that currently cannot simply be passed on by the government to a private player. The Solid-enabled PDS would then act as an intermediary leaving the data subject in control of the decisions whether to make data available (interview 4, 9/12/2022, personal communication).

Impact on data

As mentioned, shifting control over data sharing from the organization collecting data and/or using it for applications to the citizen, comes with certain implications for internal organizational data management. Solid-enabled PDSs place the citizen at the center of the data sphere. Interviewees see this as a pro, but at the same time also as a source of dependence both vis-à-vis the citizen and vis-à-vis other public organizations.

Solid-enabled PDSs are felt to be strongly linked to the legal basis of 'consent' for processing personal data. The fact that one of the core goals of these PDSs is to give control over their data back to citizens (Solid project, 2023), probably plays a role herein. However, several interviewees referred to the need to be able to process data from the PDSs under other legal bases as well: "*A lot of data collection in running the city administration is regulated by law: for example, we need your name etc. to be able to issue citizens a driver's license*" (interview 4, 9/12/2022, personal communication). An important reason for being able to process personal data without explicit

consent, is to avoid (excessive) dependence (interview 9, 19/12/2022, personal communication). Limiting the dependency on data access being granted by the citizen, can be a tool to deter fraud (Interview 9, 19/12/2022, personal communication), but it can certainly also benefit citizens in some cases: "*If you expect people to actively share data, then you risk not being able to reach and help those people who are most in need*" (Interview 13, 25/01/2023, personal communication).

Evidently, a lot of data is also shared within government. In order to safeguard the efficiency and effectiveness of the government apparatus as a whole, it is therefore necessary, according to the interviewees, that the adoption of Solid-enabled PDSs fits into a broader strategy: "*Ideally, these PDSs would be linked or integrated with the MijnBurgerprofiel*[1]*, but how these can also be matched with the eBox is still a mystery to me. It's disheartening for local governments to see that at the regional and national level people are developing the same kind of technology or solutions, but these levels are not working on this together*" (interview 11, 21/12/2022, personal communication). Unlocking personal data that is collected and/or held at one level of government but managed/ controlled by public organizations at another level, also underlines the need for a shared vision (interview 3, 2/12/2022, personal communication). Furthermore, in that respect, involving/ guiding external (partner) organizations, possibly by issuing additional legislation, is something that also needs to be considered: "*It is up to the Flemish Government to impose rules and provide guidance so that the [technology] suppliers can align with that*" (interview 4, 9/12/2022, personal communication).

Inclusiveness as an issue

Safeguarding inclusivity in a possible transition to a Solid-enabled PDS-based data system was a major theme across the interviews with public organizations. Two different elements were emphasized: (i) paying attention to variations in digital literacy, and (ii) providing alternative ways to participate in (digital) public life. With regard to safeguarding inclusiveness, interviewees said there is still work to be done.

First, it cannot be assumed that everyone will (immediately) be able to take up active management of his or her personal data via Solid-enabled PDSs. There are very large differences in digital literacy in Flanders (King Baudouin Foundation, 2022): "*In terms of challenges, I see those mainly at the technical level and at the level of the user interface. If we would assume that everyone can just get on board, regardless of age and knowledge, regardless of whether they are digital specialists or digital literates, then I think we are going to exclude a whole section of the population*" (interview 12, 13/01/2023, personal communication). One interviewee even gave a concrete example: "*You have to understand that we see people who come at our reception desk, hand over their bank card to the receptionist, and say that they would like to make a payment. Something like a Solid-enabled PDS will certainly not strike these people as being 'easier'*" (interview 5, 12/12/2022, personal communication). The danger of pushing ahead with an initiative like a Solid-enabled PDS-based data ecosystem without taking into account less digitally literate groups, could lead to further increasing inequalities in society (interview 8, 5/12/2022, personal communication). This is something many interviewees are wary of (e.g., Interview 12, 13/01/2023, personal communication; Interview 13, 25/01/2023, personal communication). Relatedly, it was mentioned that Solid-enabled PDSs should offer certain features, even if these features might run somewhat contrary to the idea of citizens as the sole guardian of their own personal data, which are also available in analog situations. In particular, this concerned the ability to appoint proxies to share data (interview 11, 21/12/2022, personal communication).

1. MijnBurgerprofiel is an online portal of the Flemish Government to store official government documents and communications (Flanders, n.d.).

Second, citizens should be offered alternatives to using Solid-enabled PDSs when interacting with the public sector. Using a Solid-enabled PDS should not become a conditio sine qua non for obtaining public services: "*But the use of the PDS should not be an exclusionary condition: If people don't have a Solid-enabled PDS, they should still be able to become members of the organization. It will have to be a set-up where the citizen can choose, and different options will have to be provided*" (interview 5, 12/12/2022, personal communication). Reference was also made to public organizations where safeguarding, or even re-introducing, those different options – either digital or analog – is already broadly embedded: "*Rotterdam has quite advanced services, and there they have chosen to do a lot of multichannel service provision, so to allow people to interact in the traditional way or do it all digitally*" (interview 10, 20/12/2022, personal communication).

The main takeaways from this section on challenges for Solid-enabled PDS adoption by public organizations are shown in Table 2.

4.3 Ecosystem Conditions

In addition to a set of opportunities and challenges for public organizations to engage in Solid-enabled PDS adoption, the analysis of the interviews also allowed to distill certain Solid-enabled PDS-based data ecosystem conditions from the public sector perspective. It is important to note that while the drivers and obstacles sit at the organizational level, these ecosystem conditions refer to the design, internal relations, and composition of the set of actors participating in Solid-enabled PDS-based data space. A first ecosystem condition revolves around meeting certain minimum requirements at the data level and at the Solid-enabled PDS level, to be able to set up a valuable data ecosystem at all. A second ecosystem condition concerns the need for some form of governance to install itself within the ecosystem. While openness and interoperability are two core characteristics of Solid, the interviewees still consider it necessary for (an) actor(s) to take on steering and coordinating tasks. A third ecosystem condition is the formation of clusters within the broader data ecosystem. The reason for this is twofold: thematic use cases immediately render the benefits of the ecosystem more tangible for the various partners, and this clustering allows the public sector to maintain its distinctiveness, i.e. having the societal interest as the core guiding principle.

Need for hygiene

A first ecosystem condition regards certain hygiene factors that public sector actors believe must be met as an absolute minimum for Solid-enabled PDS adoption to be a possibility. Unlike the organizational-level obstacles as explained in the previous section, these are requirements at the level of the (data on the) Solid-enabled PDSs themselves. In what follows, we divide the discussion

Table 2. Schematic overview of obstacles for Solid-enabled adoption in the public sector.

Challenges for public organizations	
Other priorities	Limited financial/ human resources
	Limited perceived revenue potential
Impact on data management	Need for data even without consent
	Need for broad government strategy
Inclusiveness as an issue	Limited digital literacy
	Need for alternatives

into, on the one hand, minimum requirements for the Pods, and, on the other hand, minimum requirements in terms of data.

At the Solid-enabled PDS level, interviewees insisted mainly on the necessity to safeguard a high level of information security (interview 2, 2/12/2022, personal communication; interview 13, 25/01/2023, personal communication). Relatedly, the requirement to be able to assure the authenticity of data was mentioned: "*It must be guaranteed that certain data cannot be changed*" (interview 10, 20/12/2022, personal communication). Furthermore, the interviewees also mentioned the degree of availability of the Solid-enabled PDSs as an important element (interview 2, 2/12/2022, personal communication), or even: "*I can already see the headline: 'Personal data are down in Flanders due to the failure of the Solid-enabled [PDS-based] ecosystem'*" (interview 12, 13/01/2023, personal communication). A final Solid-enabled PDS requirement revolves around allowing certain information to be archived on the PDSs, since the government is subject to legal obligations in that sense (interview 12, 13/01/2023, personal communication): "*A full archiving function is a requirement in any case. It is also important that the documents on the PDS remains available over the long term, because many documents have to be kept for a long time*" (interview 11, 21/12/2022, personal communication).

There are also certain hygiene factors at the data level. First, the Solid-enabled PDSs must contain a wide range of data. The key value creator is "*having a lot of different types of information available in one place*" (interview 9, 19/12/2022, personal communication). Second, data must be kept up to date to ensure added value over the status quo (interview 1, 30/11/2022, personal communication). On the flipside, there must also be appropriate timeliness of data availability for citizens: "*Timeliness is also a factor. When I get my college degree, it should be available immediately. Or at least it should be mentioned to me somewhere when I can expect it to be available*" (interview 10, 20/12/2022, personal communication). Third, the authenticity or truthfulness of certain data should be easily demonstrated/verified (interview 8, 5/12/2022, personal communication; interview 10, 20/12/2022, personal communication). Rights for citizens to change data points can therefore only be applied to certain data: "*for example an e-mail address and fax number, citizens should have the ability to modify these data themselves*" (interview 6, 13/12/2022, personal communication).

Need for governance

Solid is essentially an additional layer on the World Wide Web, and Solid-enabled PDSs are designed to be able to interact with any application that meets the Solid specifications. That interoperability is one of the major strengths of Solid-enabled PDSs compared to other PDS systems. However, the interviews reveal that safeguarding the full openness of the Solid-enabled PDS-based ecosystem is difficult in practice. Specifically, the interviewees see a role for a (group of) actor(s) to take on two governance tasks: (i) a form of screening of new entrants to the ecosystem, and (ii) monitoring reciprocity in terms of data sharing in the ecosystem.

With respect to governance, screening potential ecosystem participants was the main task to be attributed according to the public sector actors interviewed. Although a minority of interviewees indicated that they did not want to impose any entry restrictions: "*It seems strange to shut out certain actors, it seems to me that everyone should be able to get into the ecosystem*" (interview 8, 5/12/2022, personal communication); the majority of interviews referred to some form of screening prior to letting actors join the ecosystem (interview 4, 9/12/2022, personal communication; interview 12, 13/01/2023, personal communication). Visions about the desired breadth of such a screening vary: suggestions range from a narrow scope on information security levels (interview 6, 13/12/2022, personal communication), to a screening of the purposes for

which, and the ways in which, data from the ecosystem would be used (interview 1, 30/11/2022, personal communication; interview 11, 21/12/2022, personal communication). There is obviously a tension between setting up barriers to entry and quickly reaching a critical scale at which joining the Solid-enabled PDS-based ecosystem would be worthwhile: "*If there were enough recent data on incomes available on the Solid-enabled PDS, then that [Solid-enabled PDS-based ecosystem] would certainly be useful. If only a single social secretariat would put [the income data on the Solid-enabled PDSs], then sourcing income data from the PDSs would just constitute an extra data retrieval but not a solution. In such a case, we could not conclude that if we did not find anything in terms of income data in the PDS, that there is no income; then we would not know anything*" (interview 9, 19/12/2022, personal communication). That is a trade-off that has to be made in terms of governance as well.

A second task would be to hold ecosystem participants to a certain degree of reciprocity when it comes to sharing data. This means that for ecosystem participants it should not just be about obtaining additional data for their own purposes, but also about making data more widely available: "*Reciprocity, so that a partner in an ecosystem should also be willing to share their own data*" (interview 8, 5/12/2022, personal communication). It was also pointed out that not every ecosystem participant has the same volume of data available, but even in such a case enforcing a degree of reciprocity remains important (interview 9, 19/12/2022, personal communication)

When it comes to who should carry out the above governance activities, the interviews reveal two salient avenues. A first avenue mentions independent governance: "*Perhaps an independent body should do this. It could be set up like a Data Protection Officer now: someone who doesn't belong to the organization but is still paid by the organization*" (interview 3, 2/12/2022, personal communication); a second avenue sees a collaboration between various ecosystem actors and the government as optimal (interview 5, 12/12/2022, personal communication).

Need for clusters

Growing an ecosystem starting from clusters allows first to set up use cases completely in line with organizational priorities and idiosyncrasies, only to move to a broader ecosystem at a later stage by hooking into other clusters. In essence, it is a way to reduce initial complexity for ecosystem participants.

Solid technology, and the PDSs, can feel abstract, and it is important to avoid that public organizations are adopting Solid-enabled PDSs without keeping an eye on value creation (interview 8, 5/12/2022, personal communication). From the interviews, the need for good use cases to demonstrate the value of Solid emerged strongly: "*[Everything] should start from the use case: a use case that has value and is useful to the customer*" (interview 3, 2/12/2022, personal communication). The optimal constitution of certain ecosystem elements also depends on the specific use case at hand: "*If we are talking about an HRM application, it seems more logical to me that [hosting of the Solid-enabled PDSs] is centralized, but that depends very much on the use case*" (interview 12, 13/01/2023, personal communication).

An additional reason why there is a demand from public organizations for a type of cluster separation within the ecosystem is the so-called distinctiveness of the public sector. The core task of government was summarized as: "*Focusing on the societal interest*" (interview 2, 2/12/2022, personal communication). To strengthen the case for this point, the public sector is then often contrasted with the private sector: "*I would be careful with [allowing] commercial organizations [to join the ecosystem]*" (interview 12, 13/01/2023, personal communication). A concrete perceived danger was expressed as follows: "*I think you have to think carefully about what data is put where [in the Solid-enabled PDSs]. If you share with us your loyalty card from a grocery store,*

[...] we don't mind, but for some types of data you're going to have to put 'a wall' between data types so that one won't 'cross-pollinate' the other" (interview 11, 21/12/2022, personal communication). Reluctance to share data with private parties is also sometimes based on ethical arguments: "*As a government, it becomes problematic the moment that commercial use of data collected with public money and efforts, causes a firm to make a profit*" (interview 4, 9/12/2022, personal communication).

The insights from this section are shown schematically in Table 3.

Table 3. Schematic overview of Solid-enabled PDS-based ecosystem requirements from public sector perspective.

Ecosystem requirements	
Need for hygiene	Meet minimum requirements Solid-enabled PDSs
	Meet minimum requirements data
Need for governance	Manage level of openness
	Manage reciprocity of data sharing
Need for clusters	Importance of use cases
	Safeguarding distinctiveness public sector

5 Discussion

The resulting insights from the 13 semi-structured expert interviews are summarized schematically in Figure 2.

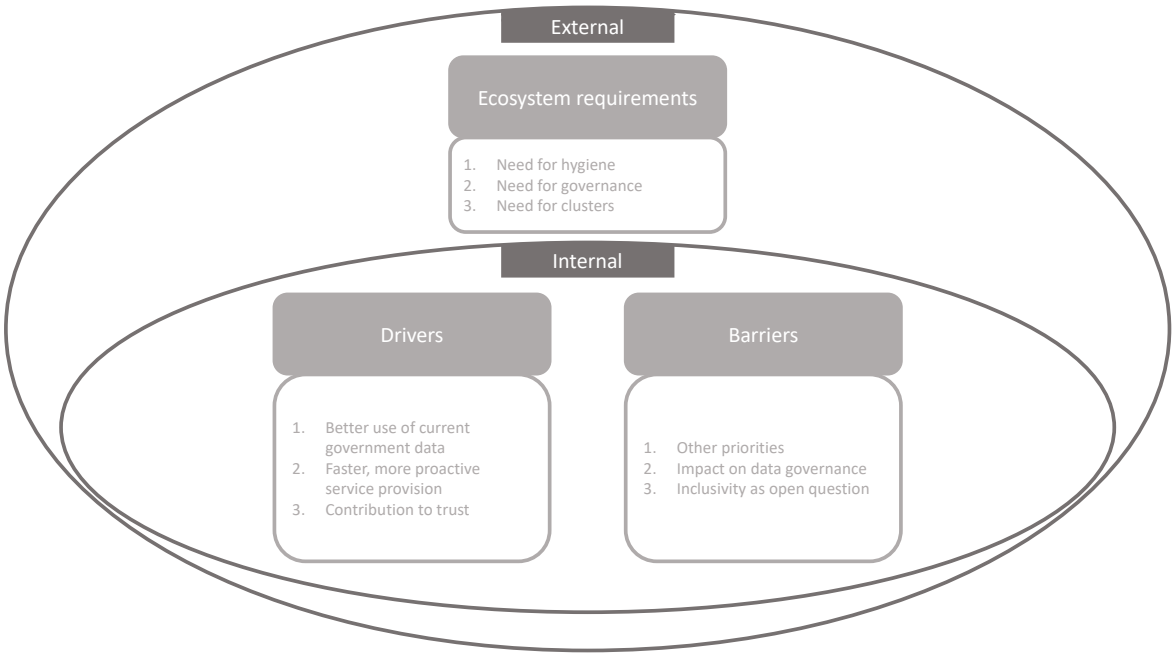


Figure 2. Schematic overview of results from expert interviews

In line with Buyle et al. (2020), we find that opportunities for PDS adoption are mostly linked to inherent intricacy of, and limited data (governance) maturity within, public administrations. The status quo of personal data handling is plagued by poor access to, and control over, data

collected by (software) service providers and application administrators, as well as a related lack of transparency vis-à-vis citizens. In the end, these factors lead to a quasi-impossibility for the public sector to substantively abide by the 'only once' principle. In view of the approach of the date of applicability of the Single Digital Gateway Regulation, which makes 'only once' a legal obligation in certain contexts (Regulation (EU) 2018/1724, 2018), this could soon become a more stringent external regulatory driver for enabling PDS use. Legal obligation, and subsequent regulatory enforcement, could push Solid-enabled PDS adoption up the priority list. Beyond legislation, also the European Union push for ethical AI (European Commission, 2020a), for which PDSs could be an enabler in terms of data sourcing, can provide additional impetus to public sector adoption.

Research shows that (perceived) utility is an important driver for adoption of PDSs (Mariani, Styven & Teulon, 2021). Our findings show that public organizations are indeed very much concerned with optimizing utility for data subjects. However, as the adoption of the Solid-enabled PDSs also sits at the organizational level, it is important to provide evidence of its utility for them. This can be part of a broad government strategy with a selection of a series of specific key use cases. Furthermore, the PDS offerings should facilitate the use of processing grounds other than 'consent' for personal data. The strong link to active consent hinders widespread adoption in public organizations where much processing occurs under 'public interest' or 'legal obligation.' Nonetheless, being able to more easily request data processing consent via PDSs could already provide opportunities for societally beneficial data uses which are currently beyond the grasp of public organizations. Specifically, it could allow for employing personal data on a voluntary basis for the common good much more readily, e.g. to further UN SDGs.

Morey, Forbath and Schoop (2015), and Kim and Lee (2012), relate offered digital transparency to trust levels. Our findings demonstrate that from the perspective of the public sector, trust in data management is an important objective. Offering Solid-enabled PDSs which enable data subjects to access and control their data is seen as an enabler in that sense. Moreover, these principles are also part of broader, and widely supported, responsible innovation frameworks (Anand & Brass, 2021; Buhmann & Fieseler, 2021; Owen, Bessant & Heintz, 2013; Principles for Digital Development, 2022). Nonetheless, it remains to be seen to what extent mere transparency can indeed foster trust, or if as mentioned by Alessandro et al. (2021) important flanking conditions, such as a good level of government performance, need to be fulfilled as well. Particularly, the inclusiveness of technology is also often linked to trust (Myeong, Kwon & Seo, 2014; van Ooijen, Ubaldi & Welby, 2019). Inclusivity is a key requirement for technology use in the public sector, it is also embedded in the UN SDG framework (United Nations, 2023a). Therefore, the user experience of PDSs should aim to be accessible to citizens of all levels of digital literacy. A single-track preoccupation with transparency, especially without due regard for comprehensibility and succinctness of transparency tools, could be ineffective when a trust increase is targeted.

Our research also provides empirical data that debunks the idea of the all-encompassing open, decentralized data ecosystem where all actors instantly freely exchange data with all types of ecosystem participants. Just as Aidinlis (2022) and Munné (2016), our research demonstrates that public sector organizations have specific requirements when participating in data ecosystems. Particularly, these requirements regard ensuring a high level of information security (e.g. in line with internal government standards), and devising an explicit governance system including screening of new entrants as well as a partitioning of the ecosystem based on use-case clusters. Seeing the central societal role of, and the vast volumes of personal data that circulate within, government, continued engagement from the public sector is crucial for the long-term success of any data ecosystem initiative.

6 Conclusion

Our analysis was based on 13 semi-structured expert interviews with representatives of public organizations active in Flanders. The core objective of the study was to provide a state-of-play regarding the adoption potential for citizen-centric personal data storage in the public sector, through a case study of the Flemish Solid-enabled PDS push.

Our results show that public organizations see three drivers to implement Solid-enabled PDSs: (i) to make better use of currently available government data, (ii) facilitate faster, more proactive public service provision, and (iii) contribute to citizen trust in government data practices. In addition, the series of interviews also revealed three challenges: (i) other (IT) priorities within the organization in a context of limited resources, (ii) the strong impact on data management, both internally and within the public sector more broadly, that Solid-enabled PDS adoption entails, and (iii) ensuring Solid-enabled PDSs' societal inclusiveness. Last, we laid bare a series of Solid-enabled PDS-based data ecosystem preconditions: (i) there is a need for Solid-enabled PDSs and the data on them to meet certain minimum requirements, (ii) there is a need for a governance layer to manage the openness of the ecosystem and promote/ enforce reciprocity of data sharing, and (iii) there is a need for development of clusters around concrete use cases within the broader ecosystem to demonstrate the value of Solid-enabled PDSs while allowing the public sector to maintain its role as guardian of the societal interest.

Wider insights of our research are fourfold. First, a more citizen-centric data management could offer citizens substantial value and resolve certain historic misalignments between public sector data practices and data (protection) legislation. The Single Digital Gateway Regulation could offer additional legal impetus in that regard. Second, in addition to citizen-centered utility, PDS providers would be wise to focus on optimizing organizational utility of PDSs. Specifically, an extension of the available legal bases for processing personal data from Solid-enabled PDSs would likely be a necessity. The fact that a wide variety of organizations enables PDS-use, will arguably be as important as the technology adoption at the level if the individual. Third, offering transparency is likely insufficient to foster trust in public sector data practices. In particular, care should be taken to safeguard the inclusivity of data-related projects and products. Last, data ecosystem orchestrators would be wise to consider specific public sector requirements when setting up data ecosystems. Successful and sustainable government-to-business data sharing will likely require a staggered, hybrid governance set-up. It is important to note that setting up data spaces should not be an end goal as such, but rather a means to ensure responsible innovation, e.g. foster AI-development, in line with citizens' and societies' needs.

The limitations of this research are primarily geographical and temporal in nature. Geographically, we focused solely on the Flemish public sector, which offers to opportunity to perform a contextual deep dive. Nonetheless, we admit this might hinder generalizability beyond similar European localities. The focus on a single area results from the fact that PDSs are currently mostly still a fringe phenomenon, and that, as a result, the widespread Flemish PDS push is rather unique. Temporally, the interviews were conducted before the full roll-out of the Solid-enabled PDS-based ecosystem. Therefore, our result might overlook certain opportunities and challenges that will present after final implementation.

Promising avenues for future research include: (i) conducting similar research gauging drivers and barriers for citizen-centric data storage solutions in different geographies to perform international comparisons, (ii) iterating the presented mapping of opportunities and challenges focused on the private sector, and (iii) following the further evolution of the Flemish PDS ecosystem to assess how actual (organizational) adoption levels evolve over time.

Acknowledgement

This research was supported by SolidLab Vlaanderen (Flemish Government, EWI and RRF project VV023/10).

7 References

Aidinlis, S. (2022). Government-to-Business (G2B) research data sharing and the GDPR: Reconciling the public with the private?. In *Research Handbook on EU Data Protection Law* (pp. 115-142). Edward Elgar Publishing.

Alessandro, M., Cardinale Lagomarsino, B., Scartascini, C., Streb, J., & Torrealday, J. (2021). Transparency and Trust in Government. Evidence from a Survey Experiment. *World Development, 138*, 105223. https://doi.org/10.1016/j.worlddev.2020.105223

Anand, N., & Brass, I. (2021). Responsible innovation for digital identity systems. *Data & Policy*, *3*, e35. https://doi.org/10.1017/dap.2021.35

Bergström, T., Franzke, J., Kuhlmann, S., & Wayenberg, E. (Red.). (2021). *The Future of Local Self-Government: European Trends in Autonomy, Innovations and Central-Local Relations*. Springer International Publishing. https://doi.org/10.1007/978-3-030-56059-1

Birch, K., Cochrane, D., & Ward, C. (2021). Data as asset? The measurement, governance, and valuation of digital personal data by Big Tech. *Big Data & Society, 8*(1), 20539517211017308. https://doi.org/10.1177/20539517211017308

Bodó, B., Irion, K., Janssen, H., & Giannopoulou, A. (2021). Personal data ordering in context: The interaction of meso-level data governance regimes with macro frameworks. *Internet Policy Review, 10*(3). https://doi.org/10.14763/2021.3.1581

Bogner, A., Littig, B., & Menz, W. (2009). *Interviewing experts*. Basingstoke [England]; New York: Palgrave Macmillan.

Buhmann, A., & Fieseler, C. (2021). Towards a deliberative framework for responsible innovation in artificial intelligence. *Technology in Society*, *64*, 101475. https://doi.org/10.1016/j.techsoc.2020.101475

Buyle, R., Taelman, R., Mostaert, K., Joris, G., Mannens, E., Verborgh, R., & Berners-Lee, T. (2020). Streamlining Governmental Processes by Putting Citizens in Control of Their Personal Data. In A. Chugunov, I. Khodachek, Y. Misnikov, & D. Trutnev (Red.), *Electronic Governance and Open Society: Challenges in Eurasia* (pp. 346–359). Springer International Publishing. https://doi.org/10.1007/978-3-030-39296-3_26

Campmas, A., Iacob, N., & Simonelli, F. (2022). How can interoperability stimulate the use of digital public services? An analysis of national interoperability frameworks and e-Government in the European Union. *Data & Policy, 4*, 19. https://doi.org/10.1017/dap.2022.11

Custers, B., & Malgieri, G. (2022). Priceless data: Why the EU fundamental right to data protection is at odds with trade in personal data. *Computer Law & Security Review, 45*, 105683. https://doi.org/10.1016/j.clsr.2022.105683

De Filippi, P. (2016). *The Interplay between Decentralization and Privacy: The Case of Blockchain Technologies* [SSRN Scholarly Paper Nr. 2852689]. Retrieved on 27. March 2023 from https://papers.ssrn.com/abstract=2852689

Digital Flanders. (2022). *Enterprise-ready Solid Platform* [Website]. Retrieved on 27. March 2023 from https://www.vlaanderen.be/digitaal-vlaanderen/het-vlaams-datanutsbedrijf/enterprise-ready-solid-platform

Directive (EU) 2019/1024 of the European Parliament and of the Council of 20 June 2019 on open data and the re-use of public sector information (recast) Official Journal of the European Union, Vol. L172 (26 June 2019), pp. 56–83.

European Commission. (2023). *International Partnerships – Sustainable Development Goals* [Website]. Retrieved on 24. August 2023 from https://international-partnerships.ec.europa.eu/policies/sustainable-development-goals_en

European Commission. (2022a). Commission staff working document on Common European Data Spaces SWD(2022) 45 final Brussels, 23.2.2022 https://ec.europa.eu/newsroom/dae/redirection/document/83562

European Commission. (2022b). *Proposal for a Regulation of the European Parliament and of the Council laying down measures for a high level of public sector interoperability across the Union (Interoperable Europe Act)* [European Commission communication]. Retrieved on 24 March 2023 from https://commission.europa.eu/system/files/2022-11/com2022720_0.pdf

European Commission. (2022c). *Proposal for a Regulation of the European Parliament and of the Council on harmonised rules on fair access to and use of data (Data Act)* [European Commission communication]. Retrieved on 24 March 2023 from https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2022%3A68%3AFIN

European Commission. (2020a). *White Paper on Artificial Intelligence - A European approach to excellence and trust* [European Commission communication]. Retrieved on 3 August 2023 from https://commission.europa.eu/system/files/2020-02/commission-white-paper-artificial-intelligence-feb2020_en.pdf

European Commission. (2020b). *The Once Only Principle System: A breakthrough for the EU's Digital Single Market* [Website]. Retrieved on 27. February 2023 from https://commission.europa.eu/news/once-only-principle-system-breakthrough-eus-digital-single-market-2020-11-05_en

European Data Protection Supervisor. (2020). *Opinion on the European Commission's White Paper on Artificial Intelligence – A European approach to excellence and trust* [EDPS Opinion]. Retrieved on 25. August 2023 from https://edps.europa.eu/sites/default/files/publication/20-06-19_opinion_ai_white_paper_en.pdf

Fallatah, K. U., Barhamgi, M., & Perera, C. (2023). Personal Data Stores (PDS): A Review. *Sensors, 23*(3), Article 3. https://doi.org/10.3390/s23031477

Flanders. (n.d.). *Mijn Burgerprofiel* [Website]. Retrieved on 27. March 2023 from https://www.vlaanderen.be/uw-overheid/mijn-burgerprofiel

Gill, A. S., & Germann, S. (2022). Conceptual and normative approaches to AI governance for a global digital ecosystem supportive of the UN Sustainable Development Goals (SDGs). *AI and Ethics*, *2*(2), 293-301. https://doi.org/10.1007/s43681-021-00058-z

Glaser, B., & Strauss, A. (1967). *The Discovery of Grounded Theory: Strategies for Qualitative Research*. Mill Valley, CA: Sociology Press.

Hujran, O., Abu-Shanab, E., & Aljaafreh, A. (2020). Predictors for the adoption of e-democracy: An empirical evaluation based on a citizen-centric approach. *Transforming Government: People, Process and Policy, 14*(3), 523–544. https://doi.org/10.1108/TG-03-2019-0016

Kim, S., & Lee, J. (2012). E-Participation, Transparency, and Trust in Local Government. *Public Administration Review, 72*(6), 819–828. https://doi.org/10.1111/j.1540-6210.2012.02593.x

King Baudouin Foundation. (2022). *Barometer Digitale Inclusie 2022* [Report]. Retrieved on 21. April 2023 from https://kbs-frb.be/nl/barometer-digitale-inclusie-2022

Kulkarni, M., & Patil, K. (2020). *Block Chain Technology Adoption for Banking Services- Model based on Technology-Organization-Environment theory.* (SSRN Scholarly Paper Nr. 3563101). https://doi.org/10.2139/ssrn.3563101

Kuo, J. H., McManus, C., & Lee, J. A. (2022). Analyzing the adoption of radiofrequency ablation of thyroid nodules using the diffusion of innovations theory: Understanding where we are in the United States? *Ultrasonography, 41*(1), 25–33. https://doi.org/10.14366/usg.21117

Lehtiniemi, T., & Ruckenstein, M. (2019). The social imaginaries of data activism. *Big Data & Society, 6*(1), 2053951718821146. https://doi.org/10.1177/2053951718821146

Lynskey, O. (2019). Grappling with "Data Power": Normative Nudges from Data Protection and Privacy. *Theoretical Inquiries in Law, 20*(1), 189–220. https://doi.org/10.1515/til-2019-0007

Mariani, M. M., Ek Styven, M., & Teulon, F. (2021). Explaining the intention to use digital personal data stores: An empirical study. *Technological Forecasting and Social Change*, *166*, 120657. https://doi.org/10.1016/j.techfore.2021.120657

Morey, T., Forbath, T., & Schoop, A. (2015). Customer data: Designing for transparency and trust. *Harvard Business Review*, *93*(5), 96-105.

Munné, R. (2016). Big data in the public sector. *New horizons for a data-driven economy: A roadmap for usage and exploitation of big Data in Europe*, 195-208.

Myeong, S., Kwon, Y., & Seo, H. (2014). Sustainable E-Governance: The Relationship among Trust, Digital Divide, and E-Government. *Sustainability, 6*(9), Article 9. https://doi.org/10.3390/su6096049

Nilashi, M., Keng Boon, O., Tan, G., Lin, B., & Abumalloh, R. (2023). Critical data challenges in measuring the performance of sustainable development goals: Solutions and the role of big-data analytics. *Harvard Data Science Review*, *5*(3). https://doi.org/10.1162/99608f92.545db2cf

Nixdorf, W. (2019). Planting in a Walled Garden: Data Portability Policies to Inform Consumers How Much (If Any) of the Harvest Is Their Share. *Transnational Law and Contemporary Problems, 29*, 135.

Owen, R. J., Bessant, J. R., & Heintz, M. (2013). *Responsible innovation* (Vol. 104). Chichester: Wiley.

Pandit, H. J. (2022). *Making Sense of Solid for Data Governance and GDPR* [Preprint]. Open Science Framework. https://doi.org/10.31219/osf.io/m29hn

Principles for Digital Development. (2022). *Responsible Data* [Pulse on the Principles Paper Series]. Retrieved on 23. August 2023 from https://digitalprinciples.org/wp-content/uploads/PulseOnThePrinciples_RD.pdf

Proden, E., Bett, K., Chen, H., Duerto Valero, S., Fraisl, D., Gamez, G., MacFeely, S., Mondardini, R., See, L., & Min, Y. (2022). *Citizen science data to track SDG progress: Low-hanging fruit for Governments and National Statistical Offices* [IIASA Policy Brief]. Retrieved on 23. August 2023 from IIASAPolicyBrief.pdf

Ranchordas, S., & Goanta, C. (2020). The New City Regulators: Platform and Public Values in Smart and Sharing Cities. *Computer Law & Security Review*, *36*, 105375. https://doi.org/10.1016/j.clsr.2019.105375

Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation) Official Journal of the European Union, Vol. L119 (4 May 2016), pp. 1-88.

Regulation (EU) 2018/1724 of the European Parliament and of the Council of 2 October 2018 establishing a single digital gateway to provide access to information, to procedures and to assistance and problem-solving services and amending Regulation (EU) No 1024/2012 Official Journal of the European Union, Vol. L295 (21 November 2018), pp. 1–38.

Regulation (EU) 2022/868 of the European Parliament and of the Council of 30 May 2022 on European data governance and amending Regulation (EU) 2018/1724 (Data Governance Act) Official Journal of the European Union, Vol. L152 (3 June 2022), pp. 1–44.

Rogers, E. M. (1983). *Diffusion of innovations* (3rd ed). Free Press; Collier Macmillan.

Sadowski, J. (2019). When data is capital: Datafication, accumulation, and extraction. *Big Data & Society, 6*(1), 205395171882054. https://doi.org/10.1177/2053951718820549

Solid. (2023). *Solid Protocol* [Protocol]. Retrieved on 13. February 2023 from https://solidproject.org/TR/protocol

SolidLab. (2022). *SolidMonitor: Privacy, persoonlijke data & datakluizen* [Research report]. Retrieved on 27. March 2023 from https://solidlab.be/wp-content/uploads/2023/01/IMEC_SOLIDMonitor_2022.pdf

Solid project. (2023). *About Solid* [Website]. Retrieved on 13. February 2023 from https://solidproject.org/about

Tjan, A. K. (2001). Finally, a way to put your Internet portfolio in order. *Harvard Business Review*, *79*(2), 76-85, 156.

Tornatzky, L. G., & Fleischer, M. (1990). *The Processes of Technological Innovation*. Lexington Books.

United Nations. (2023a). *The 17 goals* [Website]. Retrieved on 25. August 2023 from https://sdgs.un.org/goals

United Nations. (2023b). *Goals 16 - Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels* [Website]. Retrieved on 25. August 2023 from https://sdgs.un.org/goals/goal16

Van Damme, S., Mechant, P., Vlassenroot, E., Van Compernolle, M., Buyle, R., & Bauwens, D. (2022). Towards a Research Agenda for Personal Data Spaces: Synthesis of a Community Driven Process. In M. Janssen, C. Csáki, I. Lindgren, E. Loukis, U. Melin, G. Viale Pereira, M.

P. Rodríguez Bolívar, & E. Tambouris (Red.), *Electronic Government* (pp. 563–577). Springer International Publishing. https://doi.org/10.1007/978-3-031-15086-9_36

van Ooijen, C., Ubaldi, B., & Welby, B. (2019). A data-driven public sector: Enabling the strategic use of data for productive, inclusive and trustworthy governance.

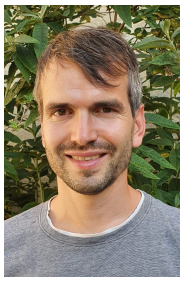
Verstraete, M., Verbrugge, S., & Colle, D. (2022). Solid: Enabler of decentralized, digital platforms ecosystems. *ITS 31st European Conference 2022, Proceedings*. 31st ITS European Conference. http://hdl.handle.net/1854/LU-8760525

Wiesche, M., Jurisch, M. C., Yetton, P. W., & Krcmar, H. (2017). Grounded Theory Methodology in Information Systems Research. *MIS Quarterly*, *41*(3), 685-A9.

Zheng, D., Chen, J., Huang, L., & Zhang, C. (2013). E-government adoption in public administration organizations: Integrating institutional theory perspective and resource-based view. *European Journal of Information Systems*, *22*(2), 221-234. https://doi.org/10.1057/ejis.2012.28

Biographies

Laurens Vandercruysse. Laurens Vandercruysse is a postdoctoral researcher at imec-SMIT, VUB, focusing on the nexus of data governance and competition. His doctoral dissertation concentrated on economic impact of the General Data Protection Regulation, and data protection impact assessments (DPIAs) in particular, in the smart city context. Current research primarily deals with socioeconomic implications of (personal) data sovereignty, and human-centric artificial intelligence.
ORCID: https://orcid.org/0000-0001-5425-1604
CRediT Statement: Conceptualization, Methodology, Formal Analysis, Visualization, Writing - Original Draft, Writing - Review & Editing



Ruben D'Hauwers. Ruben D'Hauwers is a PhD candidate at imec-SMIT, VUB, where he has worked as a researcher since 2014 investigating business models related to smart cities, SMEs, and sustainability. His research focuses on the field of Business Models in Data Ecosystems. He is a member of the Data Governance and Communities Unit. D'Hauwers holds an MSc in Business Engineering from Ghent University and an MSc in Innovation Management from Antwerp Business School. Prior to his doctoral studies, he gained international professional experience as a business developer in Belgium and Myanmar for organizations such as AIESEC and SBE nv, providing strategic support for organizations across sectors.
ORCID: https://orcid.org/0000-0002-7688-6229
CRediT Statement: Conceptualization, Writing - Review & Editing

August Bourgeus. August Bourgeus is a researcher at imec-SMIT, VUB, specialising in data governance, transparency, and citizen empowerment. He holds an MSc in Business Engineering: Data Analytics from Ghent University (2020), where his thesis examined decentralised identity and citizen data vaults using Solid technology. At imec-SMIT-VUB, he investigates how citizens perceive personal data vaults and advancing transparent data handling practices. Prior to joining in 2022, he held a research scholarship from the Collegio dei Fiamminghi at the University of Bologna from 2020-2021. As a member of imec-SMIT, VUB's Data, Governance and Communities Unit, Bourgeus' research explores reimagining citizen-government relationships through innovative data stewardship models.
ORCID: https://orcid.org/0000-0002-0566-5648
CRediT Statement: Writing – review & editing