Report Solid Readiness: Drivers & Barriers for the Private Sector

FLANDERS

Vlaamse overheid

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Executive Summary

Objective: The Solid technology is an enabler for shifting control over personal data back to data subjects. However, the actual impact of Solid strongly depends on private sector willingness to increase user control over data, a central resource of a data driven business model. This study maps **drivers and barriers for companies to consider Solid adoption.** Subsequently, we derive **recommendations on how to build a Solid ecosystem.**

Methodology: **25 semi-structured interviews** were conducted to uncover relevant drivers and barriers. Interviewees represented a wide variety of Flemish Solid actors: 3 data consumers, 11 data consumer and providers, 5 Solid service providers, 3 technology service provider, 2 ecosystem creators and one market expert where interviewed. A workshop was held with 42 participants in the Flemish Solid community.

Results: The interviews demonstrated that there is a **strong interest** in evolving from the status quo to a **personal data ecosystem** set-up.

Solid is considered an enabler for moving from a context of proprietary data silos to a true personal data ecosystem via **4 inherent features**: 1) Facilitation of **GDPR** implementation 2) Improvement of **trust and reputation**, 3) Improvement of **consent management** experience, and 4) (Data ecosystem) **interoperability**.

The private sector aims to evolve towards data ecosystems to reach three main value drivers: 1) Access to **third party data** 2) Access to **user provided and verified data**, and 3) Continuation/ Extension of **profitable data practices**.

In turn, these identified value drivers should aid in achieving the following **four business outcomes**: 1) Increase in **customer intimacy and personalization** 2) Development/ maintenance of a **data-driven business model** 3) **Process improvements and cost reductions** and 4) Business **differentiation**.

Of course, Solid adoption follows a **trade-off** between **Solid value and Solid risks**. Currently, the latter often outweighs the former. First, **revenue models** are still unclear and heavily depend on **network effects.** Second, **IT investment size** is uncertain because of a lack of maturity of the technology**.** Last, data providers are wary to **relinquish control over "a core asset"** to both users and third parties because of doubts concerning the willingness of these counterparties to (continue to) share data.

By consequence, inducing private sector investment in Solid will demand both a **reduction of IT investment costs**, and **a concretization of monetization schemes.**

Recommendation 1 is to demonstrate the business value of Solid via **real-life use cases including revenue models**. **Recommendation 2** is aimed at developing a technology infrastructure of **readily made services** and investing in the technical maturity of the Solid technology. **Recommendation 3** focuses on **creating user awareness, knowledge, and adoption** by e.g. tapping into existing ecosystems. Finally, **recommendation 4** concerns the **clarification of desirable/ effective data control and ecosystem role distributions.**

Managementsamenvatting

Doelstelling: De Solid-technologie maakt het mogelijk om de controle over persoonsgegevens in de handen van datasubjecten te leggen. Echter, de uiteindelijke impact van Solid hangt sterk af van de bereidheid van de private sector om de datasubjecten daadwerkelijk controle te geven over de centrale waardecreator in datagedreven businessmodellen. Deze studie brengt **drijfveren en barrières in kaart voor bedrijven** om **Solid-adoptie** te overwegen. Vervolgens worden **aanbevelingen** voor het **uitbouwen van een Solid-ecosysteem** afgeleid.

***Methodologie*: 25 semigestructureerde interviews** werden afgenomen om relevante drijfveren en barrières te peilen. De geïnterviewden vertegenwoordigden een grote verscheidenheid aan **Vlaamse Solid-actoren**: 3 data consumenten, 11 data consumenten en aanbieders, 5 Solid diensten leveraars, 3 technologie diensten leveraars, 2 ecosysteem creatoren en een markt expert werden geïnterviewd. Er werd ook een worksohop gehouden met 42 participanten in het Vlaamse Solid community.

***Resultaten**:* Uit de interviews bleek dat er een **sterke interesse** is om te evolueren van de status-quo naar een **ecosysteem voor persoonlijke gegevens**.

Solid wordt beschouwd als een "enabler" om van een context van propriëtaire gegevenssilo's naar een echt ecosysteem voor persoonlijke gegevens te gaan via **4 inherente kenmerken**: 1) Vergemakkelijking van de **AVG-implementatie** 2) Verbetering van **vertrouwen en reputatie**, 3) Verbetering van de **ervaring met toestemmingsbeheer**, en 4) (Data-ecosysteem) **interoperabiliteit**.

De **drijfveren van private sector actoren om te participeren in ecosystemen** voor persoonlijke gegevens zijn **drieledig:** 1) Toegang tot **gegevens van derden**, 2) Toegang tot door de **gebruiker verstrekte en geverifieerde gegevens**, en 3) **Voortzetting/ uitbreiding van winstgevende praktijken** gebaseerd op exploitatie van persoonsgegevens.

Deze geïdentificeerde drijfveren zouden op hun beurt moeten helpen bij het **bereiken van 4 bedrijfsresultaten**: 1) Toename van **klantintimiteit en personalisatie**, 2) Ontwikkeling/ behoud van **datagedreven businessmodellen**, 3) **Procesverbeteringen en kostenreducties** en 4) **Differentiatie**.

Solid-adoptie is het resultaat van een afweging tussen de waarde die Solid kan bijbrengen en Solid-risico's. Momenteel wegen deze risico's vaak zwaarder door. Ten eerste, **verdienmodellen** zijn nog **onduidelijk** en sterk afhankelijk van **netwerkeffecten**. Ten tweede, de **omvang van de IT-investering is onzeker** vanwege een gebrek aan maturiteit van de technologie. Ten slotte, **gegevensaanbieders zijn op hun hoede om de controle over hun eigen data af te staan** aan zowel gebruikers als aan derden, vanwege twijfels over de bereidheid van deze tegenpartijen om gegevens te (blijven) delen.

Het effectief aanzetten tot **grootschalige investeringen** van de private sector in Solid zal zowel een **verlaging van de IT-investeringskosten als een concretisering van de verdienmodellen** vereisen.

Aanbeveling 1 is om de bedrijfswaarde van Solid aan te tonen via **real-life use cases inclusief verdienmodellen**. **Aanbeveling 2** is gericht op het ontwikkelen van een technologie-infrastructuur van **kant-en-klare diensten en het investeren in Solid's technische maturiteit**. **Aanbeveling 3** richt zich op het **creëren van gebruikersbewustzijn, kennis en adoptie** door b.v. gebruik te maken van bestaande ecosystemen. **Aanbeveling 4** tot slot betreft de verduidelijking van **gewenste/ effectieve datacontrole** opzetten en **rolverdelingen in het Solid-ecosysteem**.

Background

The Solid technology aims to enable the **exchange of data in an ecosystem**, while enabling **data subjects to control the access to their personal data**. To this end, Solid introduces the concept of a pod as an online data space for an individual to control and manage the access to their data. Together, different pods form a Solid ecosystem, from which applications can directly integrate data from people's Solid pods, after receiving the user his or her consent to access the data. Through semantic interoperability, Solid also enables the development of data exchange in this ecosystem. Thus, for companies, Solid can enable the exchange of personal data with the consent of the user

Importantly, Solid can potentially facilitate the transition towards a changing regulatory framework concerning data, as the in the European Union (EU) induces the private sector to rethink current practices. Two EU initiatives are particularly relevant: the **General Data Protection Regulation (GDPR)** and the **Data Governance Act (DGA**), on the other hand. A key objective of this strategy is to create an EU single market for data, breaking down vertical as well as national data silos.

GDPR focuses on **accountability** of actors handling personal data, and on **transparency** vis-à-vis people whose personal data is processed. To further empower data subjects, GDPR also creates a series of explicit **data subject rights**. These rights include: the right of access (Article 15), the right of erasure (Article 17) and the right of data portability (Article 20) (Regulation (EU) 2016/679 (GDPR), 2016). However, the conversion of the ideas into the effective enjoyment of the granted rights is not trivial. Specifically, the asymmetric power relationship between private sector data handler and data subject often leads to situations where data subject rights cannot be (fully) exercised (van de Waerdt, 2020). As was mentioned, Solid could aid in achieving a part of GDPR implementation.

DGA targets u**nlocking the potential of sharing (public and private) data**. DGA has **three main areas of action**: re-using protected data held by the public sector, facilitating setting up and governing data intermediaries (e.g. data cooperatives, data marketplaces, etc.), and allowing people to pool their data for altruistic purposes (Regulation (EU) 2022/868 (DGA), 2022). In essence, the success of DGA depends on the ease with which (personal) data can be ported between actors – public-private data sharing, organization to individual, etc. –, and the compatibility of various data standards used by the different stakeholders (Gill & Metzger, 2022; Graef, Husovec & van den Boom, 2020). By decoupling data and apps, the Solid technology puts data portability at the center of its offering, placing the individual in the middle. Moreover, the semantic interoperability with which Solid is linked, is a crucial enabler for the type of cross-sectoral data sharing that DGA aims to foster.

In Flanders, Belgium, a Solid platform is being developed on the initiative of the Flemish government. The Data Utility Company[1] (Datanutsbedrijf), which was founded in early 2022, is to enable public and private data platforms by developing data driven ecosystems. Moreover, the Data Utility Company targets to increase citizen trust in data sharing by giving citizens and companies more privacy and control through personal data vaults; Solid is central in this initiative. In November 2022, the Data Utility Company is still a governmental organization, but the aim is for the company to become more independent in the future. Also in the beginning of 2022, the Flemish Government launched SolidLab[2]. This is a EUR 7 million government investment aimed at boosting the practical implementations of Solid. Three of Flanders' leading universities (Ghent University, Vrije Universiteit Brussel, and KU Leuven) are joining forces in SolidLab Vlaanderen. SolidLab works closely with the

[1] https://www.vlaanderen.be/digitaal-vlaanderen/het-vlaams-datanutsbedrijf
[2] https://solidlab.be/

Digital Flanders agency and with the Data Utility Company. Around this Solid ecosystem, different startups and companies are investigating to implement Solid.

Objective of the Study

In short, the implementation of the obligations emerging from the entry into force of GDPR and DGA can be demanding for the large majority of (private sector) actors. Therefore, **techn(olog)ical aids with which compliance and compatibility** can be facilitated, should be welcomed. Additionally, the effect of the development of the Solid ecosystem through the Data Utility Company and Solidlab on private companies need to be investigated. Thus, it is important to also consider **commercial incentives to implement Solid for companies**. This deliverable aims to comprehensively map **drivers and barriers for participating in the Solid ecosystem in Flanders from the viewpoint of private actors**. Subsequently, we derive **recommendations on how to build a Solid ecosystem.**

Methodology

1 Semi-structured interviews complemented with a workshop

To answer this question, **semi-structured interviews** were held with **24 Flemish company** representatives. A semi-structured interview method was chosen, as this method is open, allowing new ideas to be brought up during the interview because of what the interviewee says. Yet, the methodology allows for structure by keeping a framework of themes to be explored (Knott et al, 2022)

All interviews were held over Microsoft Teams and ranged from 1 hour until 1hour 45 minutes in length. The interviews were held in English and in Dutch. In most interviews, a Miro board was used which showed the questions, and the interviewees could follow the note keeping. A short introduction of the objective of the study was provided, and an overview was given on how the results would be utilized. A privacy consent document was signed by the respondents.

Additionally, a **workshop with 42 respondents** of 1 hour was held as part of the Solid Community in Flanders. 10 different quotes were chosen aligned with the questionnaire of the interviews, and respondents were asked to vote using the software 'Wooclap'. Subsequently, a discussion was held to provide more depth and to explore the reasoning of the respondents.

The interviews and workshop notes were transcribed in full sentences verbatim. Next, the answers were structured in different categories using the **axial coding** methodology (Strauss et al, 1990). It is the process of relating codes (categories and concepts) to each other, via a combination of inductive and deductive thinking. The codes related to whether they were a driver, a barrier or a related solution defining the way forward. Different category tags were defined and iterated throughout the analysis of the interview, enabling the researcher to structure the different quotes and to find analogies between the different companies' perspectives on drivers and barriers. Different iterations of analysis happened to ensure the tags were properly allocated and whether the right drivers and barriers were identified. Additionally, the identified drivers and barriers were quantified by counting the number of companies that mentioned a specific driver or barrier. Only the interviews were utilized to quantify the number of companies relate to a specific driver or barrier, as the individual opinions of workshop respondents could not be derived.

The report provides **a qualitative as well as quantitative investigation** of the series of interviews and workshop, deriving overarching conclusions. The structural review is complemented with quotes from the interviews, offering validation of identified key drivers and barriers.

2 Interview subjects

The contacts were established through the network of the Flemish Data Utility Company (Datanutsbedrijf), imec, the Vrije Universiteit Brussel (VUB) and the Ghent University (uGent).

The aim was to interview a mix of companies which could be part of the future and current Solid ecosystem.The companies indicated which role they could potentially take up in Solid. In total, 3 data consumers (which would act as a receiver of data), 11 data consumer and provider (would act as a receiver of data and under certain conditions as a provider of data), 5 Solid service providers (currently already offering Solid services), 3 technology service provider, 2 ecosystem creators (organizations aimed at creating an ecosystem on personal data exchange) and one market expert where interviewed. This wide view over the ecosystem enables to see the different perspectives of the future players in the Solid.

Within the 25 companies, 9 companies were currently already active with researching and/or implementing Solid solutions, thus representing the first movers in the Solid ecosystem. 9 companies were aware of Solid, but were still investigating whether Solid could be a beneficial solution for them or not. To 4 companies, the technology was unknown, and they needed to be introduced to the technology. Last, 3 companies already investigated Solid, but concluded that Solid was not the right technology at the time, and prefer to wait until other companies adopt Solid, or may not adopt Solid at all.

The aim of the study was to include people who were able to think strategically about the impact Solid may have on their business. The profiles of the respondents ranged from C-Level professionals, to innovation professionals and managers working on products and data.

3 Solid community workshop

The workshop was held in the context of the Solid community of Flanders. The general objective of the Solid community is to ensure that Solid is accepted and used by both end-users and service providers when going through and setting up services within Flanders and Belgium. 42 respondents participated to the workshop, including 8 researchers, 3 governmental representatives facilitating Solid, 7 governmental representatives (potentially) using Solid, 7 companies facilitating Solid and 4 companies (potentially) using Solid.

Drivers for companies to evolve towards Solid

The interviewed companies investigate Solid (see figure 1) because they want to evolve towards a data ecosystem. Solid is considered an enabler for them in this regard through the facilitation of GDPR implementation, the improvement of trust and reputation on handling personal data, the improvement of user consent management experience, and the provision of interoperability in data ecosystems

The pull towards personal data ecosystem set-ups if the result of three value drivers for companies: to be able to get access to third party data, to be able to access user provided and verified data, and to be able to (continue) to share data with third parties and set up data collaborations.

These drivers will aid companies in achieving concrete business outcomes, such as increasing customer intimacy and personalization, developing and maintaining data-driven business models, improving processes, and reducing costs, and increasing business differentiation.

Figure 1: Schematic overview of drivers for Solid adoption.

1 Solid as an enabler for personal data ecosystems

In this section we discuss how Solid enables the business drivers discussed above, and how Solid enables the transition towards a data ecosystem (see figure 2).

Figure 2: Solid as an enabler for personal data ecosystems.

1 Legal: Facilitation of GDPR implementation

15 companies indicated that they hope Solid could be a major enabler for **being compliant with the GDPR and privacy management**. One Solid application provider mentioned Solid has a major advantage over similar technologies in this regard: "*There is a strong synergy between the European legislation of GDPR and the Solid technology that enables the legislation".*[3] Additionally, another data consumer mentioned: "*European legislations like GDPR and the Data governance act are drivers to look into Solid to simplify the processes and to improve the offering to citizens*".

Some ecosystem providers or platform providers see in Solid a way to **reduce liability and compliance costs.** Also, an interviewee from a startup mentioned that **by not storing the data at their own servers, they could reduce liability, reduce costs, and avoid making mistakes with the processing of the data**[4]**:** "*the personal data of the customer does not need to be saved at the location of the company. We will 'not have to worry about being compliant'."* Another startup interviewee mentioned: "*As a startup, we should not keep ourselves occupied with taking responsibility of personal data, as a startup we cannot guarantee the safety of the data, and we cannot build systems that are hacker's proof. That is an argument to use a third-party system for data"*. Solid could support them in **reducing data (protection) risks**, both from not having to host huge amounts of personal data on their own servers and from having less responsibilities in the handling of the data of users. In this way, Solid would reduce the **likelihood of getting fined** by the Data protection Authority (DPA).

Companies consider it important **to be compliant to GDPR, also to keep access to data.** Solid is an enabler to ensure to remain relevant in the future. Related, a data consumer mentioned: "*Privacy and compliancy are important, but we also need to be able to use the data. We need to find a balance between compliance and business value*". Moreover, it is mentioned that Solid could also be an enabler **to share data with third parties in a GDPR compliant way.**"

2 User experience: Improve user consent management experience

15 companies want to also improve the user experience related to consent and identity management and see Solid as a potential technology that can support in this. An interviewee relates user experience to improving **the customer experience related to consent management**: "*If Solid can enable the ease of use for consent for the user, it would be an improvement, for example if people do not need to fill in 5 or 6 times the same data on different websites.*

Solid could enable **the consent management of** granular **data sharing**, as users can easily indicate on a granular level which who they want to share which data. A data provider mentions "*We were trying to build a technological system 10 years ago which would enable* (the consent management of) *granular data sharing to enable the sharing of data with our partners, to remove silos between the partners. This was too complex, but Solid could enable this now".*

Additionally, it can also be used to **ensure a safe and user-friendly experience regarding identity managemen**t of the user. A technology service provider thinking to implement Solid stated: "*Identity and access management is important in the current digital economy, as service providers want to offer services in a digital format to offer users an experience which is secure and use friendly*".

[3] Some companies mentioned that (they hope) Solid is aligned with the GDPR and other legislation. This is a driver companies hope to achieve, yet the alignment GDPR and Solid is not guaranteed as such, and still needs to be clarified and researched further.

[4] Companies will still need to ensure compliance, even if adopting the Solid technology. As GDPR is adopted on a risk-based best-efforts approach, data protection investments can be proportionate to company size.

3 Trustworthiness: Improve trustworthy reputation on handling personal data

16 companies indicated that Solid could be a major enabler for **increasing the trustworthiness towards the end-user, and thus increasing the willingness to share data with the company**.

One Solid service provider indicated: "*some companies that reach out to us, do this because they have an issue with their image or business model, and they need something disruptive to overcome this hurdle"*. A startup that is a data consumer and potentially a provider *mentioned "it could give a sales and marketing boost if the B2B customers see we handle data in an ethical and transparent way, and this could differentiate us with our competitors"*.

Working with Solid, which gives **transparency to the user, can lead to user trust**, which is crucial for users to be willing to (keep on) sharing data with the companies**.** This link was made explicit by one of the interviewees: "*We need to give insights in the data and communicate clearly. We need to deserve our role of being trustworthy. These are the fundamentals in our business".*

One application service provider even mentioned their business model is squarely based on this personal data handling reputation which Solid can enable: "*we want to be trustworthy, to be a neutral party. We want to make a connection to different players and to enable interactions. This requires trust of the users and of these other players".*

4 Interoperability in data ecosystems

19 companies indicated the need to **structure data using (semantic) interoperability standards** to progress to a personal data ecosystem**.** One interviewee mentioned: *"The value of data can be unlocked when everyone plays by same rules in an interoperable and standard and secure model. Therefore, we require a model that is open and interoperable, while not too centralized*". Solid can be an important building block of such a model due to its inherent features. In the mind of an interviewee, Solid and semantic data models are intrinsically linked: *"There is a high need for standards to enable Solid. Solid may not exist without semantic interoperability."* Interoperability promises to **reduce costs in IT and data management processes** as well as **security costs**, since not all data need to be handled or stored in house.

Furthermore, interoperability also **mitigates vendor-lock in dynamics**. The dynamic was aptly described by an interviewee of a startup: "*In the startup scene, there are a lot of questions with who you work, Amazon Google,.. You easily get locked in their ecosystems, and once you scale, you pay for it. We want to be less dependent on them, but there are no alternatives".* There is thus value in Solid enabling portability for companies, as was made explicit during an interview: "We would be very interested if, with Solid, data portability would be enabled so we could easily change from one provider to another with the guarantee of not being locked in."

2 Company drivers to evolve towards personal data ecosystems

The core driver for private sector Solid adoption is to **evolve towards a data ecosystem with access to high quality, authentic, up to date data**. One application service provider mentioned Solid can help to put the citizen at the center, to enable **to offer services with different players:** "*Everything turns around the citizen. Solid is a vehicle to share currently locked data in the entire system, in a citizen centric manner. This can help to share data with whoever needs to offer a service to the citizen in our ecosystem"*.

Some organizations are forced to **think in an ecosystem manner** as external triggers and complexity force them to think in a systematic way, this was mentioned by one of the interviewees: "The *biggest change in our market is that, in the past, our system was centralized. Now it became more complex, and we need to work as a system with different parties. We need a feedback loop in the ecosystem to keep*

the system working. Societally speaking, it's important data can be shared, as many parties will be part of it. In the future, this may be done with Solid".

It was also stated that Solid is **future proof in the context of data spaces as described in the Data Governance Act:** "*We want to be future proof. Data will move more in the future, and we need to know how to handle that. This can also help us to develop our data strategy in personal data spaces".*

Figure 3: Company drivers to evolve towards personal data ecosystems.

There are three main value drivers for companies in personal data ecosystems (figure 3):

1 To be able to get access to third party data;
2 Access to user provided and verified data;
3 To be able to (continue) to share data with third parties and set up data collaborations.

1 Access to high quality, authentic, up to date third party data

19 interviewees mentioned the core driver to investigate Solid is to **gain or keep access to data to the authentic source with the consent of the user.**

First, the process of sharing data can be improved through Solid. A Solid service provider mentioned that Solid is mainly seen as a means for gaining **access to the single source of truth of data that is currently already being shared.** Another Solid service provider mentioned a similar point "*The paradigm change Solid enables is that we can create a single version of the truth of data. This enables to store data in one place, close to the citizen, which enables re-use of data which is already being shared with other parties*."

Second, Solid could also enable to get **access to new third-party data.** An organization mentioned: "*We were looking for a technology to re-use insights based on personal data between different organizations for research purposes*". Additionally, Solid could unlock datasets which are currently too sensitive for sharing, as was mentioned by one of the interviewees: "*In our use cases we do not base ourselves on personal data as there are large restrictions on which data can be used. We only get access to encrypted data".*

2 Access to user generated and verified data

12 companies want to access data provided by the end user. This means they want to **keep access to data** the user is currently giving them consent for, or they want to **receive user-generated and verified data**.

First, companies want to **keep access to data they currently get access to**. One company mentioned that their current business model is based on receiving consent of the user, which may not be possible anymore in the future because of decreasing end-user trust: "*Currently we have a high number of consents of the user, and our advertisement business model relies on that. Yet, this may change due to legislation and the awareness of the user. We have a challenge to keep the number of consents to the same level as it currently is".*

Second, **user-generated data** could be of value to the companies. Data could be included by users themselves, which would increase the **data quality.** In this case, **verified data** (e.g. diplomas, credit worthiness, etc.) will be important to ensure the validity of the data. "

3 Sharing data with third parties and data collaborations

14 companies mentioned they want to be **able to share data with third parties with the consent of the user.** The continuation of current business practices was top-of-mind in several interviews: "*We want to prepare for a future where data sharing is not so easy anymore to share data, but where we still are able to do what we can do now*".

Solid can **enable the sharing of data with third parties in a transparent manner**. This way, data can likely continue be shared, since users might be less inclined to revoke consent.

In **One-on-one data collaborations**, two companies could set up a collaboration with a strategic benefit, for which they want to share data. An industry expert mentioned it can serve to set up **strategic collaborations between companies**: "*For many companies, data is like gold. They want to set up alliances and communities, to build up strategic ecosystems with their partners to develop a stronger position in the market. This enables them to target people together in a personalized way".*

3 Business drivers: business outcomes of data ecosystems

In this section we discuss why companies want to evolve towards data ecosystems, and how they will use this in their business to:

1. Increase customer intimacy and personalization
2. Maintain and develop data-driven business models
3. Improve processes and reduce costs
4. Business differentiation and first-mover effects

Figure4: Business drivers: business outcomes of data ecosystems.

1 Increase customer intimacy and personalization

21 different company representatives indicated **personalization and customer intimacy** as one of the key business outcomes for considering implementing Solid. An interviewee indicated: "*We used to target the broad public, but now we want to think from the perspective of the customer. Data is very important in that shift*". **By combining data of different sources, over different sectors and within the sector, companies want to offer personalized services and increase customer intimacy.**

One way of creating a personalized experience is to **provide better customized advice to customers** using data. This was noted by a representative by way of an example: "*we want to create an experience where we are the personal advisor within our sector. This requires a full picture. For that we need access to data, not necessarily to store all data.*"

Additionally, by **collaborating, companies can go to market together to create a personalized service offering, to develop a stronger market position together**. The common data in the collaboration can be used to go to market together, as mentioned by a technology service provider: *"By developing strategic alliances, companies can identify moments of truth of the customers, enabling them to gain a stronger market position together".*

To determine **the context of how a person can use a service**, a lot of information is required. The unlocking of personal data that Solid would enable, can allow **companies to target consumers at the right moment**. An interviewee stated exactly that: **"***By combining data, we can engage with the consumer in underserved moments, when people could consume content".*

2 Develop and maintain data-driven business models

13 companies mentioned the possibility to **keep or get new revenue streams by being able to share data with third parties with the consent of the user**. A data provider said "*We want to know contact details and opt-in data, and we want to be able to keep on sharing data, now with consent of the user. We are looking for ways to be able to share this data while the data subject also has a benefit".*

Solid could **offer a new revenue stream of data which is currently already shared**. A Solid service provider indicated wanting "*to get new incomes through sharing data, by offering the service of validating the data whether it is authentic.*" Additionally, some companies need to store already data legally, and the sharing of data could offer ways to monetize that data.

One organization mentioned to want to **offer data services to others**: "*in our platform, data is stocked in a data vault, we anonymize the data and offer insights to other companies without including personal data*".

3 Improve processes and reduce costs

11 companies mentioned that the **access to data could help them to improve internal and external processes, and thus reduce costs**. Below, some examples are given of where processes could be improved.

First, the most direct process improvement could be **in consent management** related to data sharing. An interviewee provided some context: *"The process of consent for data sharing could be reduced dramatically. There are many juridical texts that need to be signed for different departments, relationships managers need to send this to the consumer and need to ensure the document is signed. Afterwards, we need to track whether the customer really signed this. This is a heavy process just to be able to say to the customer 'we have a solution for you, could we share your contact details with this third party".*

Additionally, **administrative processes could be facilitated leading to reduced costs and an improved customer experience.** An example that was given concerned the process of the sharing of official data: "*Some processes, such as sharing official documents with the notary, could be facilitated using data sharing with Solid"*. It was stated that in the end the user would benefit from this streamlining of administration: "*With the access to data, administrative processes could be simplified. Especially if the data is interoperable this could make the processes easier, and it could improve services to the customer."*

4 Business differentiation

10 companies mentioned that Solid can help them to differentiate their company, and to remain relevant. For Solid service providers, Solid could be an **opportunity for a unique position in the market**. One Solid service provider mention that they want to be "*a first mover in a blue ocean, as when a paradigm shift comes with Solid, it will us to have a strong market position within the ecosystem.*"

Large companies come to Solid to solve challenges they face regarding their **current business model, data strategy, relationship with their customers and/or image, and search for a radical innovation which can bring them**. Others come to Solid out of curiosity and to investigate the market trends.

Some companies want to **differentiate themselves by creating a more user-friendly solution**, as a Solid service provider said, "*Companies want to differentiate themselves, as they can e.g., say that it is more user friendly because you don't have to transfer all the data from one place, or you could reuse the login*. For platform providers, it could also be a way to differentiate themselves as more user friendly *'A platform provider could differentiate and say they are more user friendly and more customer centric with Solid*".

Yet, for companies to be really willing to adopt Solid, the **pain points and drivers to Solid need to be strong enough to evolve into adopting Solid**. A Solid service provider mentioned: "*The companies that come to us have a large issue with their business model or image due to digitalization, the changing economy or even a scandal. They want a radical shift to overcome this hurdle"*.

Barriers for companies to adopt Solid

When companies need to decide regarding the adoption of Solid, they make a **trade-off between the potential business value of Solid and the cost and risk** adoption involves (figure 5). Now, this company investment decision is postponed by most companies due to uncertainty regarding the value and cost and risk drivers.

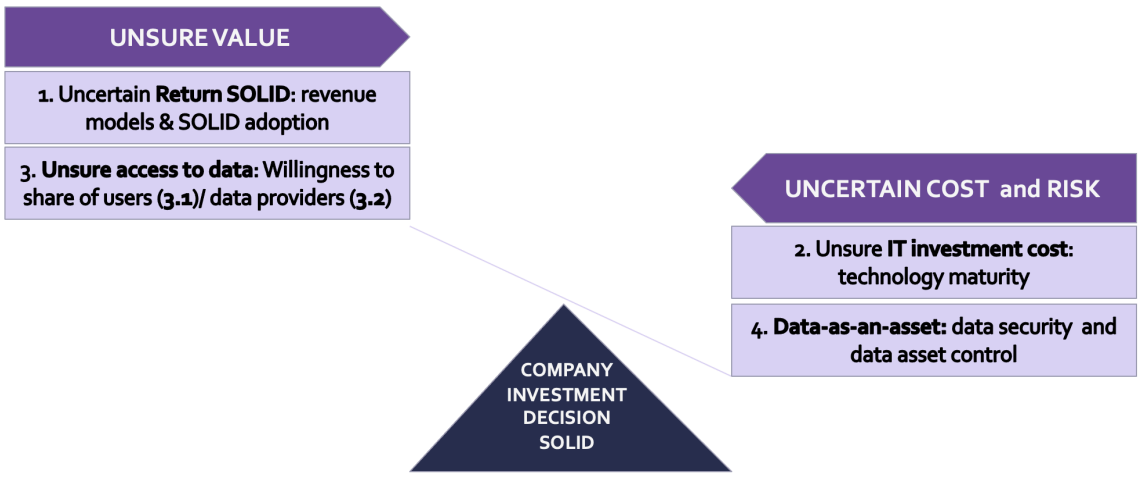

Figure 5: Barriers for companies to adopt Solid.

The **unsure value** is due to the uncertain return of Solid. The **revenue models of Solid** are unclear, as well as the **Solid adoption of other stakeholders and users (barrier 1).** This is linked to unsure IT investment costs. Companies need to make significant **investments** to change their data and IT infrastructure, while the **technology is not mature yet (barrier 2).**

Additionally, the main driver for Solid adoption is the access to data. Yet, there is an **unsure access to data (barrier 3)** as the willingness to share of users is unsure. On top of that, data providers see **data as their core asset**, and therefore they want to control this asset. They are reluctant to share competitive data with competitors and other players in the ecosystem.

1 Barrier 1: Uncertain return of Solid drivers

The return on Solid depends on whether **sufficient data is available in the network and on the possibility to capture the created value**. The availability of data depends on the **network effects** in the ecosystem – **users** as well as other **stakeholders in the ecosystem** need to also adopt Solid to make it worthwhile. One interview subject indicated that the network dynamic is important in the adoption decision: *"Solid needs to be utilized by different ecosystems before it will be worthy to adapt our IT systems. It needs to be adopted by users, and other companies"*. A chicken and the egg situation occurs, as companies will only invest if other companies also do so, while users will only adopt Solid when there are many Solid solutions. Additionally, **business-and revenue models in Solid need to be concretized.**

1 Chicken and the egg: Solid adoption

9 companies fear that not sufficient users will adopt Solid, and that not enough users will have data pods companies can connect to. There need to be **sufficient users using Solid** to make it worthwhile for companies to adopt Solid. According to the companies, the adoption of users will depend on the **user experience and the technical knowledge of the user.**

Several companies indicated that the **user experience of Solid** is a barrier for adoption of the user for now. As, one company mentioned: "*companies that want to receive data will look at the ease of the interface for the user.*".

Some companies mentioned that the **technical knowledge of the user** will be important. Yet, some companies are critical whether the citizens will be interested or be knowledgeable enough for this. An interviewee put it concisely as: "*I am not sure whether most of the population is interested in what happens with their data. A part is not digital and will be out of the game".*

2 Adoption of the ecosystem

12 companies mentioned that Solid will only be valuable once **network effects occurred in the ecosystem**, and enough companies have decided to implement Solid. This depends to a large extent on the emergence of use cases for Solid.

On one hand, it needs to be **adopted by the ecosystem** (governments and companies) to make it worthwhile, as it highly depends on developing a data ecosystem. A company mentioned: "*In order to make Solid work out, different applications need to integrate Solid. Do users want this, and do companies want to change their current modus operandi?".* Additionally, for companies to be willing to adopt Solid, there needs to be an **ecosystem of Solid solution providers** which can support them to make the change.

For companies working in a Belgian or Flemish scope the companies mention there will need to be a **national scope** to make this interesting for the companies, while to make it worthwhile for international companies, an **international scope** will be required to make investments worthwhile.

3 Unsure Solid business and revenue model

Five companies mention that there is still uncertainty for different companies how the business model will work for Solid. One question that featured prominently is **who will pay for what:** "*The Solid business model is a challenge. Who will pay who in the chain? Currently, companies want to let the users pay as little as possible. One way could be to let the one who wants data pay. This is an unsure model."*

Another question that is raised is **how companies can be incentivized to change from the current model towards a new model:** "*From the companies receiving data there is also a hesitation to pay for data. Currently they get a lot of data for free, so this is a change from the current model".* It contradicts the current business model of many companies, as was highlighted by an interview subject: "*We are currently in a free economy where the customer is not controlling the data. It requires a different mindset, and someone will need to pay, there will be a price".*

2 Barrier 2: Unsure IT investment Cost

1 Solid cost drivers

For 11 companies, the costs of the IT investment in Solid are currently too high to invest. **The main cost driver relates to the change of the existing IT infrastructure, which needs to be adapted to the Solid standards**. **Changing the IT infrastructure** is a large change for companies, this thought was voiced during the interviews: "*If you want to use Solid, you need knowledge and do investments to integrate the technology. This is a new technology which is different from what companies currently use."*

For companies who **already made investments in IT infrastructure**, it may be a significant barrier, and they will wait to see if it is used sufficiently in the ecosystem. In short: "*For companies who have no existing systems this is an easier decision then companies with legacy IT systems."*

2 Solid technical maturity

Additionally, there is still an **R&D cost as Solid is not yet an established technology.** Therefore, the technological readiness of Solid is currently still a barrier for 8 companies.

Several companies are already implementing Solid but are facing **technological issues** because the Solid technology is **not entirely mature**, it was mentioned that: "*We want to launch our product, but there keep on coming new problems. There are always uncertainties about the evolution".*

One company also mentioned they and their partners currently lack the **technical knowledge to implement Solid** "*The technical knowledge of the ecosystem to implement Solid is not there yet. We do not know yet how complex it will be to implement Solid"*.

3 Barrier 3: Unsure access to data

For **companies, the access to third party data** through Solid is uncertain**:** most in the ecosystem **wants to get access to data, but few want to give access**. The companies fear that **consumers** will not consent out of lack of trust. Additionally, there is a **reluctance by companies to give access** to data that is currently under their control, which depends on **different factors**.

1 User: Willingness of the user to give consent

10 companies are concerned whether the user will be willing to give consent to the companies. The main barriers are the incentives for the users, user experience, and trust in the company.

A first question is whether there will be **sufficient incentives for the users to be willing to share data, and to give consent**. This was mentioned by a particular interviewee as well: "*The main question is, what's in it for the user to use Solid? We will need to convince the user with a value proposition to share data with us. It will not always be easy to do this".* The companies indicate that this depends on the user, as some people care about controlling their data, while others just care about the value they get in return.

The user experience of the consent was mentioned the most as a barrier for Solid, and the willingness of users to share data. Several companies are concerned that the user experience of Solid will be like the experience with cookies: "*It could become something like with cookies, where everyone either clicks 'yes accept all" or "reject everything". If that would be the case, the value of Solid is nonexistent"*. Several companies mentioned that especially **granular consent** is of a high importance: "*For authorization of sharing data, a granular consent is required. That's not easy yet*". This is an important issue to be resolved, as the user experience of consent management is also an important driver for companies to investigate Solid in the first place.

One company mentioned the trust depends a lot on the **type of pod provider, which may differ between commercial and governmental pods.** Also, **trust in the company** may vary from use case to use case, as was noted during an interview: "*Use cases for targeted advertising are not sufficient to make people want to share. The problem is that it will not motivate people, and even scare them".*

2 Ecosystem data provision

16 companies indicate that other companies will be **reluctant to give access to company sensitive and company critical information**. This barrier was mentioned the most, and therefore it indicates the data provision in the data ecosystem will be a major barrier. In short: "*To receive data is the main issue".* The willingness to share data depends on **with whom the data is shared and the data type**.

The willingness to give access depends on **with whom the data is shared**. Most companies do not want to share their data with **competitors.** An interviewee mentioned: "*You do not want to improve the position of your competitor with data, especially if this is disadvantageous for your business".*

The willingness to give access to data depends also on the **type of data**: **business critical data vs. non-critical business data**. Data can be business critical for different reasons. One company mentioned it depends on who processed and put effort in the data: "*It depends on where the IP of the data is. As a user you can offer an ingredient of a cake, but our company makes the cake. So, the IP of the cake would be with our business, while the raw data will belong to the user*".. Data can also be business critical if the company's **business model is based on the selling of this data.** A company representative noted: "*We would love to get data on the profiles of users, but we will not share this data for free with other parties. We make money with this data, so we cannot just share it for free. So, we would not allow a user to sell this data to other companies*".

4 Barrier 4: Data -as-an-asset

There is a reluctance to adopt Solid as several companies perceive it as a threat to their **current data assets**: They do not want to share competitive data; they **do not trust other players** with this data, and they want to ensure the **data is stored securely**.

1 Trust and dependence on others

Another related barrier is that 5 companies indicated they are reluctant to **trust other organizations to become a pod provider**, they may have **legal reasons** why this is not possible, or they may be reluctant due to the uncertain **role of the government**.

On one hand, there is also still **uncertainty on whether entities behind the Solid solutions can be trusted,** and what will be the impact on power dynamics. It was indicated that this was a source of insecurity: "*Who is going to build the Solid solutions. The entity who will build those data vaults will be a very strong entity. The layers who offer this will have a lot of power in the market. Portability will be required, but how will that work exactly?"*

In some cases, this may be due to **legal responsibilities**. They may not want to share the data to keep control over the data. Moreover, the **role of the government** is not clear yet, and this creates some friction for some organizations.

2 Pod security

The **security of the Solid pods** is an important requirement for companies, as was mentioned by 7 companies. Many questions remain, those were also voiced by interviewees: "*Will data be saved securely? Will I be safe? Who is governing the data? If someone gets access to this data, here may be a major data leak*". Companies may prefer not to take the risk to move the data from being securely saved on their premises towards a centralized pod.

Recommendations for Solid ecosystem development

Companies will be willing to invest in Solid when **IT investment cost will be reduced, and when the potential return is increased** (figure 6). Therefore, the Solid ecosystem needs to demonstrate the **business value of Solid (recommendation 1),** and to develop a **technology infrastructure of readily made services (recommendation 2**).

Additionally, to increase the **access to data for data consumers**. This can happen through **user awareness, knowledge, and adoption (recommendation 3)** to increase user adoption and willingness to share. For data providers, the **control to data needs to be ensured** by **(re)considering the distribution of control and system roles (recommendation 4).**

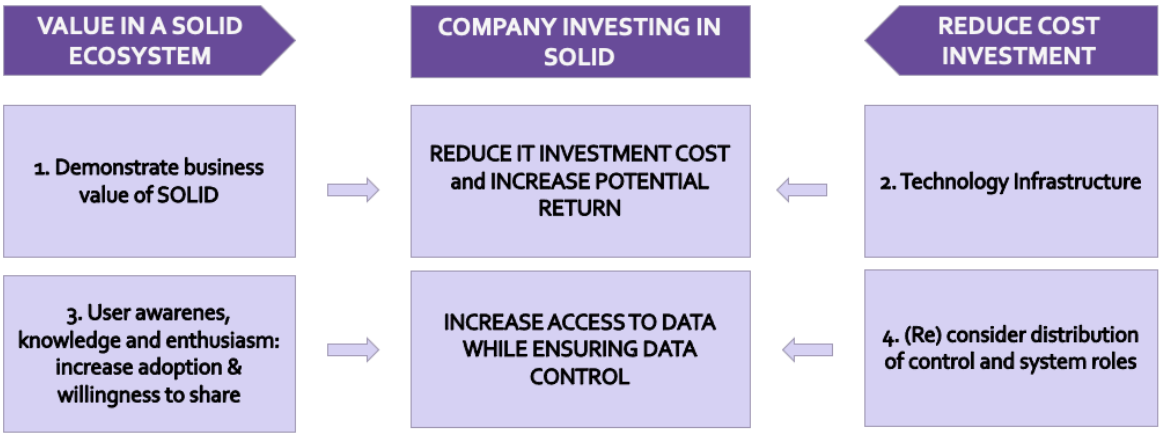

Figure 6: Recommendations for Solid ecosystem development.

1 Recommendation 1: Demonstrate business value of Solid

For companies to make an investment decision in Solid, they require a business case showing the possible return of Solid. This business case depends on potential use cases for Solid, the business and revenue models of Solid need to be clarified, the adoption and willingness to give access to data by other companies needs to be addressed.

1 Use cases for data consumers and data providers

For companies to adopt Solid, there is a need for **Solid use cases** to materialize. It was mentioned that these use cases will need to solve a pain of the user: *"There need to be good Solid use cases which are attractive for the consume (user), and which have a significant added value"*, but also a pain of the companies: *"If we want to find a development of the market for Solid, we need a messaging based on the pain of the company. What is the issue we are solving with Solid?"*

2 Develop Solid revenue models for data providers and consumers

Yet, as was discussed in the drivers above, there are different ways of **creating new business and revenue models with monetary and non-monetary value.** To develop revenue models, special attention needs to be given to how the data can evolve into business outcomes for the data consumers. For data providers, there will be a trade-off between the return companies get from receiving data, with the 'cost' they get from sharing data with others. The outcome of this consideration will determine whether they will be willing to share data, or not. In short: *"There is a consideration between "how much data can I use from other companies to improve my service" with "I do not want other companies to use my data".*

2 Recommendation 2: Technology infrastructure

1 Readily made Solid services

The Solid ecosystem needs Solid service providers and application service providers that can provide **readily made Solid services** which may be able to lower the investment costs as the technology matures.

The ecosystem needs first-movers in the form of Solid service providers and application service providers. By being the first, these companies can differentiate themselves by developing their expertise with Solid, by developing a first user base and by developing a trustworthy position in the Solid ecosystem. This way, data consumers and data providers may follow if an existing ecosystem of Solid service providers emerges.

2 Technical maturity

To reach technical maturity, an important focus will need to be put on further technical research and development of Solid, to ensure the **stability of the solution**. Additionally, an important focus needs to be made on technical maturity to overcome the barrier of **security**. This was indicated as key because: *"Trust in security and privacy will be crucial for companies to be willing to outsource their data and data sharing."*

3 Recommendation 3: User awareness, knowledge, and enthusiasm

1 Increase user adoption through an improved user experience

To ensure user adoption, creating a significantly improved user experience will be required. Additionally, the user experience of consent management was one of the primary drivers for companies to investigate Solid, but they still fear the user experience will not be sufficient as it is at the moment. To create this, one company mentioned that the **user experience will need to be different based on the use case**. In the case of very sensitive data, a lot of identification and authorization steps will be required to be secure, whilst for other data these steps will be too difficult for the user, and he will not do it. One company mentioned that users also will need a good visualization of with whom data has been shared and for what: *"The user will need a good interface to visualize with who data has been shared and for what. This will need to be transparent for the user. This is something I am currently missing".*

Some companies mentioned that **users will not have to know they are using the Solid technology, but that the user experience will be the most important factor for the user**.

2 Tap into existing ecosystems

To ensure user adoption of Solid, it may need to be integrated in **existing ecosystems to grow the user base**. Thus, ecosystems that exist can enable Solid to grow, without having to develop their own separate ecosystem.

3 Engender trust of the user to share data

Foremost, the companies will need to ensure that the **data will be used correctly by the companies to gain the trust of the user**. Second, the companies indicate that the willingness to share data of the consumer will depend significantly on the use case and on the people. Therefore, there will be a need for a **personalized approach of creating trust.** A company representative described it as follows: *"Creating transparency is personal. For a lot of people, it will be a lot of work to get this overview of the data. Will people have time, experience and be willing to put this effort?"*

4 Consider (monetary) incentives for the user

One point of discussion that was raised was that companies may want to **consider paying or incentivizing users to share their data:** "*An end user may want to give data if he gets a better service in return. This may work, but it differs a lot from use case to use case. There is a cost to implement this. Who will pay for that?"* Whether the incentivization needs to be monetary remains to be researched. One participant was skeptical about this based on research in the United States: "*There were models in the US where incentives were given for the user to share their data. This was not successful, as the data quality was not good. It didn't matter if the data was correct or not, so the user just shared incorrect data just to get the incentive".*

4 Recommendation 4: (Re)consider distribution of control and system roles

1 Joint control between user and data provider

In the current situation, the data providers can decide whether access to data is given to a certain player, or whether this access is not granted. To move into developing a Solid ecosystem with access to data, the data provider will need to be incentivized to share data, and they will need assurance that certain types of competitive, company sensitive data will be safe in the Solid ecosystem. Companies want to generally have **control with whom the data is shared**, and next to that they want to have **control over what happens with the data**.

Yet, Solid aims to bring the control to the user, but for this a clear definition needs to be made for **which type of data the user can have control, and for which data the data provider can have control**. A **joint control between the user and data provider** can be a potential way forward to convince data providers to share additional data in the Solid ecosystem for specific types of data. A trade-off could be made on which types of data will be controlled by whom:

- Data controlled by the user solely (e.g., strictly personal data);
- Data controlled jointly by the data provider and the user (e.g., inferred data, data on algorithms);
- Data controlled by the data provider solely (e.g., competitive and company highly sensitive data which does not involve personal data).

Further research needs to identify which data should be controlled jointly.

2 Sensitive data protection: Aggregators and technology

If the data in these collaborations is still business sensitive, **trustworthy aggregators** could play a role in ensuring data can be shared in the ecosystem. If there is a lack of trust between certain companies, these aggregators can be a trusted middle way to ensure willingness to share data can materialize.

Additionally, **technological solutions which ensure the sensitivity of the data is protected** could be implemented. One startup is building a solution which enables to share the data without showing. This way, a partnership could be set up where only the outcome of a question is shared, not the data nor the algorithm. One interviewee pointed to a current practice: "*One solution is to share the data without showing. Companies can share a derivative of the data. The data could be put in a black box, together with an algorithm which makes the necessary calculations. Nobody would get access to the algorithm nor the data. That way, the outcome can be shared, without sharing the sensitive data or the algorithm. This way we can build trust for sensitive data*."

3 Role clarification

To enable trust in the ecosystem, the different roles of players need to be clarified. Certainly, the **role of the pod provider and identity provider** is a role which will need to be clarified, as companies want to be sure that the data will be managed by a trustworthy player. Additionally, which player takes up

the role of data provider is important, as this player will need to be trusted by the user and by companies.

Additionally, **the role of the government**, especially the Data Utility Company (Datanutsbedrijf), will needs to be clarified. Some players are not sure whether it will become a service provider for them, or if it may be a competitor. Thus, a clear positioning will need to resolve this trust issue.

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