Business model scenarios for engendering trust in smart city data collaborations

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Abstract: Smart city data has the potential to be used to support evidence -based decision making. Yet, to fulfil this potential, private data needs to be shared with governments in data collaborations, in which. trust between the participating actors is a major prerequisite. This paper aims to provide an answer on 1) what the business conditions and challenges for smart city data providers collaborating to share sensitive data to engender trust among each other are and 2) what the impact of open and closed business model configurations on the trustworthiness of smart city data collaborations is. A case study analysis of the Smart Retail Dashboard aims to set up a data collaboration between smart city data providers and cities to improve the evidence-based decision making of local retail policy makers. An analysis is made of the data sharing business model conditions of trustworthiness in an open, closed and hybrid model. The paper concludes with the advantages and disadvantages of each scenario to engender trust and how these scenarios solve the earlier determined challenges.

1. INTRODUCTION – DATA COLLABORATIONS FOR EVIDENCE-BASED DECISION TOOLS

City officials aim to make decisions based on objective and measurable parameters. Technology and data have some role to play in supporting or implementing policy (Hollands, 2008), but how that role should be filled remains unclear and is often the result of trial and error. The trend towards data-driven policymaking, which refers to policy decisions made based on objective empirical and evidence-based evaluation research about the context, need and efficacy of different policy programs rather than subjective intuition (Janssen & Helbig, 2018) is raising in importance.

As urban policymakers are faced with unique opportunities, the utilisation of urban big data technologies to make advancements towards the sustainable development of a city becomes more prevalent in cities (Kharrazi et al, 2016). Indeed, while data-driven policy making has always been present to more or lesser extent in policy making, the availability of vast amounts and new forms of data introduced by new information and communication technologies, as well as the increasing ability to combine data from diverse sources and domains can provide new types of tools and insights to policy makers. This data can be captured from Internet of Things solutions (e.g., sensors in public parking garages, passer-by sensors), privately owned data (e.g., transaction data of financial institutions…) or detailed data on the public domain (e.g., from satellite imaging).

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Local governments have access to open data sources and their own data, but the access to different Internet of Things and private data is limited. As the data is currently owned by different stakeholders, data silos which are not interconnected occur. To remove these data silos, data sharing between the different players is required to support the cities to make the evidence-based decision-making opportunities a reality. A potential solution are data collaboratives, which are "cross-sector (and public-private) collaboration initiatives aimed at data collection, sharing, or processing for the purpose of addressing a societal challenge" (Susha, Janssen, and Verhulst, 2017).

Several challenges are preventing data collaborations between private companies and governments, as many companies are reluctant to share data due to a lack of trust (Richter & Slowinski, 2019; Naslund, Kembro, & Olhager, 2017; Spiekermann M. , 2019; Dahlberg & Nokkala, 2019; European Commission, 2018). Data sharing can cause commercial risk, as companies refrain from sharing sensitive information with other companies, which might reduce a competitive advantage (Martens, 2020 ; Thilo & Verhulst, 2017; Jarman & Luna-Reyes, 2016; Agahari, 2020). Additionally, sharing data might cause companies to lose control over their data and requires redesigning the governance in inter-organizational relationships (Abraham, 2019). Therefore, trust is regarded as a prerequisite for a data ecosystem to survive among strong competitors (Schreieck et al. 2016; Hein et al. 2016; Abraham, 2019).

Business model literature can shed new light on the challenges related to trust in data ecosystems. The way how the business model of a data collaboration is designed is of high importance for increasing trust, as misuse or abuse of data is getting more prevalent (Lee et al, 2017). The structure of data collaborations, roles, trust, openness, and control are key aspects in the design of the business model (Schreieck et al, 2016; Hein et al, 2016; Tiwani et al, 2010).

The strategy of opening or closing an ecosystem Schreieck et al. 2016; Hein et al. 2016) is an important decision in the design of the network-level business model of the data collaboration. A closed model heavily regulates the access to the platform and is limited to a selection of partners. An open model is aimed at a broad and unknown group of participants (Spiekerman, 2019). Limited research has been done on what the impact of the openness is on the levels of trust and the willingness to collaborate between players in the data ecosystem. In this paper, the authors aim to give an answer to the following questions:

- *What are the business conditions and challenges for smart city data providers collaborating to share sensitive data in order to engender trust among each other?*
- *What is the impact of open and closed business model configurations on the trustworthiness of smart city data collaborations?*

These questions are analysed in this paper through applying the Data Sharing Business Model Framework (D'Hauwers et al, 2021) which can be found in figure 1, on an evidence-based decision tool being developed in Flanders, Belgium: the Smart retail Dashboard. First, the Smart Retail Dashboard is introduced in section 2, followed by an analysis of the Smart Retail Dashboard ecosystem, covering the first research question '*What are the business conditions and challenges for smart city data providers collaborating to share sensitive data in order to engender trust among each other*' in section 3. Next, different business model scenarios will be presented for the collaboration between companies in the Smart Retail Dashboard, answering the question '*What is the impact of open and closed business model configurations on the trustworthiness of smart city data collaborations?* ' in section 4. Finally, the different business model scenarios are compared and we explore to which extent they cover the business conditions and challenges, in the discussion section of the paper.

2. CONTEXT AND AIM

2.1 Case Study: Smart Retail Dashboard project

The increased demand for data-driven policy making for the local economy led to the 'Smart Retail Dashboard' project, initiated by the Flemish Governmental Agency 'VLAIO' (Vlaams Agentschap Innovatie en Ondernemen), which is responsible for innovation and entrepreneurship in the region. The aim of the Smart Retail Dashboard is to support policy makers in Flemish cities with making decisions based on urban data sources through collaborations between public and private data sources. Within the scope of this project, researchers from the Interuniversity Microelectronics

Centre (IMEC), a research and development organization based withing Flanders, are managing a feasibility study to assess the need for gathering different existing data sources both from within the government (including socio-demographic data, data on opening hours etc.) as well as from external/ private/smart city data sources and visualizing this data in a Smart Retail Dashboard in order to support policy makers and eventually retailers in making decisions based on actual smart city data. The use cases and required data of the Smart Retail Dashboard are shown in Table 1.

Table 1: Use cases and data sources of the Smart Retail Dashboard

Use Case	Data Source
Attract retailers to the city	Profiles of visitors, Crowdedness, Turnover of retailers, Transactions of visitors
Develop retail strategy	Supply data of retailers, Profiles of visitors, Purchasing streams, Turnover of retailers, Transactions of visitors
Event Management	Profiles of visitors, Crowdedness, Turnover of retailers, Transactions of visitors, Weather data, Walking routes in the city
City Marketing	Profile of visitors, Impact marketing campaign, Motives of visitors, Transactions of visitors, Walking routes in the city

IMEC performs the feasibility study in distinct phases:

- Phase 1: Defining the needs and challenges regarding use of data of cities and retailers.
- Phase 2: Defining the requirements of cities and retailers for a Smart Retail Dashboard.
- Phase 3: Defining the conditions and availability of private data sources.
- Phase 4: Open call for smart city data sources and IT providers to build and pilot the Smart Retail Dashboard; and
- Phase 5: Run a pilot version of the Smart Retail Dashboard to test it in two cities.

The project is in phase 4 at the time of writing, where an open call for smart city data sources and IT providers to build and pilot the Smart Retail Dashboard is developed. Based on the outcomes of research phase 3, the conditions and availability of private data sources, a business model analysis was performed which is the subject of this paper.

2.3 Methodology

In section 3 of the paper, an analysis of the smart city data provider ecosystem for the Smart Retail Dashboard will be performed employing a case study methodology. The scope of a case study is "an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident" (Yin, 2014). The data sharing business model framework (D'Hauwers, Walravens, 2021), is used as a tool to analyse data sharing ecosystems in a research setting. It also provides the building blocks to design business models for data sharing on a network level. It is based on four distinct factors:

- Value: How is value created and captured through financial models?
- Data governance: How is the quality of data ensured?
- Ecosystem trust: How is the trust in the ecosystem ensured?
- Data trust: How is the trust in the data ensured?

Each building block is made up of a different factor. For example, the building block "value" is determined by ecosystem value, value proposition, etc. For each factor, there are different choices which need to be made to determine a business model configuration, which means that ecosystem value can be transaction-centric or data-centric. A combination of different choices is the foundation of a business model configuration, as the distinct factors are likely to influence each other. These factors constitute the business model choices that will need to be made, which results in the business model configuration of a data ecosystem.

The framework serves as a useful tool to develop a topic list to perform and analyse interviews. The framework is applied in a research setting to identify the status of the Smart Retail Dashboard. The analysis is based on interviews with 11 companies, selected based on their current activities in providing evidence-based decisions tools, as well as based on the analysis of the data needs of cities, which was an outcome of phase 1 and 2 of the Smart Retail Dashboard research. Based on the analysis, the main challenges for developing the business model of the Smart Retail Dashboard are identified.Business model scenarios are developed based on the data sharing factors of an 'open model', 'hybrid model' and 'closed model' as developed by (Spiekerman et al, 2019) and analysed based on the interviews and on workshops with the agency VLAIO with the market data collaboration conditions in the smart retail dashboard
Based on the data sharing business model framework (Table 3), an analysis is made of the data sharing

ecosystem of the Smart Retail Dashboard. Below, an explanation is given based on the four main components of the data sharing business model framework: value, data governance, ecosystem trust and data trust.

Table 3: Data sharing business model Smart Retail Dashboard

SMART RETAIL DASHBOARD			
VALUE		**DATA GOVERNANCE**	
Ecosystem Value	**Data Centric/** Transaction Centric	**Policies & Processes**	**Yes**/no
Value Proposition	Data/**Information**/Product/Service	**Quality standards**	Global/European/National/ **Sector**/Company level
Revenue Model	Free/**Freemium**/ Fee/ **Subscription**	**Quality Monitoring**	**Central**/Decentral
Cost Model	**High**/Medium/Low	**Conformance**	**Legal/Agreements**/ Informal
	Concentrated/ **Distributed**		
ECOSYSTEM TRUST		**DATA TRUST**	
Trust	Trust/**No Trust**	**Trust data**	Trust/**No Trust**
Data Sharing	Open/ Closed/ **Hybrid**	**Collaboration**	Trust/**Contracts/Power dynamics**/Open
Data ownership	Central/**Decentral Dominant player**/distributed/ open	**Interoperability**	**Standards**/No standards
Market dynamics	Cooperation/**Competition**	**Traceable**	Yes/**No**
Data type	**Personal data**/ Open Data/ **Proprietary data**	**Control data**	**Consult/ Reuse**/Remix/ adapt/ built upon
Customer ownership	**Direct / mediated**		
Sharing Risk	**Commercial/ legal/ sharing**		

2.2 Value

The Smart Retail Dashboard requires data-centric services (services on data-analysis and data visualisations) from different stakeholders, such as banks, telecom providers, passer-by data providers (e.g., from WIFI-sniffers or Bluetooth beacons) and other service providers in order to provide information services to cities in the form of a retail dashboard. The ecosystem value of the Smart Retail Dashboard comprises of ensuring that public authorities can make decisions based on actual data. In order to provide this value, the different actors combine smart city information and data such as transaction data, passer-by, visitor profiles and so on, to support cities to make decisions regarding retail plans, mobility plans, events, city marketing. As the policy demands might shift over time, the required data sources might also change. This requires flexibility in terms of the service offering of the Smart Retail Dashboard.

The revenue model for the different actors ensures monetary incentives to share data and is based on license fees and usage fees. The interest of the different cities and the ecosystem value is high, as it can enable cities to ensure the sustainability of the local economy, especially after shops in Flanders were closed for a significant amount of time after the COVID-19 crisis. Yet, the budgets the cities must allocate to pay for the Smart Retail Dashboard are limited (10.000EUR up to 30.000EUR per year). Additionally, in Belgium between 20 and 50 cities might be able to be willing to pay for the Smart Retail Dashboard, thus the total addressable market is small. The costs of data processing and standardization in the case of combining a lot of data might be high, which poses a challenge to make the development of the Smart Retail Dashboard realistic.
Given the societal value of the Smart Retail Dashboard, governmental support of higher governments (on the Flemish level) is required. An important criterion for choosing an appropriate business model will be to ensure that overall costs are not too high, thus still making the Smart Retail Dashboard an interesting opportunity for participating data platforms and data providers.

2.3 Ecosystem trust

There is a limited ecosystem trust due to commercial risk, especially between competitors. Additionally, there is no trust that certain players might reshare the data with external stakeholders, which might cause the companies to lose commercial value. Additionally, the privacy risk is high in the ecosystem.

Data ownership is decentralized with a limited number of dominant players, such as banks and telecom providers, or by public entities such as the city councils. As the data in the smart retail dashboard concerns personal information (transaction data, passer-by, and visitor profiles), the data is subject to the GDPR legislation and might only be shared after several privacy check-ups. Additionally, companies might refrain from data sharing due to the public opinion regarding data sharing, as in e.g., Kortrijk (a mid-sized city in Flanders) a data-sharing collaboration between the city council and a telecom provider came negatively in the media (Datanews, 2019). As the data also concerns proprietary data that companies do not wish to share with competitors or with cities, as the commercial value might be lost.

The customer relationships are in some cases direct (for telecom providers and banks) but could also be indirect (passer-by data owned by the city council). Ethical and legal questions might arise on whether the citizens need to provide consent in order to be able to share the data, which is currently not the case in the case of passer-by data.

2.4 Data Governance

Privacy infringement is a considerable risk in the Smart Retail Dashboard, especially in the case when data from different data providers is combined. The data owner and the data platform have the role to ensure processes to avoid the risk of **re-identification** of anonymized data. The Smart Retail Dashboard needs to conform with the **GDPR legislation** (European Commission, 2018), which might contradict with the **PSD II** legislation (European Commission , 2018), which supports the sharing of data between financial providers and open data directives. On one hand, the personal data needs to be protected, but on the other hand, the Smart Retail Dashboard data concerns public data which might need to be shared when possible.

To ensure the quality of the data, different **quality standards** are required, such as the 'Definitiehandboek Drukte in de Stad' (Smart Flanders, 2018), a definition handbook in which contains arrangements between Flemish cities on structured definitions of profiles and characteristics that can be used when measuring crowdedness in the city. The quality of the data will need to be monitored by the data platform, and the quality of data needs to be ensured by the individual data providers.

2.5 Data trust

The trust in the data is low, especially with the city councils involved, mainly because different standards were used in the past, which led to a low historical and geographical comparability of crowdedness in the city.

As a result, the Smart Retail Dashboard needs to comply with **standards** in the "Definitiehandboek Drukte in de Stad" (see above). Additionally, OSLO standards (open data standards) (Vlaamse Overheid , 2012) and OASC **Minimal Interoperability Mechanisms** (OASC , 2019) can ensure interoperability between the different companies. These standards can make sure the cities and the companies will be able to share data in a comparable and trustworthy way. Additionally, the data is currently not **traceable** by the owners of the data, and thus companies have no control over who can use the data and whether the data can be reshared. Using licenses, companies exercise more control over who can use the data. In this case, licences need to allow the consultation and re-use of the data, but not to reshare the data.

2.6 Main Challenges

Based on the analysis of the data collaboration conditions, the following challenges are the major barriers for a Smart Retail Dashboard data collaboration:

- Due to the competitive nature of the market, there is a limited **trust in the ecosystem**, resulting in a low willingness to share data.
- Due to the nature of the data (**personal data**), the collaboration needs to ensure trust can be created in the processing and gathering of the data.

The following two points are important preconditions for the business model to be successful:

- Develop a value proposition which is easily **adaptable to the changing city needs.**
- Due to the limited total addressable market, a **realistic revenue model and collaboration model** needs to be identified.

3. BUSINESS MODEL SCENARIOS

The market conditions show that many actors operate in the ecosystem in a competitive environment. In order to overcome this lack of trust in the ecosystem, collaboration models need to be determined.

The factor utilised to develop scenarios are the data sharing model parameters **'open, hybrid or closed'** (Spiekerman et al, 2019). Based on these parameters, the major questions that can be raised is whether a model should be established which is:

- Open: a collaboration where all data owners can join the data collaboration,
- Closed: a closed consortium with only selected data owners,
- Hybrid mode: a closed consortium with the possibility to add data owners when required.

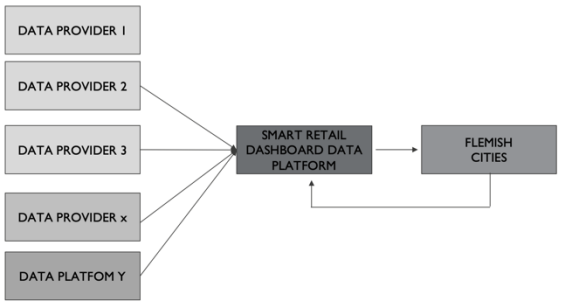
Below, the three scenarios are discussed, showcasing the possible value networks of the data collaboration with different positive and negative factors related to the scenarios.

3.1 Open model

In the open model, all data providers are allowed to contribute to the Smart Retail Dashboard if they fulfil

basic criteria, and receive a fee based on the percentage of their data contribution to the final offering. Additionally, the city could add data of their own, acquired from third-parties or gathered by themselves, on the data platform. That way, the data platform can utilize the city data to enrich the data insights gathered on the data platform. Also, other data platforms could be integrated with the Smart Retail dashboard platform (e.g., legacy systems, governmental dashboards…).

Figure 1: Open model Smart Retail Dashboard



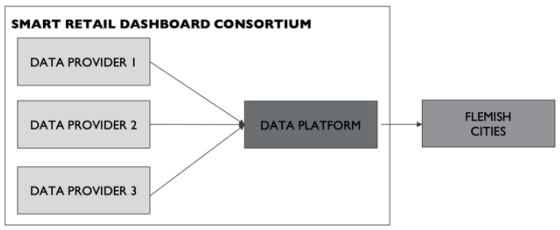
The data platform is a neutral player, who can be trusted by all the parties. The neutral player could be a trusted governmental player or a trusted private partner depending on which entity is trusted by the ecosystem. In the case of the Smart Retail Dashboard this needs to be a player who cannot get personal benefit from selling the data, and thus cannot be a data provider him or herself to be independent. Thus, a data provider cannot play the role of a data platform as they might have individual objectives. The data platform is the final responsible for the data governance, which concerns the data quality and compliance to (privacy) regulations. It has a broker role, ensuring to gather the data with the use of APIs and to standardize the data. The data platform combines the data, while managing re-identification risk and ensures encrypting data where needed.

Additionally, the data platform coordinates the data providers by allowing who can contribute their data, based on predetermined criteria. Additionally, as potentially different data providers are competitors, the data platform keeps the data separated in silos, so the different data providers do not have access to data of its competitors. The trusted data platform should set up governance rules on who can access the data, who can contribute to the data platform and what are the guidelines for collaborating.

3.2 Closed model

In the closed model, a limited amount of data providers creates a consortium. The consortium is composed of complementary players, who do not compete but collaborate. The data providers receive a fee based on the percentage of their data contribution to the final offering to the cities, as is negotiated in the beginning of the collaboration model. Adding data by the cities is not possible in this model.

Figure 2: Closed model Smart Retail Dashboard



The data platform can also be a data provider, if this player has the technological and coordination capacities to fulfil this role. Also, the data platform needs to be trusted by the other participants of the consortium to play this role.As it concerns a closed ecosystem, the trust is created through agreements and contracts between the closed consortium prior to setting up the platform. As the different participants have full control over who is part of the ecosystem, trust is a precondition to enter the closed consortium at the beginning of the collaboration. As the partners have mutual benefits of entering in this partnership, trust arises out of this discussion.

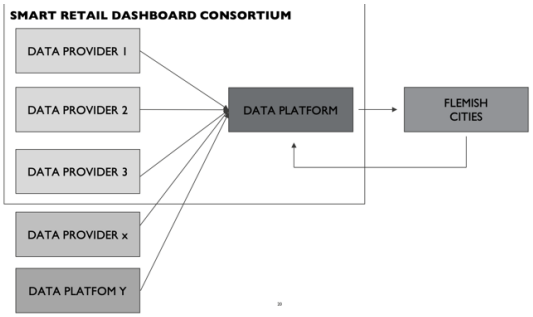
The data platform is the final responsible for the data governance, thus the data quality and compliance to (privacy) regulations, yet all the partners have an important responsibility. The data platform thus combines the data, while managing re-identification risk and ensures encrypting data where needed.

3.3 Hybrid model

In the hybrid model, a limited amount of data providers creates a consortium. The consortium is composed of complementary players, who do not compete but collaborate. The data providers receive a fee based on the percentage of their data contribution to the final offering to the cities, as is negotiated in the beginning of the collaboration model. Yet, through subcontracting additional data providers could be added to the consortium, either on a short term – or long-term basis. The data platform decides which subcontractors can be added to the consortium,

based on requests of the cities. Additionally, the city could add data of their own (acquired from third-parties or gathered by themselves) on the data platform. That way, the data platform can utilize the city data to enrich the data insights gathered on the data platform. Also, other data platforms could be integrated with the Smart Retail dashboard platform (e.g., legacy systems, governmental dashboards).

Figure 3: Closed model Smart Retail Dashboard



Like the closed model, the data platform can also be a data provider, if this player has the technological and coordination capacities to fulfil this role. Also, the data platform needs to be trusted by the other participants of the consortium to play this role.As it concerns a closed ecosystem, the trust is created through agreements and contracts between the closed consortium prior to setting up the platform. As the different participants have full control over who is part of the ecosystem, trust is a precondition to enter the closed consortium at the beginning of the collaboration. As the partners have mutual benefits of entering in this partnership, trust arises out of this discussion. As it concerns a model where the core consortium members decide on which external partners can enter the consortium, they can shape the guidelines and conditions for entering the partnership and thus can base this decision on whether they trust the potential new entrant.

The data platform is the final responsible for the data governance in a similar role as in the open model, as it needs to ensure the data quality and compliance to (privacy) regulations. It has the role of integrating and gathering data (from consortium members subcontractors and of the city), ensuring to gather the data with the use of APIs and to standardize the data. The data platform thus combines the data, while managing re-identification risk and ensures encrypting data where needed.

4. DISCUSSION

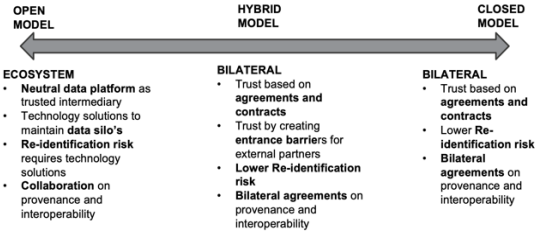
The research questions guiding this paper were 1) *What are the business conditions and challenges for smart city data providers collaborating to share sensitive data to engender trust among each other?* and *2) What is the impact of open and closed business model configurations on the trustworthiness of smart city data collaborations*. Based on the challenges determined in the third section of this paper, the different models were analysed, resulting in the pro- and contra arguments discussed below.

The different options are analysed using input from interviews with potential data providers, a workshop with data providers and with the Flemish Governmental Agency 'VLAIO' (Vlaams Agentschap Innovatie en Ondernemen), based on the following factors:

- Ecosystem trust: to which extend is the low trust in the ecosystem due to the competitive nature of the market solved?
- Data Trust: to which extend is the privacy risk solved?
- Value proposition: to which extend is the value proposition flexible to adapt to the needs of the cities?
- Cost model: to which extend is the cost model affordable and kept on a sustainable way

Figure 4 shows the main differences between the open, closed and hybrid models, as discussed below.

Figure 4: Open vs. hybrid vs. closed model



The **open model** is a model with a high complexity, as it requires competitive companies to collaborate with each other. As it concerns an ecosystem approach with a multitude of partners, an ecosystem governance to maintain trust is required. Technological solutions might tackle this issue by keeping the data in different silos, as well as a model with a trusted third party with no stakes in selling the data. Yet, this can still cause trust issues, as competitive companies might not want to collaborate, and fear that it would lower their competitive advantage. In terms of data, it also requires a more

complex technological solution to combine data, as more data sources are included. Thus, a higher risk for re-identification exists, which might cause anonymized personal data to be 're-identified'. Additionally, to engender data trust technologies and agreements between the partners are required to ensure the data is traceable to ensure provenance. Agreements need to be made between the different partners regarding interoperability, which require collaboration between the entire ecosystem. The advantage of this model is the highly flexible solution, as it would be easy to allow additional data providers to enter which would enable it to adapt to the needs of cities. However, due to the more complex technological solution and the amount of coordination that would be required, the costs might be higher.

The **closed model** only consists of complementary players which are not competitive. As it concerns a bilateral collaboration with a limited number of partners, a more traditional business relationship can be maintained. Thus, the closed model relates to higher trust in the partnership as agreements are made prior to entering the collaboration. Additionally, as there is a limited amount of data which needs to be combined, lower risks of re-identification occur, which results in a lower coordination effort. There is also a lower degree of technological solutions required to ensure provenance, due to smaller number of partners. Agreements need to be made between the different consortium member interoperability, which require bilateral discussions. The coordination and technical costs will be significantly lower compared to the open model. The disadvantage is the limited flexibility vis-à-vis the needs of cites as less data sources are included.

The **hybrid model** is a combination of the open and closed model, as only complementary players are part of the collaboration. Similar to the open model, a more traditional business relationship can be maintained as it concerns bilateral agreements. Thus, the closed model relates to higher trust in the partnership as agreements are made prior to entering the collaboration. Additionally, there is a limited risk of re-identification resulting in a less complex model. There is also a lower degree of technological solutions required to ensure provenance compared to the open model, due to smaller number of partners, yet for the subcontracting partners province solutions are required. Trust is created through contracts and agreements prior to the partnership, and new entrants can enter based on whether they are trusted by the core consortium members. As subcontractors are allowed into the model, additional data sources could be added upon request, increasing the flexibility of the Smart Retail Dashboard, while still being able to reduce the costs significantly compared to the open model.

5. CONCLUSION

To develop a trustworthy business model, different challenges need to be overcome regarding **trust in the ecosystem** (Do the different partners trust each other?) and **trust in the data** (Can privacy requirements be maintained? Can provenance of the data be ensured? Can interoperability between the partners be guaranteed?). When overcoming these challenges in a data collaboration, important preconditions are the value proposition and the cost model occur. In the design of data collaborations, the **openness of the data collaboration** is a crucial factor which influences the trustworthiness of the business model. Thus, important decisions need to be made in the design phase of the data collaboration. The level of openness determines whether the collaboration will consist of bilateral relationships or networked relationships in an ecosystem.

To engender trust in the **open model**, where the collaboration operates in an ecosystem, several complexities need to be overcome. The collaboration between the companies might include trusted intermediaries and needs to consider the neutrality of the partners. The number of agreements that need to be made regarding standardisation, provenance and interoperability are numerous, and technological solutions are required to ensure that the data cannot fall into the wrong hands or to ensure privacy issues cannot prevail. Thus, the cost will be higher, whilst it might generate a more appealing value proposition and will enable the ecosystem to innovate faster in the case of changing customer needs. In a **closed and hybrid mode**l, the complexities are of a lower degree, as it consists of fewer relationships, which can be solved through mutual trust and agreements, and the data interactions are less complex. Thus, the cost will be lower, but the model will be less able to provide an appealing and flexible value proposition. When deciding which model is the most beneficial for a data collaboration requires a trade-off between complexities and related costs, with the desired value proposition and flexibility it wants to provide.

In further research, the different degrees of openness in the trustworthy data collaborations will be analysed and validated with a more concrete division of roles, as well as a real-life trade-off will be made of the decisions related to the business model of the Smart Retail Dashboard.

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