



# D7.2 “Sustainable business model for TRUSTS data marketplace II”

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# TRUSTS Trusted Secure Data Sharing Space

## D7.2 "Sustainable business model for TRUSTS data marketplace II"

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## Glossary of Terms and Abbreviations Used

Abbreviation / Term	Description
ACM	Association for Computing Machinery
AML	Anti-money laundering
APIs	Application Programming Interfaces
BDVA	Big Data Value Association
CKAN	Comprehensive Knowledge Archive Network
D2.1	Deliverable 2.1 "Definition and analysis of the EU and worldwide data market trends and industrial needs for growth"
D2.3	Deliverable D2.3 "Industry specific requirements analysis, definition of the vertical E2E data marketplace functionality and use cases definition II"
D2.7	Deliverable D2.7 "Architecture design and technical specifications document II"
D3.6	Deliverable D3.6 "Data Marketplaces with Interoperability Solutions II"
D3.10	Deliverable D3.10 "Platform Status Report II"
D4.1	Deliverable D4.1 "Algorithms for Privacy-Preserving Data Analytics"
D7.1	Deliverable 7.1 "Sustainable business model for TRUSTS data marketplace I"
D7.2	Deliverable 7.2 "Sustainable business model for TRUSTS data marketplace II"
D8.1	Deliverable D8.1 "Dissemination and communication strategy, design guide, materials and communication channels"
DAO	Databroker
DMA	Data Market Austria
EC	European Commission
EFA	European Fundraising Association
EOSC	European Open Science Cloud
EU	European Union
FRs	Functional Requirements
GDPR	General Data Protection Regulation
HCM	Hierarchical Component Model
ICT	Information Communication and Technology
IDC	International Data Corporation
IDSA	International Data Space Association
MRL	Market readiness level



Abbreviation / Term	Description
MVP	Minimum Viable Product
PTPO	Platform-To-Platform Openness
QA	Quality Assurance
SMEs	Small and medium-sized enterprises
STOF	Service, technology, organisation, and finance
T7.1	Task 7.1 "Sustainable business models"
TU Delft	Delft University of Technology
TRM	Transaction monitoring
TRUSTS	Trusted Secure Data Sharing Space
UC	Use case
W3C	World Wide Web Consortium
WP	Work package

## Executive Summary

This deliverable is part of WP7, "Business Model, Exploitation & Innovation Impact Assurance," of the "TRUSTS-Trusted Secure Data Sharing Space" project. D7.2 focuses on selecting and evaluating business model options for the TRUSTS platform. The business model options proposed in this deliverable suggest a path for bringing the TRUSTS platform to market.

The deliverable is divided into two main parts:

- Part A focuses on TRUSTS as a data marketplace. The assumption is that the data marketplace operates in the current landscape of the data economy. In Part A, two versions of a business model are designed: a base model with adequate features to create value and an add-on model with additional value propositions. We provide multiple business model options such that a TRUSTS operator can select the business model that fits the current and future data marketplace landscape.
- Part B focuses on TRUSTS as a federator of data marketplaces. In this part, the assumption is that TRUSTS evolves into a federator of an ecosystem of data marketplaces. Federation could help resolve the fragmentation of today's data economy without interfering in health competition between existing data marketplaces. As federation is complex to achieve, a federation business model likely becomes possible only in the longer term after the data marketplace model from Part A has become operational. The value propositions of such a federator platform involve an (advanced) search engine, comparison site, and one-stop shop.

In each part of the deliverable, risks and actionable recommendations are derived.

In order to commercialize *TRUSTS as a data marketplace*, the following recommendations are made:

- Subsidize the initial data providers. As data marketplaces create value by matching the supply and demand of data, the initial users will derive little value. Therefore, we advise subsidizing the initial users. Attracting the initial data providers will be essential to kick-start the platform and attain a critical mass of users. As more data providers join, a larger variety of data will become available, making the platform more attractive for data consumers, thus generating a network effect.
- Charge a transaction fee: For every transaction made, a percentage should be paid to the TRUSTS platform. In this way, the revenue streams become more robust as the platform grows to create more transaction opportunities.
- Consider complementary pricing models: The transaction fee can complement a membership and subscription fee. Besides generating revenues, a membership fee will create a threshold for users to join, which helps ensure the quality of data provided on the platform. A subscription fee will, hopefully, ensure long-term commitment to TRUSTS.
- Create a small range of offerings first, and diversify later: TRUSTS should focus on an initial niche of offerings rather than seeking to provide an entire range of offerings in an early phase. Specifically, the advice is to leverage insights and offerings from the TRUSTS use cases to propel the platform with initial data sets. Feedback from initial users of TRUSTS offerings will likely provide insights into what new offerings should be prioritized to create additional added value.
- Promote visibility to attain trust: TRUSTS should engage in promoting its visibility. This would help reduce barriers to sharing data and promote acceptance of TRUSTS in different communities.

- Leverage the anonymization tool. The TRUSTS tool for anonymization is a valuable incentive for actors to share data as consumers increasingly consider privacy as a key part of their buying decisions.

Considering the long-term vision of *TRUSTS as a federator*, this deliverable reveals a clear path forward. In today's fragmented data economy, data providers and consumers struggle to locate data assets. However, the diversity of data marketplaces across industries and countries also poses freedom of choice and competition. Federation could resolve fragmentation without damaging the diversity of data marketplaces across industries and geographies. Based on an analysis of aggregator business models in other fields, a business model for the context of a federated data marketplace was developed. An empirical study in this deliverable suggests that the offerings of a federator business model positively contribute to trust, mitigate risks, and eventually increase data providers' willingness to exchange business data via a federated data marketplace. Part B thus gives vital evidence of the business viability and practicability of achieving the data marketplace federation's long-term ambition. The TRUSTS project implemented essential characteristics for this data market (e.g., data exchange TRUSTS Component, data exchange client component, registry of data markets). The proposed roadmaps provide actionable steps to explore scaling up the TRUSTS platform to fulfil a vision of federation, thereby removing fragmentation that inhibits the growth of the data economy.

While Part A and B have different assumptions of what TRUSTS will provide in the market, both provide multiple internally consistent options for commercializing the TRUSTS platform. The deliverable thus informs a future operator of the TRUSTS platform on different business model options to consider, scenarios to choose from and practical recommendations to realize the business model.

# 1 Introduction

D7.2 "Sustainable business model for TRUSTS data marketplace II" addresses the work and effort performed under WP7 "Business model, exploitation & innovation impact assurance," especially on Task 7.1 "Sustainable business models." The objective of this deliverable is to select and evaluate business model options that could inform the commercialisation of the TRUSTS platform.

Selecting a viable business model is essential for any business. Nevertheless, selecting a business model is not a straightforward process. It involves considering scenarios impacting how the business model could be implemented to create and capture value. Different business model options and choices pose different obstacles. Considering the business model's options is even more critical for data marketplaces since many have failed for several reasons or remained in their conceptual phases. The present deliverable aims to develop, evaluate, and refine business model options for commercialising the TRUSTS platform. This deliverable provides risks and recommendations for commercialisation based on the different business model options.

In the previous version of this deliverable, D7.1 "Sustainable business model for TRUSTS data marketplace I", and in D2.1 "Definition and analysis of the EU and worldwide data market trends and industrial needs for growth," multiple business model options were identified TRUSTS could pursue that. However, the myriad of options identified does not necessarily provide a sustainable basis from a business standpoint of commercialising TRUSTS.

Part A of this deliverable provides both base business model options and add-on business model options for commercialising the TRUSTS platform. The base business model is intended to provide a basic business model foundation. The add-on business model options expand the foundation upon which TRUSTS can leverage. Part B of this deliverable takes a step further to explore potential commercialisation options for TRUSTS, considering the TRUSTS platform as a federation of existing data marketplaces.

## 1.1 Mapping Projects' Outputs

This section aims to map the TRUSTS Grand Agreement commitments, both within the formal Deliverable and Task description, against the project's respective outputs and work performed. Table 1 shows how the objectives described in the Grand Agreement have been attained, both in D7.1 and this deliverable (D7.2).

Table 1: Adherence to TRUSTS GA Deliverable & Tasks Descriptions

TRUSTS Task Description T7.1 Sustainable business models		Respective Document Chapter(s)	Justification
<i>T7.1 Sustainable business models</i>	<i>The aim of this task is to select a viable, feasible and sustainable business model for the data marketplace platform developed in the project. Practical business models will be developed following the method of action</i>	Chapters 2 and 3 of this deliverable.	Chapter 2 discusses the business model options developed within the TRUSTS project (TRUSTS as a data marketplace, i.e., the base and the add-on business model options). Chapter 3 provides an

<b>TRUSTS Task Description</b> <b>T7.1 Sustainable business models</b>		<b>Respective Document Chapter(s)</b>	<b>Justification</b>
	<i>design research which gives a structure for structuring a scientific design project in a practice-oriented situated setting. The artifact of the action design research is a set of presumably viable business models. The business model will be developed by applying tools for business model innovation as developed in TUD's award-winning platform businessmakeover.eu. The tools will be applied in workshops with project participants and, later on in the project, outside stakeholders.</i>		outlook to the future by discussing TRUSTS as a federated data marketplace. We employed business model toolings such as the business model canvas, STOF model, or partner radar from businessmakeover.eu to develop the TRUSTS business models.
	<i>To inform the business model development, first, through desk research and interviews, a range of potential data marketplace business models will be explored, leading to a taxonomy of possible business model design options. In doing so, this task will closely interact and leverage outputs of "T2.1 EU and worldwide data markets."</i>	D7.1. "Sustainable business model for TRUSTS data marketplace I"	The taxonomy has been described in D7.1 (submitted in M18)
	<i>Evaluation of business models will be done in three ways: (1) by conducting a summative evaluation on the implications of business model choices on critical success factors that measure the viability of the business model; (2) by informing T7.5 on concrete actions and activities needed to realise the business model and testing the feasibility of these actions based on T7.5 findings;</i>	Chapters 3 and 4 of this deliverable	The implications of various business model options have been evaluated through interviews, workshops, and quantitative studies. The results are described in chapters 2 and 3 of this deliverable.  T7.1 and T7.5 had recurrent meetings to share inputs and align with each other tasks.

TRUSTS Task Description T7.1 Sustainable business models		Respective Document Chapter(s)	Justification
	<i>(3) by applying TUD's method of business model stress-testing to evaluate the sustainability of the business models in different future scenarios (e.g., different levels of citizen trust in data economy or different levels of regulatory regimes).</i>		The business model stress testing has been conducted as part of the pre-study.
<b>TRUSTS Deliverable</b>			
<i>D7.2 Sustainable business model for TRUSTS data marketplace II (TUD) R, PU [M36].            The report describes the designed business models for TRUSTS.</i>			

## 1.2 Deliverable Overview and Report Structure

This deliverable is divided into two parts. Part A focuses on TRUSTS as a data marketplace, whereas Part B focuses on TRUSTS' long-term vision as a federated data marketplace.

**Section 2: [“Part A: TRUSTS as a Data Marketplace”](#)** consists of the following subsections:

- **Section 2.1: [“Theoretical Background”](#)** is dedicated to understanding business models. It describes the business model canvas used as templates and tools to visualise business model components and options.
- **Section 2.2: [“Research Methodology and Intermediate Analysis”](#)** outlines the approach taken throughout the report in developing business model options. It focuses on the workshops and other interactive activities leveraged to provide insights into TRUSTS' business needs and reflect the approach and iterative steps taken to achieve its aim. Moreover, this section discusses key outcomes of the workshops and interactive activities that serve as a base for developing the initial two business model options (base and add-on business models).
- **Section 2.3: [“TRUSTS Business Model Options”](#)** elaborates on the base and add-on business models informed by the workshop with internal and external participants.
- **Section 2.4: [“Risks and Recommendations”](#)** focuses on evaluating the base and add-on business model options with experts on data marketplaces and business models. It focuses on two key aspects, feasibility and viability, essential for evaluating the business model. This section's vital outcome is refining the earlier developed base and add-on business models within the current context of data marketplaces.

**Section 3: [“Part B: Outlook to the Future - TRUSTS as a Federated Data Marketplace”](#)** consists of ten subsections.

- **Section 3.1: [“TRUSTS as a Federated Data Marketplace: Rationale”](#)** justifies the positioning of TRUSTS as a federator.
- **Section 3.2: [“Conceptual Background”](#)** elaborates on relevant concepts as a foundation for analysis.

- **Section 3.3:** [“Research Approach”](#) discusses the approach taken to execute research in Part B.
- **Section 3.4:** [“Aggregator Business Models”](#) explores (meta-)platforms utilising aggregator business models in other domains.
- **Section 3.5:** [“Aggregator Business Model Dynamics”](#) reveals four types of aggregator business models.
- **Section 3.6:** [“TRUSTS Federated Business Models”](#) contextualises the previous finding on aggregator business models into TRUSTS federated business models.
- **Section 3.7:** [“The Interaction Between Data Providers and Consumers”](#) elaborates on the potential elaboration between data provides and consumers in the federation model.
- **Section 3.8:** [“Evaluating Value Creation of a Federated Data Marketplace”](#) statistically assesses the potential efficacy of federation offerings to trust, perceived risks, and willingness to share data.
- **Section 3.9:** [“TRUSTS Roadmaps Towards a Federated Data Marketplace”](#) provides roadmaps further to scale up TRUSTS as a federated data marketplace
- **Section 3.10:** [“Future Research for Scientific Communities”](#) outlines research agendas in data marketplaces.

**Section 4:** [“Conclusion”](#) concludes the journey of TRUSTS business model exploration in the project phase. Additional information that informs this deliverable is included in [the Appendices](#).

### 1.3 Interdependencies of T7.1 with Other Parts of TRUSTS

Figure 1 below summarises the interrelation between T7.1 and other parts of TRUSTS. On the left side, the figure shows how T7.1 interrelates closely with T2.1 “EU and worldwide data markets” by consuming insights related to data marketplace definitions and characteristics. T7.5 “Commercialisation initiatives and action plan” also profoundly interrelates since the business model options from T7.1 will be translated into actionable commercialisation actions. On the right side, the figure summarises the interrelation between Task 7.1 and other related tasks of WP7 and WP5 by providing necessary support. The figure also clearly shows that D7.2 is built based on the knowledge we understand from D7.1.

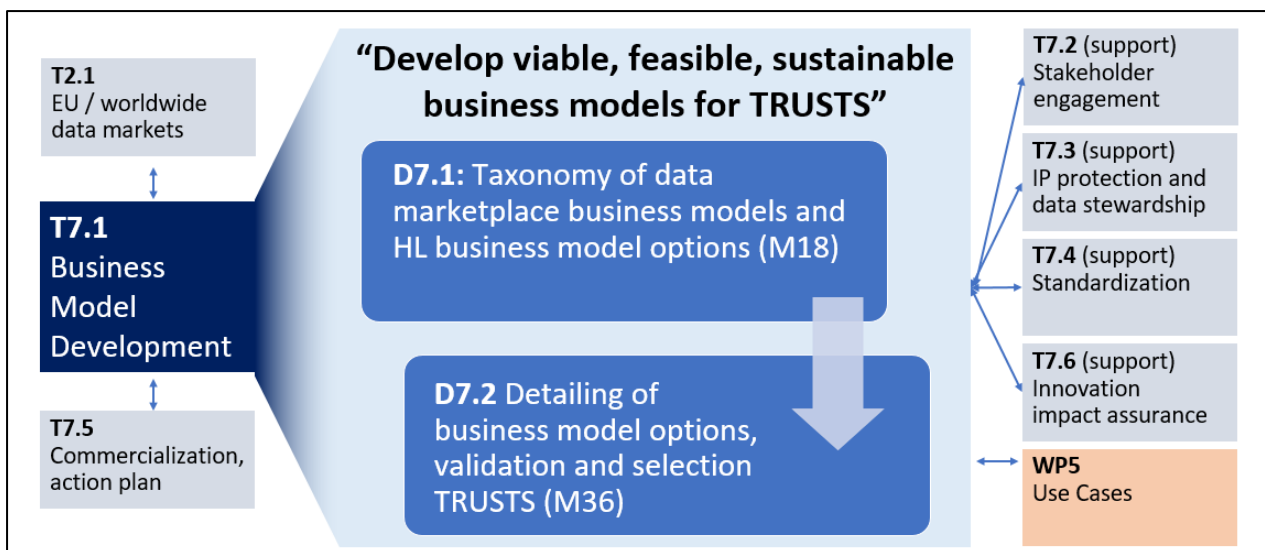


Figure 1. Interdependencies of T7.1 with other parts of TRUSTS



## 2 Part A: TRUSTS as a Data Marketplace

### 2.1 Theoretical Background

This section provides a theoretical background of the concepts used. The previous deliverable, D7.1 "Sustainable Business Model for TRUSTS Data Marketplace I," delivered a taxonomy of business models for data marketplaces and provided a general conceptual underpinning on business models. To avoid repetition of earlier theoretical foundations of business models discussed in D7.1, this report provides business model components that D7.2 relied on for developing business model options.

#### 2.1.1 Business Models

There are multiple definitions for business models. For example, a business model is described as a framework for converting technical inputs into economic outputs (Chesbrough & Rosenbloom, 2002) or the design of value delivery to the customer (Teece, 2010). Business models have also been described as models to visualise "transaction content, structure, and governance" design to create value from various sources and discover new business opportunities (Amit & Zott, 2001). Despite the variety in business model definitions, most researchers broadly describe one or more components of business models (see Figure 2) (Hartmann et al., 2014).

Year	Author	Cited	Business model components
2010	Chesbrough	3686	Value proposition, market segment, value chain, cost structure and profit potential, revenue mechanisms, value network, competitive strategy
2010	Teece	7046	Select technologies and features, benefit to customer, market segments, revenue stream, capture value
2010	Osterwalder & Pigneur	11182	Customer segment, value proposition, channels, customer relationship, revenue streams, key resources, key activities, key partners, cost structure
2002	Chesbrough & Rosenbloom	5482	Value proposition, market segment, value chain, cost structure and profit potential, value network, competitive strategy
2001	Amit & Zott	7175	Novelty, lock-in, complementary, efficiency
2008	Bouwman et al.	449	Services, technology, organizational arrangements, finance

Figure 2. Business model components (Bergman, 2020)

#### 2.1.2 Business Model Canvas

This report uses a business model canvas to represent the business model components (Osterwalder & Pigneur, 2010). The business model canvas is consistent with D7.1, where it was used to develop taxonomies for data marketplaces. The business model canvas reflects various components identified across extant literature. The components of the business model can be grouped into three overarching categories: (1) value creation, (2) value delivery, and (3) value capture (Teece, 2010).



**Value creation** describes how the company uses its resources to create value for its *customer segments*. Customer segments are diverse groups of entities to which the business delivers value. The customer segment could be categorised based on sectors, income, and geographical location. Companies influence the overall customer experience by creating *customer relationships* to reach their distinct customer segments (Osterwalder & Pigneur, 2010). These relationships range from personal assistance with a high level of human interaction to automated services performed online with minimal human interaction. *Value propositions* are offerings (products or services) by an enterprise to its customers. For the offerings to be of value to customers, it is expected to solve a problem or a customer's pain.

**Value delivery** is about the asset arriving at the customer. Chesbrough and Rosenbloom (2002) conceptualise the value chain that distributes the value offering. The value chain comprises the processes, activities, relevant resources, and capabilities required to build and distribute the proposition. Bouwman et al. (2008) mention the value network that defines relationships with other partners, considering the supply of resources. Four main components can be identified in the value chain and value network (Osterwalder & Pigneur, 2010). These are the *channels*, *key resources*, *key activities*, and *key partners* which broadly capture value delivery. Companies communicate, distribute and sell their value proposition through their channels.

The channels are the customer-company interface through which customers purchase the products or services. Companies produce and deliver their value proposition using key resources. These are physical, financial, intellectual, and human resources. Examples of the key activities that companies perform are the production of the value proposition, maintenance of the channels, and training of employees.

A firm relies on key partners to provide its service. Partnerships are formed, for instance, to outsource certain operations or achieve efficiency through the specialisation of partners. For example, a firm can outsource human resource management to a company specialising in this front. By outsourcing operations that are not within their area of expertise, firms can reduce costs and achieve efficiency.

**Value capture** concerns the monetisation of created and delivered value. Many businesses assume that when they create a product or service, the customer will pay for it (Teece, 2010). According to Teece (2010), this is a common market mistake. Companies sell their technological invention instead of a solution that the customer needs. It is unlikely that companies can capture value from items that do not solve a problem. Capturing value from the trade of intangible goods is also problematic. Property rights of intangibles are unclear, which makes its pricing difficult. The trade of such goods requires a revenue model that captures value from selling a solution, not an item. The revenue model includes the revenue streams and the pricing model. Osterwalder and Pigneur (2010) distinguish revenue streams ranging from licensing, brokerage, and pricing models (e.g. fixed and dynamic pricing). Value capture also includes the cost model that covers all company expenses to operate the business model.

### 2.1.3 Data Marketplace Business Models

In D7.1, "Sustainable Business Model for TRUSTS Data Marketplace I," different taxonomies for business was developed. These taxonomies describe the data marketplace's business model characteristics. The taxonomies provided an overarching description of components of business models for data marketplaces. However, descriptions provided in a taxonomy do not explain how or why the business model is viable or feasible. Viability refers to whether the proposed business model could create sufficient value/capture value for stakeholders. Feasibility captures whether the proposed business model is possible to be

executed/what the hurdles are. It focuses on examining the key resources and activities essential for feasibility.

In deliverable D7.1, a data marketplace is defined as "a digital platform, acting as an independent third-party that connects and facilitates data trading and financial transactions between data providers and data buyers." (TRUSTS, 2021d, p.19). In this definition, the data marketplace is multi-sided, bringing together distinct groups of actors (e.g., data providers, data buyers, and third-party service providers) to create and capture value (Bergman et al., 2022; van de Ven et al., 2021). Business models could thus explore the potential of data marketplaces that are currently considered unfulfilled. This potential is not fulfilled as most data marketplaces initiatives have often failed or struggled to scale. Little data is exchanged via the data marketplaces. In a few instances where data is shared, it is often based on a non-profit business model or via bilaterally negotiated contracts (Koutroumpis et al., 2020). While the Internet provides the opportunity to employ innovative business models, data marketplaces do not seem to profit from this. The adopted business models are limited and focused on secure revenue streams and hierarchical organisational settings, thus constraining the broader exposure that could be tapped as the data economy grows.

#### 2.1.4 Pre-study of Viability: Linking Obstacles and Business Model Choices<sup>1</sup>

Data marketplace shutdowns during the past years indicate business model viability issues caused by numerous obstacles. An obstacle is "something that impedes progress or achievement" (Merriam-Webster.com dictionary, n.d.). We define a data marketplace obstacle as something that impedes the progress or achievement of data marketplaces. Thus, understanding data marketplace obstacles and how they affect their business models is critical for viability. Viability consists of two elements:

1. the ability to facilitate the main activity of data marketplaces: data exchange between providers and consumers;
2. the financial stability to keep the activities going in the long run.

The existing literature pays little attention to an explanatory model that relates data marketplace obstacles to business model choices for assessing viability. This model should explain why creating a viable data marketplace business model is challenging based on the obstacles we can identify. This led us to the following research question: *"How can we use the relationships between business model choices and obstacles to assess the viability of data marketplace business models?"*

To answer this question, we followed a multiple-case study approach using a framework created by (Eisenhardt, 1989) that describes the process of building theory from case study research. We started by explorative theorising of the conceptual background. We found that the obstacle categories for data marketplaces are:

1. trust;
2. lack of governance mechanisms;
3. privacy and control;

<sup>1</sup> This subsection is based on a Master's Thesis in TU Delft undertaken by Petit, A. (2021) supervised by Mark de Reuver and Hosea Ofe as part of the TRUSTS project.

Petit, A. (2021). *Is data really the new oil? An assessment of the viability of data marketplace business models*. Delft University of Technology. Delft, the Netherlands. <http://resolver.tudelft.nl/uuid:cc20ef21-7931-4ae6-9534-8bdb8c18686d>

4. product quality and product description;
5. matching data providers and data consumers;
6. data pricing mechanism, and 'others' that do not fall within a specific category. We also find five data marketplace requirements for efficient operations: *safeness*, *no repugnance*, *provenance information*, *thickness*, and *no congestion* (Roth, 2002, 2008). Safeness means that there are no incentives to misrepresent or undertake strategic action, leading to reduced efficiency. No repugnance means that there are no social norms or legal restrictions that limit the use of pricing as an allocation mechanism. Provenance information means there is no information asymmetry: enough information is available to assess the quality of traded goods. A "thick" market means there are enough opportunities to trade with other participants in the market. No congestion means that there should be no reason for transaction times in the marketplace to be slowed down.

The marketplace requirements were assigned to the identified obstacle categories. We find that:

1. Trust and governance affect safeness
2. Privacy and control affect no repugnance
3. Product quality and product description affect provenance information
4. Matching and other (unspecific) affect the thickness, and
5. Pricing affects no congestion.

All requirements influence the desired outcome: a viable data marketplace. Because we believe the business model choices relate to the impact that the obstacles could have, they indirectly affect the viability of a data marketplace business model. The summary of the relationship between business model choices, obstacles, requirements, and viability can be seen in Figure 3.

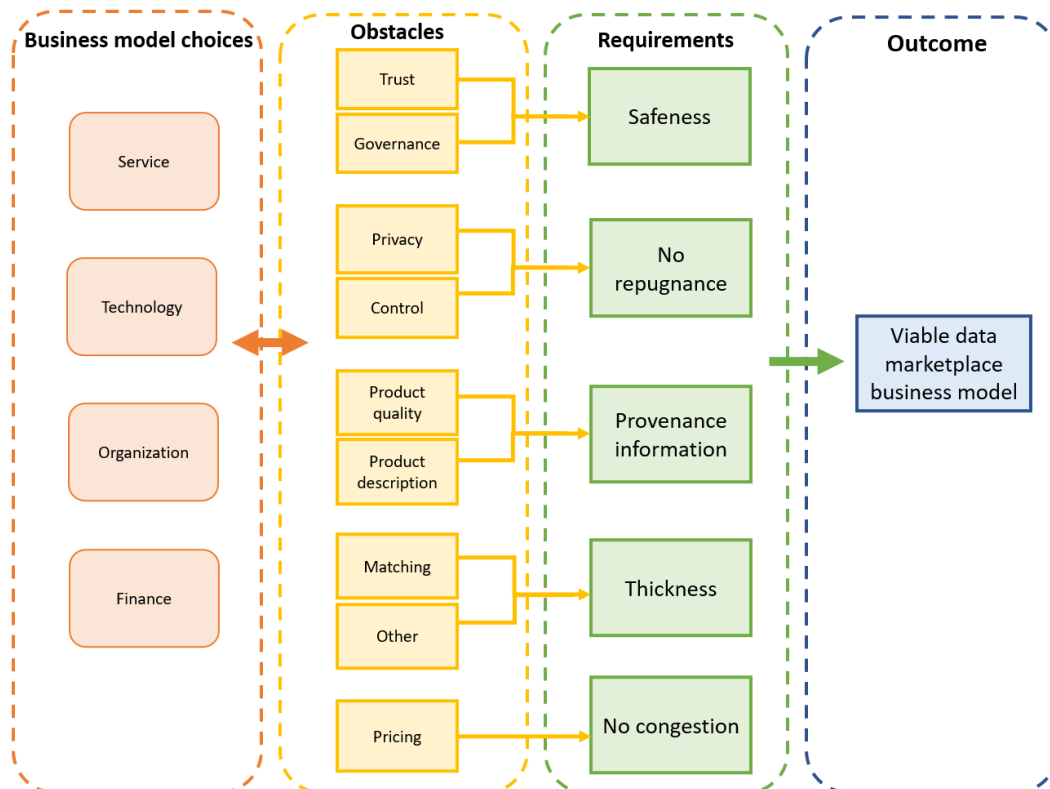


Figure 3. The relationship between business model choices, obstacles, requirements, and viability

The preliminary selected three data marketplaces by theoretical sampling to conduct a multiple-case study, resulting in the selection of Databroker (DAO) as an IoT/B2B data marketplace, VETRI as a personal data marketplace, and the DX Network as a B2B data marketplace. We utilise business model choices from the previous deliverable D.7.1 and (van de Ven, 2020) to conduct business model stress tests (Bouwman et al., 2018). The results from the stress tests were conducted by conducting literature reviews, participating in a focus group discussion to discuss data marketplaces, and interviewing data marketplace experts.

When analysing the data, we realised that the relationships between business model choices and data marketplace obstacles were not clearly interlinked. Thus, assessing the actual viability of a data marketplace business model goes beyond just the relationships between business model choices and obstacles. Viability should consider aspects beyond the taxonomy, such as **dynamic capabilities** and **strategy**. Viability should also consider external factors like **governmental rules and regulations**.

Based on the result, this pre-study cannot conclude the relationship between business model choices, b) direct impact on obstacles, and c) indirect impact on the viability of a data marketplace. However, we could hypothesise on the importance of the context in which business model choice is made for overcoming obstacles and assessing increasing viability. In other words, a data marketplace can strategically prepare itself by developing dynamic capabilities based on its business model choices (DaSilva (DaSilva & Trkman, 2014).

The highlighting findings from the pre-study are as follows:

1. An enterprise data marketplace can be an opportunity to build trust and allow for more sensitive data exchange cases.
2. Data processing or analytics tools in a data marketplace form an opportunity to increase perceived product quality.
3. A decentralised blockchain-based platform architecture allows for a trustless data marketplace.
4. Cryptocurrencies can be used as monetary instruments in data marketplaces, but their user interface should remain simple. Similarly, smart contracts enable automatic (micro)payments.

Because the recommendations we can make based on the results of this research go beyond making certain business model choices, we formulated a more general proposition: "The better the marketplace requirements are safeguarded by considering the business model strategy for a business model choice (from an obstacle perspective) and the influence of the external factors, the higher will be the viability of the data marketplace."

Thus, to increase the viability of data marketplaces, we recommend safeguarding the requirements of safeness, no repugnance, provenance information, thickness, and no congestion.

1. To safeguard safeness, we recommend creating a trustless environment. Also, we think it would be beneficial to stress the trustworthiness of a data marketplace in marketing and communication. Furthermore, a data marketplace should anticipate the upcoming regulations and profit from its implementation when possible.
2. To safeguard no repugnance data, marketplaces could consider selling pre-determined insights or provide consulting on the decisions that can be made based on the data. This allows for more control over the data exchange.
3. This same argumentation can be used for safeguarding provenance information. Product description and quality will be less of a problem when insight is sold instead of raw data. Another option is developing an efficient method of metadata generation that also considers the data requirements of data consumers.

4. To safeguard thickness, the main point to consider is the pool of participants. Whether working with a narrow pool or a big pool of participants for making matches, a data marketplace should ensure that its business model leads to a high willingness to participate and a high ability among its participants.
5. We can only recommend staying up to date on the newest developments in the data pricing mechanism research field to safeguard no congestion.

## 2.2 Research Approach and Intermediate Analysis

This section provides an overview of the methodological approach of explorative activities for business model options for TRUSTS (Figure 4). Moreover, this section also provides an intermediate analysis of each activity. Our primary approach to gathering insights into business model options was workshops. Workshops are a popular methodological approach that is increasingly used (Ørngreen & Levinsen, 2017). A key value of workshops is that they allow participants to interact. Such interactions are valuable for brainstorming among stakeholders on different themes.

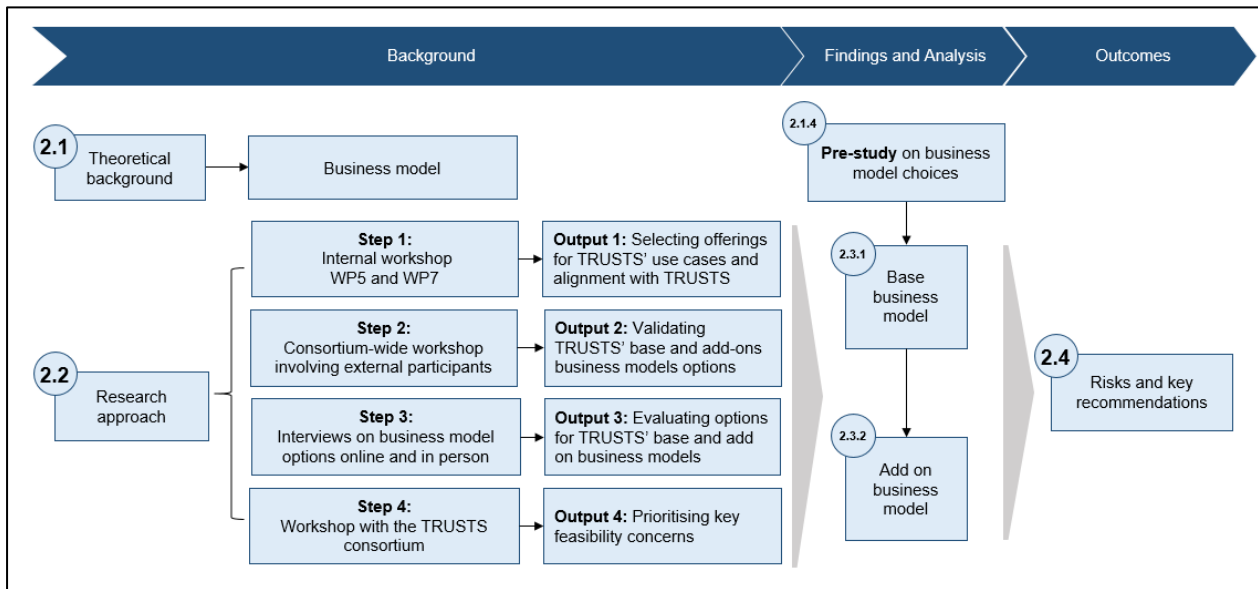


Figure 4. Research methodology for Part A

As a methodological approach, workshops are equally valuable since they create opportunities for creative thinking as participants relate to multiple ideas more loosely without constraints. Such interaction in workshops is particularly valuable in stimulating design thinking in ideation and considers a broad range of interests, ideas, and perspectives from multiple stakeholders related to business model innovation (Geissdoerfer et al., 2016). For example, workshops have been used to explore business and generate ideas for business models (Geissdoerfer et al., 2016). Since this task involved exploring different options valuable in the business model options for TRUSTS, workshops are thus a valuable approach to gathering feedback and ideas from multiple stakeholders.

The Miro board tool was the primary tool for organising the workshops. The mirror board is an interactive tool that allows multiple participants to share ideas that can be written and visible to all participants. In

total, Task 7.1 organised three workshops. In addition to that, we also conducted a series of semi-structured interviews (see Table 2).

Table 2. Overview of research approach for the business model developments

Step	Workshop date and duration		Type of audience	Workshop objective	Workshop output
1	A workshop with WP5 and WP7 to explore the base and add-on business model options	20th December 2021, from 10:00-12:00	20 researchers from WP5 and WP7	To brainstorm among UCs' offerings for TRUSTS business model options which were later to be exposed to the consortium and external participants	Offerings for TRUSTS' base and add-on business model
2	The second workshop	20th January 2022, from 09:00-11:00	TRUSTS-wide consortium and external participants	To explore additional ideas from TRUSTS partners and external participants for the base and add-on business model options	Internal validation of business model offerings to present initial offerings in the business options proposed by WP7 and UC partners
3	Ten semi-structured interviews	Summer 2022	Experts on business models and data sharing outside the TRUSTS consortium	To evaluate the viability and feasibility of business models options	Refined business model options
4	Workshop with TRUSTS consortium, online and in-person in Vienna	2nd June 2022, hybrid, live in Vienna and Online	Participants in the workshop included the wider TRUSTS consortium (all WPs)	To evaluate the critical viability and feasibility aspects of business models options	Identify critical aspects of business that affect viability and feasibility

### 2.2.1 Step 1: Workshop with WP7 and WP5 to Explore Business Model Options

The first step towards developing business model options for TRUSTS was an internal workshop held on 20th December 2021, from 10:00-12:00. To ensure that the business model options that we developed in the TRUSTS project would be aligned with the use cases developed in the project, this first workshop was focused on mapping the use case elements to business model options. The grey boxes in Figure 5 concern the base TRUSTS business model elements identified during brainstorming during the workshop

preparation. During the workshop, the workshop organizers (TUD) asked the participants of WP5 and WP7 to indicate to what extent the use cases (UCs) they work on cover each of these business model elements. This led to the mapping, as depicted in Figure 5.

As can be seen in Figure 5, participants assigned each of the offerings to the different use cases. The workshop touched on three use cases (UCs). These included:

- UC1 smart big-data sharing and analytics of anti-money laundering (AML) compliance.
- UC2 the agile marketing through data correlation.
- UC3 demonstrates the data acquisition to improve customer support services.

### 2.2.1.1 Intermediate analysis of step 1

Most of the business model elements were covered by each of the three use cases, while some (e.g., IPR management and basic applications) were covered by two of them. This mapping allowed us further to refine TRUSTS' base and add-on business model. Although all three use cases differ, they provided an initial basis upon which relevant TRUSTS offerings can be extended to include other sectors. We utilized the result form workshop 1 to further validate TRUSTS offerings on the wider TRUSTS consortium.



Figure 5. The mapping between TRUSTS offerings and UC elements<sup>2</sup>

<sup>2</sup> Please zoom in on the figure in the following link:

[https://miro.com/app/board/uXjVOWlqkwI=?invite\\_link\\_id=402907542096](https://miro.com/app/board/uXjVOWlqkwI=?invite_link_id=402907542096)



[illegible]

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In general, the additional ideas listed above aimed at enhancing the operational interoperability of the TRUSTS platform with other external infrastructure and data spaces. While these technical features constitute key offerings that help strengthen and make the platform attractive to potential users. Some partners indicated that "they would like to further discuss the security certification services; we can propose how to develop this certification for the platform, and we can analyse how we can offer this certification for customers too."

Consulting services

Yes Yes Yes  
Yes Yes Yes 6

Setup of local infrastructure e.g. corporate node

Yes Yes Yes 3

Transactional insurance

Yes Yes Yes  
Yes Yes 5

Storage, computing power

Yes Yes Yes Yes  
Yes Yes 6

Data services e.g. cleansing, visualization, de-anonymization, analysis, quality check & validation etc.

Yes Yes Yes Yes  
Yes Yes Yes  
Yes 7

AI models training services

Yes Yes Yes  
Yes Yes 5

Bundled subscriptions to GAIA-X, IDSA, DIO, Dairo, etc.

Yes Yes Yes Yes Yes 4

Taxonomy and ontology modeling

Yes Yes Yes 3

Training courses

Yes Yes Yes 5

Advanced Search and personalisation (store preferences, search results etc)

Yes Yes Yes  
Yes Yes Yes 6

Promotion mechanisms for data and services e.g. 'higher ranking' et al.

Yes Yes Yes  
Yes Yes Yes 6

Brokerage Services e.g. professional who 'hunts a required dataset'

Yes Yes  
Yes Yes 4

Provide Pricing Benchmarks and similar (for transparency)

Yes Yes Yes  
Yes Yes 5

Harvested data provision. E.g Open Data that is enriched...

Yes Yes  
Yes Yes Yes  
Yes Yes 6

Trusted circles of users that collaborate in a room/space/circles together

Yes Yes  
Yes Yes 4

Rampant data sample is synthetic data - needs more discussion in detail for real benefit

Unclear  
Can be valid only for public data 5

Related to the **add-on business models**, most workshop participants also indicated a "yes" for offerings on the add-on business model option. New ideas and features for the TRUSTS were also suggested. These

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included (1) On-demand collaboration spaces which are embedded and autonomous, (2) providing support for static and real datasets, and (3) streaming datasets. Some participants were unsure about the relevance, like in proposed services such as basic application: Private Set Intersection (PSI) homomorphic encryption.

As we had analysed the TRUSTS business model perspective from the desirability aspects (i.e., offerings), we conducted semi-structured interviews in step 3 to examine more about the viability and feasibility aspects.

### 2.2.3 Step 3: Semi-structured Interviews to Evaluate Business Model Options

The purpose of step 3 was to gather feedback and evaluate the business model options by conducting ten semi-structured interviews with respondents who knew business models and data sharing. Respondents were purposely selected to ensure relevant insights that could (re)shape the business models' options. The interviews were framed around two aspects of evaluating the business model: viability and feasibility. Viability refers to whether the proposed business model options offer a sufficient avenue to create or capture value for stakeholders. Feasibility captures whether the proposed business model is possible to be executed/what the hurdles are. It focuses on examining the key resources and activities essential for feasibility. The interviews began by providing a general background of TRUSTS.

Table 3. An overview of interview participants

Participant	Expertise	ID
Data marketplace consultant	Consultant with experience in semantic web expert and data sharing	R1
Data marketplace manager	Expert and head of a data marketplace	R2
Data analysis and strategy modelling expert	Data analyst with experience in market insights	R3
Data sharing consultant	Senior consultant specialised in the development of data spaces	R4
Data sharing consultant	Experienced consultant in the development of financial services from data insights	R5
Business consultant	Consultant in business strategy and data in public transport	R6
Business consultant	Consultant in business strategy and data in public transport	R7
Business consultant data sharing	Project manager on IT and data projects	R8
Data consultant	Experts in financial services	R9
Business owner	Specialised in data sharing in automotive and telecom	R10

The business model canvas was used to visualise the business model options. The first part of the interview focused on the base business model, while the second part focused on the add-on business model. The objective of the semi-structured interviews was to explore the following:

- Whether the proposed business model options could create sufficient value
- The hurdles of business model options

- Whether the proposed business model can be executed
- How the business model options could be more robust
- Describe the ideal business model or elements that might be missing in the proposed options.

### **2.2.3.1 Intermediate analysis of step 3**

The following discussion evaluates the base and add-on business models based on feasibility and viability criteria. Participants were allowed to discuss relevant aspects that need to be revised in the business model offerings.

#### **2.2.3.1.1 Feasibility**

Feasibility captures whether the proposed business model is possible to be executed. It focuses on examining the key resources and activities essential for feasibility. Insights from the interviews are discussed subsequently.

**Key partners:** Based on the expert interviews, most agreed that the business model's main components are feasible to implement. Participants agreed with the general components of the business models (key partners, key resources, cost structure) and the constituent elements of each component included in the base and add-on business model.

During the interviews, respondents agreed on the different partners shown in the business model canvas. For example, the respondents indicated that the involvement of the EU policymakers would help make TRUSTS feasible, giving the EU credibility to the platform. Similarly, the respondents indicated that business associations and initiatives are critical partners in boosting acceptability in key industries. As for data asset sellers/data providers and buyers, it is essential to have a distinct offering to these different actors. Respondents also indicated that having different key partners as part of the TRUSTS platform was essential. Care must be taken to align the partners' and business interests. For example, a respondent indicated that "the issue is not about bringing in all the little parts of technical complements. All the technical partners, and there is a little confusion on the exact way to solve the same problem" (R2). Some participants indicated that the key obstacle is aligning the goals of all key partners. Some respondents indicated that it was possible to bring many key partners and resources to facilitate data sharing. However, it would be challenging to address the interest of all partners.

**Key resources:** Overall, respondents indicated that the critical resources of the business model were feasible. For example, respondents indicated that it is essential for trust to include a certification on the platform. As R5 indicated, "I must be sure of all these [data]. There must be some certification that says this is a four-star company, and if there are four-star companies, they will also have a help desk or support." This suggestion aligns both the offering of the base and add-on business model options that require the need for certification.

It was equally agreed that it was essential to ensure that not simply different technical components are brought together for the platform to function correctly. However, we must ensure that different technical systems are interoperable, with standards compatible for new partners to join or link up to the platform in the future. This requirement impacts the business model because it provides the flexibility for a wide variety of inexperienced users to join the platform incurring not so much cost in adjusting to the platform's specification. For the TRUSTS Platform, an open and flexible approach would increase the chances of new users joining the platform, creating the potential to monetise transaction fees and brokerage fees.

#### 2.2.3.1.2 Viability

Viability concerns whether the business model can create and capture value for stakeholders. The interviews provided mixed views on viability related to creating a sustained stream of revenues and constraining the costs.

**Revenue Stream:** A core issue identified was the difficulty of generating revenue from data exchange. A respondent indicated that the idea of selling data is not new. However, "many people out there will not put a dollar in a project to sell data. Instead, people will prefer to experiment with a project that exchanges data to hope that something could grow out of the project in the future" [R3]. This comment is relatively understandable given that the trading of data and data marketplace is relatively in this infancy. While the TRUST platform faces this concern in the short run, many platform companies often do not generate revenue even in their first few years of operations. However, there are indicators that as the strategic importance of data grows, more businesses will gradually consider data trading as viable. For instance, around 30% of organisations (public/private) are actively searching for and developing new products and services reliant on shared data and services.<sup>5</sup> Thus while companies may be reluctant to share their data, the TRUSTS platform will be viable in the long run when data selling becomes mainstream. This can be seen in social media platforms where Facebook relies on and utilise data from its users for Target's adverts. While this is not a direct sale on the part of users, Such trends are positive indicators for the growth of the data economy and data market size. For example, it estimated that by 2026, on average, 30% of Global 2000 company revenue is estimated to be derived from data shared across industries.<sup>6</sup>

Another risk for TRUSTS' revenue streams is that users may bypass the TRUSTS platform to conduct transactions with data sellers once a data seller has been identified. This has a risk for TRUSTS' platform in two ways. First, bypassing the platform to conduct transactions with data sellers directly means the TRUSTS platform becomes merely a medium for data discovery. This means that income generated from brokerage fees and transaction fees might be reduced. Second, bypassing the platform after the initial discovery of data assets means the platform will not be sticky in maintaining and growing a sustained base. This means data asset sellers might consider the platform as not valuable to use the platform for exposing their data assets to the public. For example, a respondent indicated, "if we go to a more commercial environment....I want to have immediate contact with the seller of this data." [R6]. While this could be a concern, it is important to note that the TRUSTS platform also has options such as providing brokerage services to support users in searching relevant datasets. For example, TRUSTS platform broker services and dedicated human brokering hunting for data assets or sellers should entice users to consider other benefits. Showcasing the personalised assistance in data curation and cleansing provided as added services for the customer is vital in reducing the need for customers to opt to trade with data providers directly.

A respondent also indicated that users need to know the content of what they are buying before making an offer. As one respondent indicated, "if I am trying to buy this data, I will go to another company selling this, and I want to know everything. It is not something I would pick; just bring me this data, and I believe everything. So, I need more information on it, which means I also need support from their company. I want to be sure that the data is accurate." [R5]. Thus to keep users and build the ecosystem around the TRUSTS

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<sup>5</sup> IDC FutureScape: Worldwide Future of Industry Ecosystems 2022 Predictions, <https://www.idc.com/getdoc.jsp?containerId=US47771821>, accessed on December 20, 2022.

<sup>6</sup> IDC FutureScape: Worldwide Future of Industry Ecosystems 2021 Predictions, <https://www.idc.com/getdoc.jsp?containerId=US46918520>, accessed on December 20, 2022.

platform, mechanisms must be implemented to make users stick to the platform instead of being redirected to conduct a transaction outside the platform.

As costs are concerned, respondents had mixed feelings. First, while it is possible to say that data is valuable, a key concern is that companies still struggle to realise the potential of data. This means that the TRUSTS platform will need substantial upfront costs in the marketing domain to make the data marketplace viable. For example, a respondent indicated, "A lot of the assumptions of creating a platform rely on that people will make money by directly selling data. However, many people are not yet convinced that there will spend money on data. Instead, there is a need for a way to create a data-sharing project" [R1].

Having discussed the feasibility and viability aspects with experts outside the TRUSTS consortium, we wanted further to validate these aspects with the internal TRUSTS consortium.

#### **2.2.4 Step 4: Workshop with TRUSTS Consortium Online and In-Person in Vienna**

We already identified various base and add-on business model options through the first workshop (step 1) and the second workshop (step 2). We evaluated the viability and feasibility of these options with experts external to the TRUSTS consortium through interviews (step 3), which resulted in various statements concerning the viability and feasibility. To evaluate with a larger group of experts whether our statements make sense and which of those statements are most critical, we conducted a final workshop (step 4). This final workshop was held in Vienna on the 2nd of June, 2022. Participants in the workshop included the wider TRUSTS consortium, involving participants from multiple work packages. The workshop included the following four activities.

##### **1. Reading the business model statements**

First, the workshop participants were provided with ten statements that touched on various aspects of the business models (i.e., key activities, key resources, and key partners):

- Key activities
  - TRUSTS partners will continue the development and research efforts after the completion of the project.
- Key resources
  - TRUSTS “end-to-end” platform will reach the deployment stage (at least level 7) according to Technology Readiness Level (TRL) framework: System prototype demonstration in an operational environment at a pre-commercial scale.
  - We can secure and manage all technologies that are required to protect intellectual property.
  - TRUSTS can always be up to date (and comply) with the IDSA and GAIA-X components, even after the completion of the project.
  - We believe that if certain functionalities (e.g., billing smart contract) are not integrated with the overall platform, TRUSTS can still work as an operational data marketplace.
  - We believe that the TRUSTS “end-to-end” platform will have enough data assets to attract data consumers at the end of the project.
- Key partners
  - Industry and academia will remain committed to engaging as a part of TRUSTS.
  - Associations and initiatives are looking for a platform to collaborate in data exchange.

- Third-party data services want to utilize TRUSTS infrastructure to build their data services via TRUSTS data apps.
- Companies will consider TRUSTS as the established conduit for data trades.

The workshop participants were given time to read these ten statements concerning the viability and feasibility of the business model options. We used Miro Board as a shared working environment.<sup>7</sup>

## 2. Prioritizing the business model statements

In the second activity, the workshop participants were asked to identify the four most critical statements for the survival of a business. During the discussion of these statements, some statements were slightly adjusted. The four statements that were assessed as most critical were:

- TRUSTS can create the partnerships required after the project's completion.
- We believe the EU and policymakers will remain committed to advancing data trading after the project's completion.
- TRUSTS communication channels (e.g., website, social media) will still be retained and available for the public.
- We have a TRUSTS operating company after the completion of the project.

The four statements were ordered from most critical to business survival to least critical, and participants assessed to what extent the workshop participants believed that the TRUSTS consortium could realize these statements (on a 5-point Likert scale ranging from strongly disagree to strongly agree) (Figure 8).

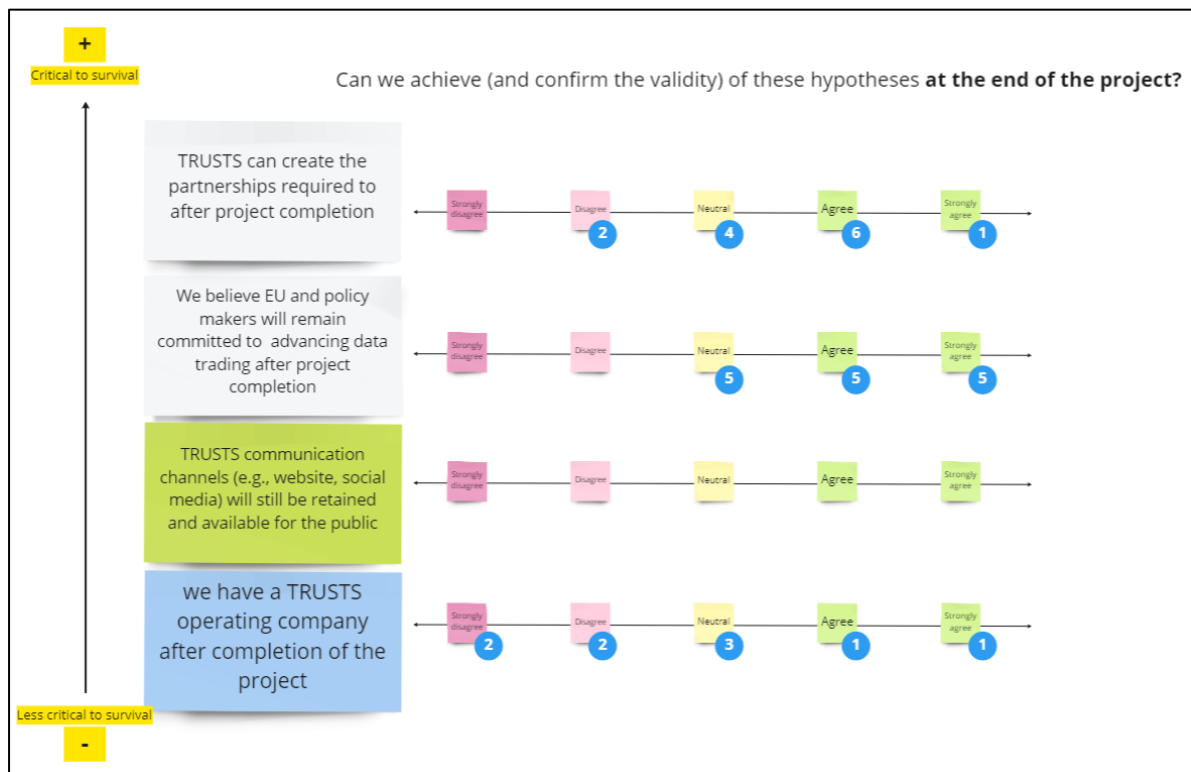


Figure 8. Screenshot of the Miro Board assessment of the most critical statements.

<sup>7</sup> <http://www.miro.com>

#### **2.2.4.1 Intermediate analysis of Step 4**

Most participants were confident that TRUSTS can create the partnership required after project completion, especially because TRUSTS has a direct link to initiatives such as IDSA and GAIA-X to scale up TRUSTS further. This was also in line with the discussion about the EU's commitment and policymakers' commitment to advance the vision of the data economy further. One discussion point was to promote more available use cases to attract funders.

Concerning the time limitation, the third hypothesis was not discussed in detail since the TRUSTS communication channels (e.g., website, social media) would still be retained and available for the public.

Finally, there was a critical discussion on the fourth hypothesis: whether TRUSTS can have a direct operating company after the project completion. To achieve this objective, one discussion point was to continue looking for funding to operationalize TRUSTS to reach sufficient network effects. Alternatively, many opportunities exist for further upscale and commercialisation (e.g., licensing parts of TRUSTS).

To conclude, we conducted four steps to identify and evaluate various options for the TRUSTS base and add-on business model: workshop 1 (step 1), workshop 2 (step 2), interviews (step 3), and workshop 3 (step 4). Based on these steps, we analysed the various business model options, which we will report in the next section.



## 2.3 TRUSTS Business Model Options

The subsections below present both TRUSTS base and add-on business models.

### 2.3.1 Overview of the TRUSTS Base Business Model

The TRUSTS base business model indicates the “minimum” schema for TRUSTS to be commercially viable (Figure 9).

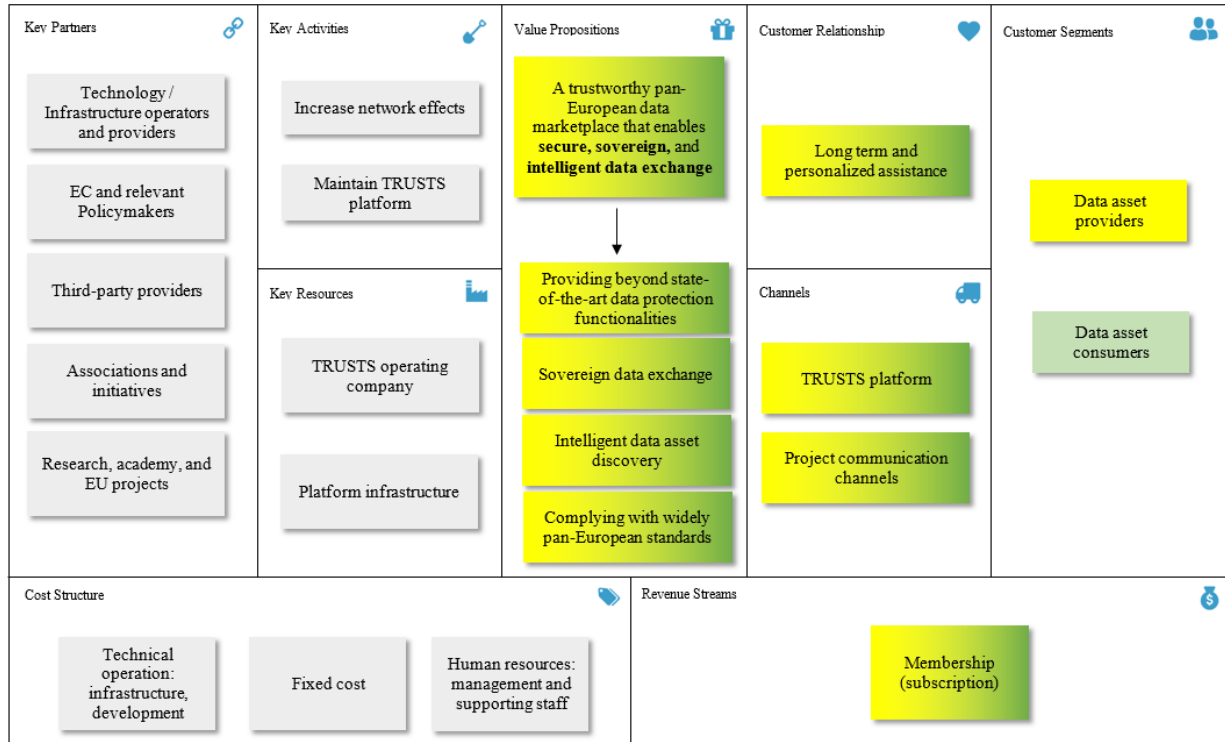


Figure 9. The TRUSTS base business model

#### 2.3.1.1 Customer segments

We start the discussion by defining the focused target of customer segments. Among a wide array of user groups identified in the business model taxonomy (refer to D7.1), TRUSTS can focus on the two primary groups (i.e., data providers and consumers) in the base business model. According to the D7.3 “Communities Engagement Strategy,” the following definition of data providers and consumers is adopted (TRUSTS, 2021e).



Table 4. Customer segment definitions

Customer segments	Definition according to D7.3
Data providers	“...entities providing data asset supply as <i>Data-as-a-Product</i> through listed meta-data listed in the TRUSTS catalogue.” (p. 35)
Data consumers	“...are entities generating demand for <i>Data-as-a-Problem-Solution</i> : data, data services or data-related solutions deemed fit for addressing their (business) problems. Accordingly, they also generate direct demand for trade services, data services, and solution design.” (p. 35)

These two user groups represent the most critical users in the multi-sided/platform business models: the supply and demand sides. Without these two primary users, TRUSTS cannot gain sufficient network effects to sustain itself in the future. In any multi-sided/platform business model, focusing on these two users as a starting point is appropriate: it is easier to scale from external actors than from internal firms (Parker et al., 2016). The emphasis on these two groups is reflected in the #1 and #2 workshop results, where many of the discussed offerings aim to solve pains or promote gains to these user groups. For instance:

- a) Data asset catalogues, and
- b) Personalised search recommendations provide matchmaking mechanisms to match these two user groups better.

Moreover, the pre-study results explicitly emphasise the interaction between these two user groups by highlighting the need to build trust between data providers and consumers.

As a starting point, we focus on two industries within the EU: 1) financial and 2) information and communication. As our industrial Consortium partners come from the financial industry (e.g., Piraeus Bank — banking), as well as the information and communication industry (e.g., NOVA — telecommunication), this focus brings advantages to fully utilising their industrial expertise: to understand the opportunities for data exchange, taking both perspectives of data providers and consumers.

This expertise advantage is also reflected in the UC demonstration. For example, UC1, smart big-data sharing and analytics of anti-money laundering (AML) compliance, demonstrates one of the typical business activities in the financial industry, such as AML screening and transaction monitoring (TRM). UC2, the agile marketing through data correlation, also demonstrates the intersection between these two industries: by combining Piraeus Bank and NOVA datasets via Private Set Intersection (PSI), data consumers can access loan analytic dashboards. UC3 demonstrates the data acquisition to improve customer support services, also the expertise of the financial and telecommunication industry by partnering with ALPHA Bank Group, which acts as a data provider.

Considering the potential market size, we can reflect on the newest update of the European DATA Market Study 2021–2023.<sup>8</sup> The data market value in the targeted industries reaches a third of the overall market value, showing promising arenas to enter. These two industries also have a relatively good growth rate (see Figure 10).

<sup>8</sup> <https://digital-strategy.ec.europa.eu/en/library/results-new-european-data-market-study-2021-2023>, accessed on December 20, 2022.

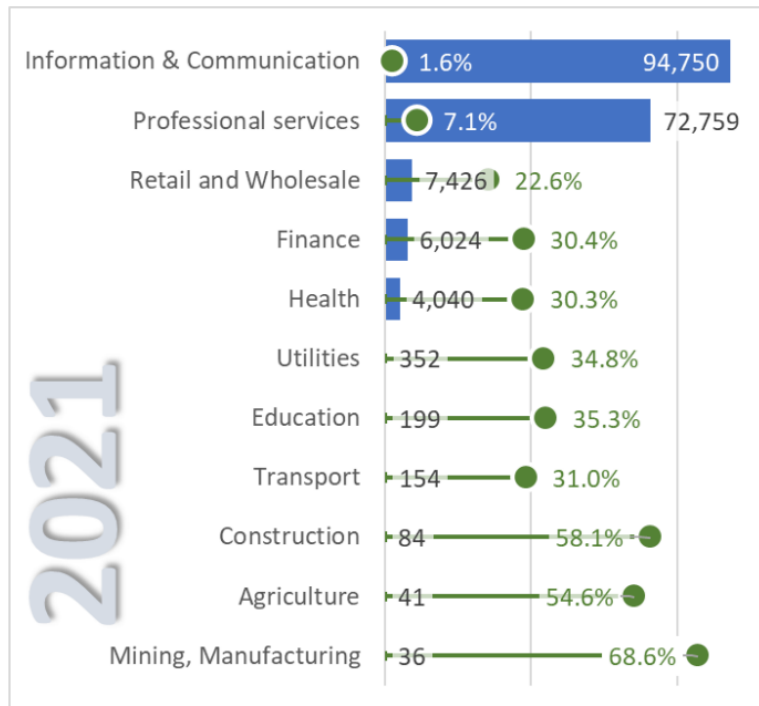
Industry	2019	2020	2021	Growth 2020–2021	Rate
Agriculture	214	242	245	1.3%	
Construction	253	256	283	10.4%	
Education	1,522	1,614	1,634	1.3%	
Finance	12,176	12,782	13,487	5.5%	
Health	1,794	1,943	2,040	5.0%	
Information & communications	6,131	6,446	6,801	5.5%	
Mining & manufacturing	12,252	12,240	13,124	7.2%	
Professional services	7,819	7,326	7,486	2.2%	
Public administration	3,158	4,307	4,818	11.9%	
Retail & wholesale	6,202	6,507	6,610	1.6%	
Transport	2,697	2,632	2,661	1.1%	
Utilities	2,415	2,610	2,702	3.5%	
Home	1,794	1,730	1,736	0.3%	
EU27	58,427	60,635	63,627	4.9%	

Figure 10. Data market value by Industry within EU 27 (€M)<sup>9</sup>

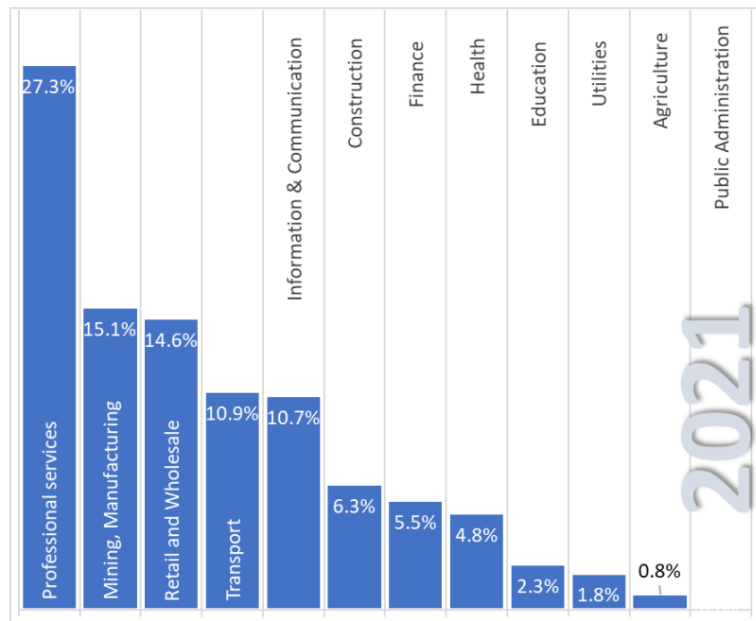
Targeting the banking and the information and communication industry fits well with the number of existing companies that act as data providers and consumers. For example, in 2021, the companies in the information and communication industry dominated the data provider role. The companies in the financial industry ranked fourth by showing a promising growth rate (Figure 11).

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<sup>9</sup> Ibid.

Figure 11. Data suppliers companies by industry:2021 and 2020-2021 growth<sup>10</sup>

From the data consumer perspective, both industries ranked relatively well in the middle chart (Figure 12).

Figure 12. Data User companies' Share of Total by Industry, 2021<sup>11</sup><sup>10</sup> Ibid.<sup>11</sup> Ibid.

The Data Market report also considers the market size based on the two types of organisation sizes: Enterprises, which have more than 250 employees, and small-medium sized enterprises (SMEs), which have 1-249 employees. Unsurprisingly, SMEs dominate data market end-users because of the enormous percentages of SMEs in Europe. It turns out that these SMEs stats to involve in Data Economy activities. For data providers, SMEs account for more than 95% of propositions. Similarly, large enterprises only represent 1.6% of data consumers. See Figure 13 and Figure 14 bellows.

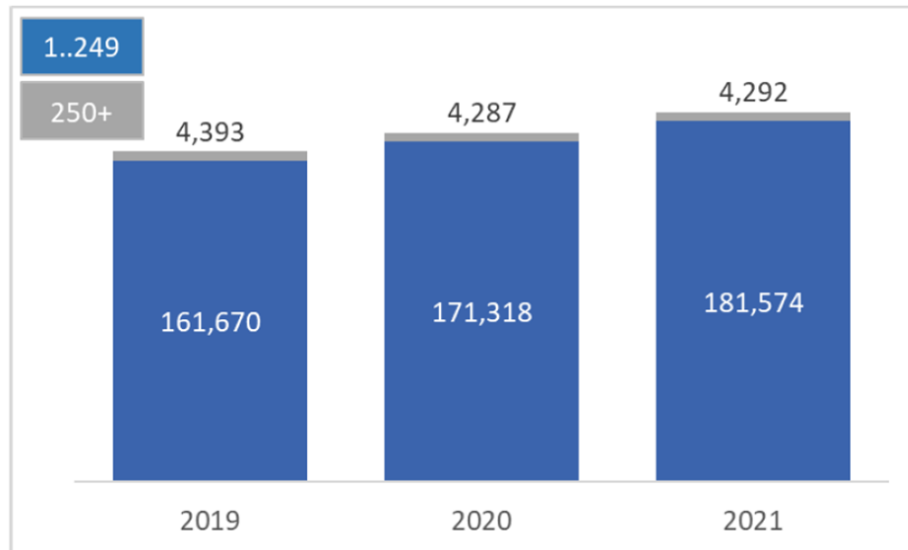


Figure 13. Data provider companies by company size band, 2019-2021<sup>12</sup>

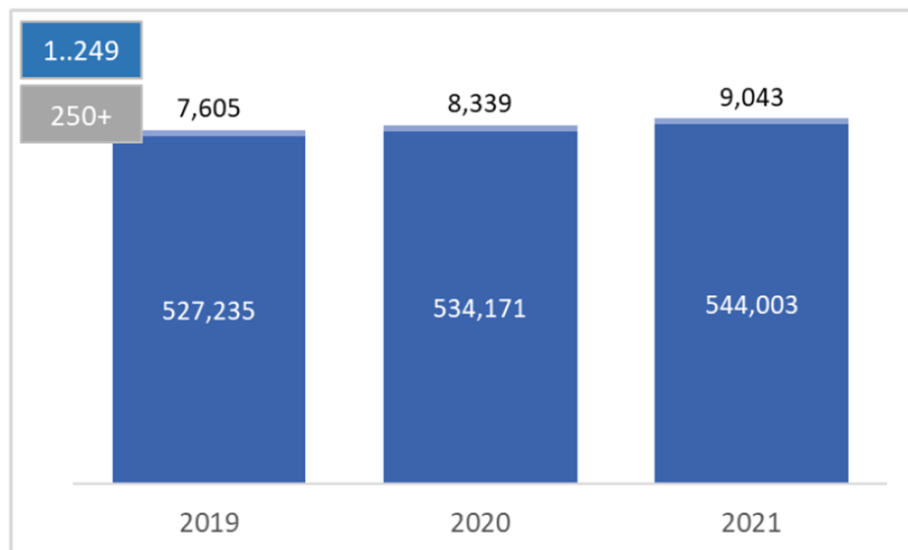


Figure 14. Data consumer companies by the size band, 2019-2021<sup>13</sup>

<sup>12</sup> Ibid.

<sup>13</sup> Ibid.

Given the statistics, TRUSTS will not only focus on large enterprises (as represented by TRUSTS Consortium partners) but also target SMEs as crucial end-users. Particularly, TRUSTS targets these two types of organisations in the financial and information and communications industries.

### 2.3.1.2 Value propositions

Having identified the focused customer segments of TRUSTS, we now discuss the core value propositions of TRUSTS. The overall value proposition of **TRUSTS is a trustworthy pan-European data marketplace that enables secure, sovereign, and intelligent data exchange**. The breakdowns of TRUSTS value proposition statements are as follows:

1. TRUSTS help data providers who want to monetise their data assets by:
  - a. Providing **beyond state-of-the-art data protection functionalities**, such as anonymisation and encryption. Consequently, data providers can focus on elaborating (or enhancing) the value of their data assets without worrying too much about negative consequences such as data breaches, knowledge spillovers, or data quality losses. According to the pre-study, this value proposition enables *safeness*. This value proposition is discussed in the D7.1 taxonomy and during the #1 and #2 workshops, resulting in an explicit functional requirement: TRUSTS should encompass mechanisms for keeping transactions from being infringed [FR14]. TRUSTS aims to extend and implement the previously built anonymisation tool, the so-called PrioPrivacy (for technical details, see Bampoulidis et al., 2019). In addition, TRUSTS develop six risk analysis modules to help data providers prevent the risk of de-anonymisation (refer to D4.1 “Algorithms for Privacy-Preserving Data Analytics”). Related to encryption, TRUSTS develops a new End-to-End Library for Private Set Intersection, the so-called PSItacus. This library supports data sets and end-to-end encryption for network connections, with better performance and stability. Hence, it can guarantee the secure transcription of data exchange. These two offerings are implemented within the TRUSTS platform. These two core offerings are highlighted as a core value proposition of existing data marketplaces (Fruhworth et al., 2020), but few are implementing these offerings.
  - b. Enabling **sovereign data exchange**. Data sovereignty generally refers to the exclusive rights of organisations to decide ownership and control over their shared data (Abbas et al., 2022; Jarke et al., 2019; Lauf et al., 2022). With this capability, data providers can know whether data consumers use the exchanged data assets according to pre-determined agreements, avoiding potential data asset usage beyond these agreements. The D7.1 taxonomy, workshops #1 and #2 discussed the critical component of realising data sovereignty: smart contracts. These smart contracts technically embed pre-determined agreements and can automatically check whether data asset usages are according to these agreements. To enable greater control and audit purposes, smart contracts enable transaction logs and proposition of evidence in the case of disputes. The discussion in the workshop gives inputs to the functional requirements (FR) of TRUSTS; for instance, in the FR10, “the system should provide contract mechanisms as a validation means of sellers/buyers agreements” and FR15, “The system should provide the ability to connect to billing mechanisms for enabling consumers to pay providers according to the agreed smart contract.” These FRs are realised by the component C24 - Smart Contract Execution. Data sovereignty in data exchange, either at end-users or organisational levels, is among the most important topics discussed in the “board rooms” (see a report provided by

datasovereignty.org).<sup>14</sup> The newest stream of EU policy-making agendas, such as the Data Governance Act, also mentions data sovereignty as a key principle of data sharing. Nevertheless, data sovereignty has not become a key concern in existing operated data marketplaces (See Bergman et al., 2022; Fruhwirth et al., 2020; Spiekermann, 2019; van de Ven et al., 2021). Hence, TRUSTS aim to be among the first mover to ensure a sovereign data exchange in data marketplaces.

2. The workshop results also indicate that TRUSTS aims to help data consumers looking for data assets to address their (business) problems by **enabling intelligent data asset discovery**. In doing so, the workshops discussed the TRUSTS offerings: data asset catalogues and personalised search recommendations. With these offerings, data consumers can reduce the “searching” time and get recommendations tailored to their specific needs. Data consumers will be exposed to ranked wide options of data assets, ranging from raw datasets, applications (need to be installed on their own premise), or services such as advanced analytics. These offerings, of course, will also benefit data providers because the visibility of their data assets will be increased, resulting in a higher chance towards the next step: exchanging their data assets. This value proposition gives inputs to the FR group of Intelligent data/service exploration (i.e., FR5-FR11), which are realised by C4 – Recommender. According to D2.7 Architecture design and technical specifications document II (TRUSTS, 2021b), this recommender system serves three primary goals: developing a recommender system algorithm that goes beyond the mere raw data (incorporating data services and applications), analysing the primary user interactions to serve as an algorithm input, and Incorporating implicit feedback from users is used to analyse and fine-tune the recommender system (e.g., clicks on recommendations). Competitors often do not consider intelligent data asset discovery as their value proposition (reflected in the taxonomy result where existing data marketplaces do not articulate intelligent data asset discovery). Thus, TRUSTS can distinguish its marketplace by explicitly stating this value proposition.
3. TRUSTS help end users (i.e., data providers and consumers) who want to exchange business data assets to **comply with widely pan-European standards**, such as GAIA-X and IDSA. TRUSTS comply with that standards because the technical components of TRUSTS are developed (or reused) based on these standards; for example, C18 - Broker and Metadata Storage are reused from the IDS. By following these standards, TRUSTS also implies that the developed data marketplaces are trustworthy, meaning TRUSTS follows specific quality thresholds (e.g., providing anonymisation tools to avoid personal data leakage). End-consumers benefit from standards by reducing the risk of getting legal liabilities because of incompliance with specific standards and regulations (e.g., GDPR). In addition, end-users can experience the consistency and reliability of TRUSTS data marketplaces. Therefore, they can focus more on preparing data assets than dealing with data marketplace complexities. According to the second workshop results, aligning these standards increases TRUSTS's network effects. For example, end-users from competitors or other European projects can easily switch and try TRUSTS offerings (meaning reducing the chances of lock-in effects and winner-take-all dynamics). Reflecting on the pre-study results, alignment with these standards means two things. First, standards safeguard data quality: end-users can have well-informed meta-data and samples. Second, standards contribute to no congestion: it is easier to end-users to follow mature processes rather than iteratively learn something 'new' every time conducting data exchange transactions.

The discussion above shows the processes of selecting and developing the TRUSTS value propositions based on 1) the previously delivered business model reports D7.1 “Sustainable Business Model for TRUSTS Data Marketplace I,” 2) pre-study, and 3) multiple rounds of empirical studies (i.e., workshops). In general, these value propositions give inputs to defining functional requirements and, after that, translate into

<sup>14</sup> <https://datasovereignty.org/>, accessed on December 20, 2022.

TRUSTS offerings—refer to D2.7 “Architecture design and technical specifications document II” (TRUSTS, 2021b) and D3.10 “Platform Status Report II” (TRUSTS, 2021c).

### 2.3.1.3 Customer relationships

TRUSTS can adopt the strategy of **personalised assistance and long-term relationships** to sustain the customer relationship, meaning TRUSTS invests more in tailoring the specific needs and aim for repetitive transactions of existing end users. Referring back to D7.1, TRUSTS selects the “customer intimacy” principle to manage customer relationships, particularly for data providers and consumers. The focus on customer relationships was discussed during the first #1 workshop. One participant triggered the discussion of having “helpdesk services, particularly in the early stage of TRUSTS operations.” To complement this, training materials should be prepared in advance. This strategy was validated in the second workshop, where mostly all participants agreed to invest more in customer relationships and long-term commitments. In addition, our pre-study analysis also finds that sharing pre-determined insights or providing consulting on the decisions that can be made based on the data can safeguard *no repugnance* of data marketplaces, allowing more control over the exchanged data assets.

Other rationales for selecting this strategy are as follows:

- TRUSTS as a data marketplace is different from a “traditional” digital platform (e.g., owing to the nature of data as an experience good and its non-rival quality) (Koutroumpis et al., 2020). In addition, data can be de-contextualised, re-combined and re-contextualised (Aaltonen et al., 2021). Therefore, data as a unit of transactions can be realised in new ways: the unit could range from raw datasets to readily usable data analytics modules (we call these data assets). Hence, as elaborated by the research output in D7.1 and Bergman et al. (2022), it is essential to have data “solutions” instead of data “items.” To create value and attract data consumers, data must be bundled into a personalised solution. This is why TRUSTS enable infrastructure to offer data assets beyond mere data items. For example, the implementation of this strategy is reflected in the UC1 “Smart big data sharing and analytics of Anti-Money Laundering (AML) compliance.”
- In addition, TRUSTS also aims to balance intelligent data discovery processes with strong personal relationships to retain potential end-users. Personalised assistance is also helpful, especially to SMEs, to prepare for their participation in Data Economy via TRUSTS, as they often lack the skills to participate in data exchange.
- Acquiring new end-users can be hard now, given that European Data Economy is still in its fancy stage. Hence, keeping existing end-users by enabling repeated transactions while slowly acquiring new end-user customer bases fits the existing Data Economy landscape.

### 2.3.1.4 Channels

One core *distribution channel* to reach the targeted customer segments are the **TRUSTS platform**. Data providers and consumers must register with the platform to find each other. They must only perform transactions via the TRUSTS platform to guarantee data sovereignty, security, and privacy. Relating to D7.1, users (i.e., data providers and consumers) can use TRUSTS offerings with two options: a web-based interface and standardised TRUSTS connectors. The web-based interface suits more with small-medium enterprises (due to a lack of capabilities) to access primary TRUSTS offering such as registering and accessing data catalogues. On the other hand, TRUSTS connectors enable users to access advanced offerings such as machine learning-based analytics from data apps. The second option is more suitable for large enterprises with strong in-house data capabilities. In addition, the workshops also discussed the



importance of providing seamless user interfaces and user experiences, confirming the importance of creating Component 5 - Platform Interface (CKAN).

Related to the communication channels, TRUSTS employs many **project-related communication activities**. Referring to D8.1, “Dissemination and communication strategy, design guide, materials and communication channels,” TRUSTS engages with potential actors through social media activities such as LinkedIn, Twitter, and ResearchGate (TRUSTS, 2021f). TRUSTS has a dedicated project website to showcase relevant communication activities, such as webinars, podcasts, press releases, and newsletters. TRUSTS partners also engage in (academic) conferences and paper development. To make the TRUSTS outcomes more tangible, TRUSTS also highlights its services with UC demonstrations. Other communication channels employed by TRUSTS are micro-learning, training, providing tutorials, and capacity-building programs. During the development phase, TRUSTS partners conducted numerous focus groups and joint workshops with experts to discuss business, technical, or legal-related aspects. In addition, TRUSTS partners also conducted multiple rounds of interviews and developed questionnaires to understand user needs. Beyond the project, the project-related communication channels will be handed over to the TRUSTS operating company. These channels will be retained as they already have suitable user bases.

One crucial point is the “key message” that should be delivered to these communication channels. As the pre-study indicates, TRUSTS must emphasise the message of trust-enabling offerings, which must be included in the promotion of TRUSTS. This would be useful as marketplace participants perceive how it is also influenced by the marketing and communication of the data marketplace operator and among data marketplace participants. It is thus beneficial to stress the trustworthiness of a data marketplace in marketing and communication. For example, a referral program that stimulates public dialogue among participants will create (indirect) trust. It should be considered that different users might have diverse needs to achieve trust. Some might only need to be notified of the benefits; some might require some education or explanation on the technologies used. In addition to trust-related promotions, TRUSTS can also select the two most important materials related to vendor promotions and data assets showcases.

### **2.3.1.5 Key activities**

The pre-study emphasises the importance of **gaining sufficient network effects** (i.e., critical mass) to safeguard lack of thickness: no sufficient data providers or consumers who join TRUSTS; no data assets available within TRUSTS data marketplaces. If TRUSTS has no pool of participants, no data can be exchanged, and thus no business model can be exploited. This pool will be enormous if there is a high willingness to participate and a high ability to do so. Both aspects are the primary concern in safeguarding the thickness of TRUSTS. Therefore, to make the TRUSTS business model viable, it should be researched precisely under what circumstances users would be willing to participate. Therefore, it can even be suggested to create “risk profiles” based on the sensitivity of the data. Risk-averse businesses can exchange public data, while risk-seeking businesses can focus more on sensitive data, such as strategy data. Public data would then lead to a lower reward than more sensitive because it also carries a lower risk for sharing—just as in investing, this would be a high-risk, high-reward approach.

Gaining sufficient network effects can be achieved in many ways. For instance, TRUSTS can enhance the marketing and promotion of data marketplaces. This may involve creating and distributing promotional materials, forming partnerships with relevant organizations, and investing in paid advertising. In addition, the operator can provide training and educational resources to help customers learn how to use the data available on the platform and extract value from it. This may include creating tutorials, webinars, and other materials.



The TRUSTS operator should **maintain the TRUSTS platform**. This may entail testing and debugging the platform as necessary. As with any software application, testing and debugging the data marketplace platform is essential to ensure it is error-free and properly functioning. This may entail user acceptance testing, identifying and fixing bugs, and monitoring the platform for potential issues. Overall, establishing and maintaining the data marketplace platform is a crucial activity that will help ensure the platform is reliable, secure, and simple for data providers and consumers.

#### 2.3.1.6 Key resources

**TRUSTS operating company** plays a vital role in TRUSTS continuity after the project's life. The operating company will take over the whole (or partial) TRUSTS components via agreed mechanisms, such as licensing. Having an operating company means that TRUSTS should fulfil, at least, basic organisation resources. According to Porter's Value Chain, TRUSTS operating company should provide resources for primary and supporting activities. The primary one consists of *inbound logistics, operations, outbound logistics, marketing & sales, and services*; the supporting one consists of *firm infrastructure, human resource management, technology development, and procurement*.

To be more specific, another highlighted key resource to run TRUSTS offerings is **platform infrastructure**. As TRUSTS aim to achieve sovereign data exchange, TRUSTS employs a decentralised architecture paradigm: TRUSTS does not collect and store data assets from data providers. During the project, one of TRUSTS' partners, LSTech, lead the endeavours in ensuring the platform infrastructure. TRUSTS infrastructure aims to provide a stable and secure environment in hosting the TRUSTS platform and its components. These infrastructures include Google Cloud computer clusters, disaster recovery plans, continuous integration development approaches, and API integration.

#### 2.3.1.7 Key partners

The TRUSTS key partners were grouped into the partner radar tool.<sup>15</sup> The partners can be generally divided into four categories: suppliers, investors, collaborators, and others. Each of these partners can have three levels of influence: 1) great influence, 2) limited influence, and 3) little influence. According to the tooling explanation: *“The level 1 partners are strategic partners that are very important or even critical to your business. You have a close relationship with them and need to involve them in your decision-making process, taking their perspective into account. The level 2 partners have some influence on your business. They are not critical, but they provide valuable contributions to your business. These partners may be hard to replace. You would like to inform or maybe consult these partners, but they do not have to be involved in major business decisions. The level 3 partners may provide complementary resources. Partnering with them occurs on an operational level; they have very little influence on your business.”*<sup>16</sup>

One key supplier for TRUSTS is **infrastructure providers**. Like TRUSTS did in the project phase, TRUSTS employs Google Cloud to run its operations. This selection brings benefits: TRUSTS can focus on its value proposition for data exchange rather than spending too many resources to develop its in-premise infrastructure from scratch. Typically, these this partner provide storage space or computing power. According to our pre-study, selecting infrastructure is essential to avoid congestion: *“there should be no reason that transaction times on the marketplace are slowed down.”* If TRUSTS still workforce is still limited and needs to make a trade-off between exercising its core offering vs infrastructure, it is better to build a partnership with infrastructure providers. If TRUSTS is still in its infancy stage and has low bargaining

<sup>15</sup> TRUSTS partner radar tool: <https://businessmakeover.eu/tools/partner-radar>, accessed on December 20, 2022.

<sup>16</sup> Ibid.

power, it will be challenging to influence the infrastructure providers (e.g., in terms of pricing). Hence, we assigned infrastructure providers to level 1 partners, as TRUSTS cannot run without them.

Regarding investors, TRUSTS is funded by European Union’s Horizon 2020 research and innovation programme under grant agreement No 871481, meaning TRUSTS are still influenced by **European Commission (EC) and relevant policymakers**. The EC and policymakers are key partners (level 1) for TRUSTS because they offer potential networking opportunities for future funding, key actors, or gaining specific resources. Depending on the commercialisation paths (e.g., seeking other funding rounds, selling whole/part of TRUSTS), future investors will always be key partners for TRUSTS.

When envisioning TRUSTS as an operating company, TRUSTS need collaborators to deliver its value proposition. Recalling TRUSTS value proposition statement: trustworthy pan-European data marketplace that enables secure, sovereign, and intelligent data exchange, TRUSTS, using platform principles, can open up its infrastructure to invite **third-party providers** to innovate on top of the TRUSTS platform to achieve this value proposition. This is discussed explicitly in workshop 2. For example, TRUSTS can provide basic applications such as homomorphic encryption. When discussing this, one participant commented, "those applications need to be tailored to a specific collaboration and for a specific scenario." Meaning TRUSTS need internal developers to guide and execute these applications. If TRUSTS still lacks resources, it is better to invite third parties to develop and maintain their application because these specifications are often complex. The pre-study also discusses third-party providers' potential to contribute to TRUSTS business models because they increase the breadth of TRUSTS offerings. With this foundation, TRUSTS selects "an app store" as a data service enabler (refer to options in D7.1). This discussion provides input for the creation of Component 19 - App Store. These providers can be assigned to level 2 because they are important to leverage TRUSTS offerings, but TRUSTS can still run without them.

Referring again to the value proportions that comply and align with pan-European standards, it means TRUSTS has committed to joining **data-sharing associations** such as IDSA and GAIA-X. In fact, one of the TRUSTS partners is IDSA, bringing benefits to accessing IDSA networks and events. One concrete benefit is the external workshop entitled “Data Spaces & Semantic Interoperability,” which is led by IDSA in task 7.4. In summary, TRUSTS can connect with potential data providers and consumers by accessing and joining these association networks. In addition, complying with the state-of-the-art standards of these associations will be a great selling point. Referring to options in D7.1, TRUSTS can select IDSA and GAIA-X as two key partners. This selection is also reflected in the technical development, for instance, when TRUSTS reuses the C1 - Dataspace Connector based on the IDS component. Therefore, these data sharing associations are TRUSTS' important partners (level 1). TRUSTS collaborates with other data sharing associations, such as Big Data Value Association (BDVA). BDVA often provides opportunities for TRUSTS to showcase the products by attending and presenting at BDVA’s events (such as European Big Data Value Forum 2022). This type of collaboration can be assigned to level 3 because TRUSTS’ business processes are independent of BDVA.

Other partners include **research and academy**. TRUSTS will benefit by partnering with research and academy to increase its exposure. The TRUSTS consortium often presents its work in research and academic conferences (e.g., First ACM Data Economy Workshop) and can showcase its missions and offerings. TRUSTS can also collaborate with research and academy to conduct events; for instance, TRUSTS ran a Workshop: Data Spaces & Semantic Interoperability. In this workshop, organisations such as the World Wide Web Consortium (W3C) and the Vienna University of Economics and Business joined forces to run this event on 3<sup>rd</sup> June 2022. This type of partnership is often ad-hoc. Therefore, it suits the best with the level 3 description of partner radar.

TRUSTS can also conduct partnerships with **EU projects**. A common way to do this is to create an event or exchange ideas to look for collaboration. TRUSTS has communicated with, for instance, KRAKEN and i3-Market to brainstorm ideas and promote each other events. In the long run, these research projects may benefit from exercising the offerings of TRUSTS. Currently, these EU projects do not influence TRUSTS business processes; hence we can map as little influence partners.

#### 2.3.1.8 Cost structure

Figure 15 presents the projected key categories and elements of the TRUSTS operator cost structure.

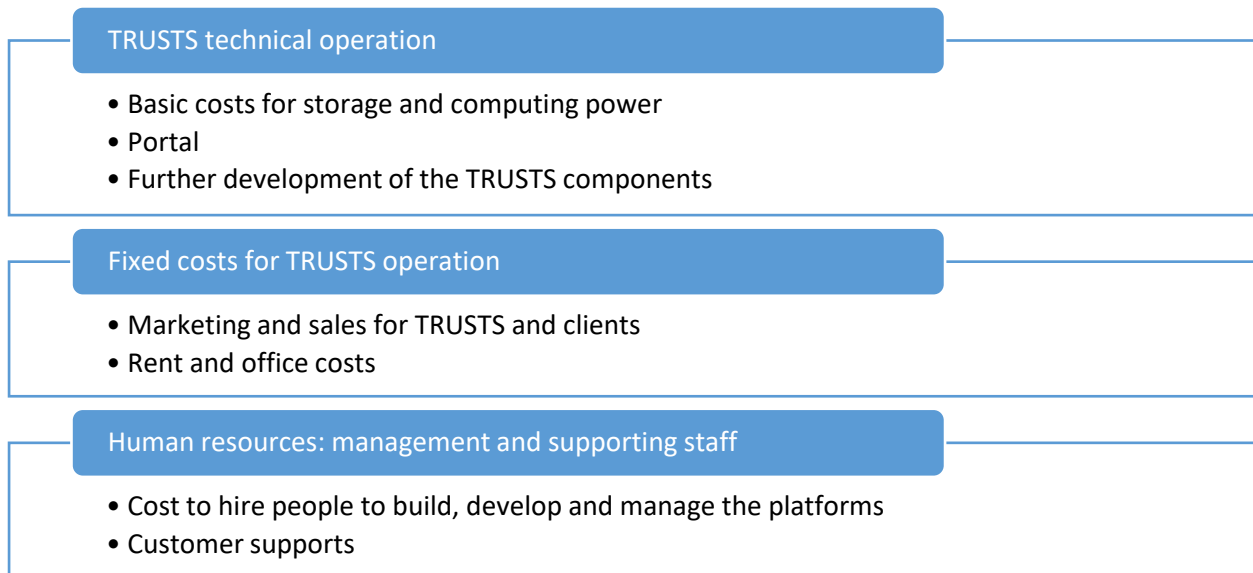


Figure 15. Cost structure

#### 2.3.1.9 Revenue structure

TRUSTS generates revenue from multiple streams (refer to D7.1). The most feasible option for the base business model is the subscription model. There are several reasons why a subscription revenue model may be particularly suitable for TRUSTS in its early stages:

- A subscription model enables TRUSTS to forecast and budget for future revenue more precisely, as TRUSTS can anticipate a specific monthly revenue from customers. This stability can be especially advantageous for a start-up company as it establishes itself and grows.
- Typically, subscription models create consumer loyalty because subscribers commit to utilising the platform for an extended time. This can be especially advantageous for a platform in its early stages, as end-user retention is crucial to TRUSTS's long-term success.
- Subscription models offer regular revenue, which can assist a business in better managing its cash flow. This can be especially crucial for a platform in its early stages, which may not yet have a significant customer base and maybe building its revenue streams.
- A subscription model is easily modifiable and adaptable as the platform grows and improves. To suit the needs of various sorts of users, the platform may, for instance, offer various subscription tiers with varying features and pricing.

Overall, a subscription revenue model can provide a predictable and reliable revenue stream for a platform in its early stages, aiding the company's long-term growth.

### 2.3.2 Overview of the TRUSTS Add-on Business Model

Figure 16 presents the overview of the TRUSTS add-on business model.

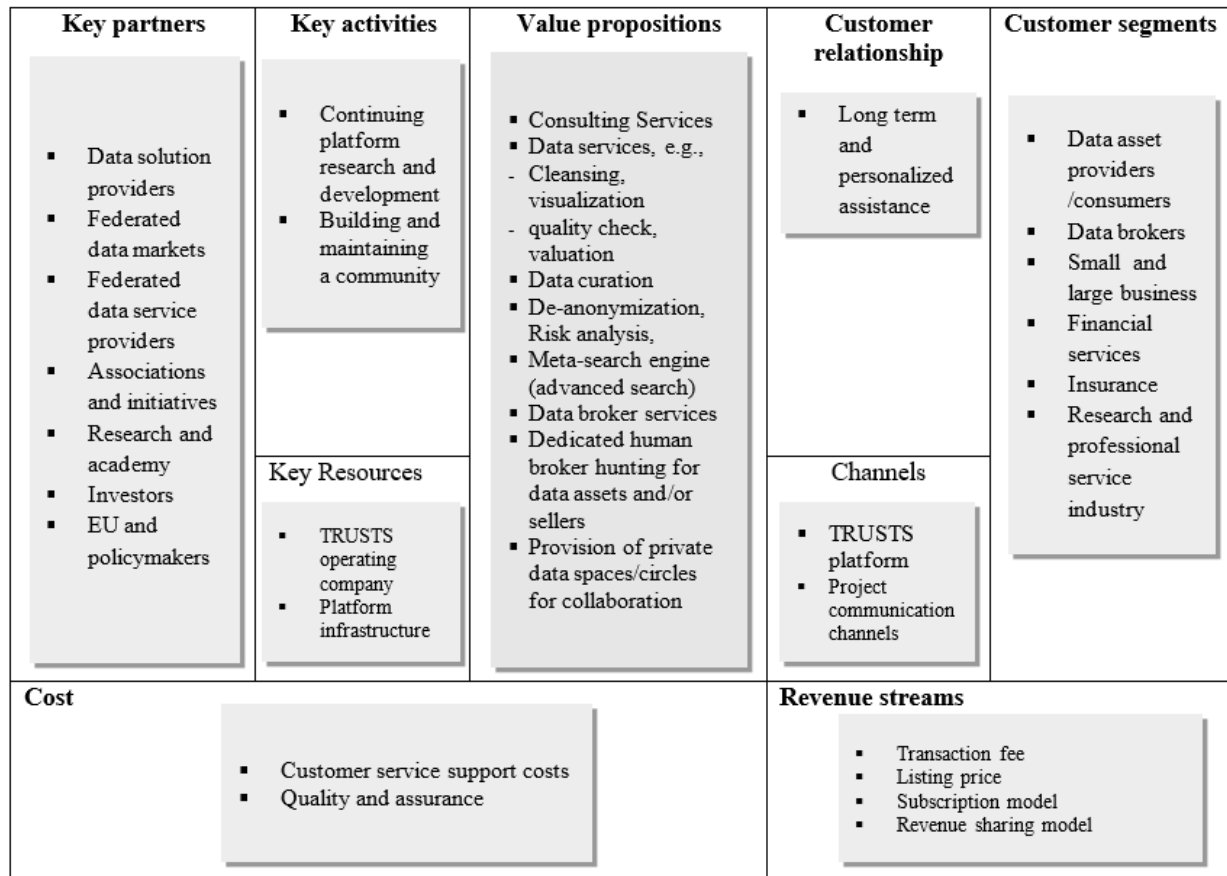


Figure 16: Overview of the TRUSTS add-on business model

#### 2.3.2.1 Customer segment

In the add-on business model, the customer segments are differentiated according to the size of the businesses and industry sectors. The additional customer segment of data brokers aims to extend the diversity of data available on TRUSTS's platform beyond data providers and consumers.

##### Small and large businesses

Large businesses (250+ employees) also constitute a key customer segment for TRUSTS. Large businesses generally store most of their data themselves. However, as businesses increasingly compete based on data insights, TRUSTS can still target large businesses since they require external data to enhance their operations. For example, large organizations with data and the ability to process it would get a more reliable and stable data stream from TRUSTS as a backup to their existing data sources and analysis.

Besides static data, TRUSTS would provide them with a standardized, long-term data stream (dynamic dataset) to serve as an emergency backup if their data sources and tools become unavailable.

Table 5, enterprises employing between 1-249 employees constitute a significant segment number of data providers.<sup>17</sup> By 2025, SMEs' projected share of data users is expected to be 98.1%. As major data users, small businesses lack the infrastructure to host data in large volumes and therefore depend on external data marketplaces for data needs (Koutroumpis et al., 2020). Besides their lack of data infrastructure, SMEs are also an attractive customer segment for TRUSTS since they lack access to data, creating a need to search for external data sources to fulfil their data needs. The TRUSTS Platforms will provide capabilities (e.g. anonymization, risk analysis, and data services). These offerings discussed in workshops 1 and 2 broadly address the needs of small businesses that do not have the resources for large data operations. Given their newness, small businesses are likely to lack large volumes of data. As such, they will rely on TRUSTS for their data needs.

Large businesses (250+ employees) also constitute a key customer segment for TRUSTS. Large businesses generally store most of their data themselves. However, as businesses increasingly compete based on data insights, TRUSTS can still target large businesses since they require external data to enhance their operations. For example, large organizations with data and the ability to process it would get a more reliable and stable data stream from TRUSTS as a backup to their existing data sources and analysis. Besides static data, TRUSTS would provide them with a standardized, long-term data stream (dynamic dataset) to serve as an emergency backup if their data sources and tools become unavailable.

Table 5. Number of Data Users by Company size, 2019-2021, 2025<sup>18</sup>

Thousands; %	Number of data providers			
	2019	2020	2021	2025
Member States	Units	Units	Units	Units
1-249 employee	527.235	534.171	544.003	621.490
250+ employee	7.605	8.339	9.043	11.869
Total EU27	534.840	542.510	553.046	633.359
SMEs share	98,6%	98,5%	98,4%	98,1%

### Industry sectors

In the add-on business model, TRUSTS' target sectors are not limited to the finance and telecom sector, which feature in the base business model. The rationale for selecting specific sectors is mentioned below.

**Research and professional service industry:** Data is essential to build and verify models for the research and innovation sector. This sector consists of universities and commercialised technical consultancy firms. Universities are non-profit and are generally open to exploring new types of technologies. Commercialised technical consultancy firms use data to advise governmental and non-governmental institutions. This makes them a good fit for TRUSTS, as they would gain from having access to a broader scale of data.

**Insurance:** Insurance companies require reliable data for their operations. Due to privacy concerns and regulations, data must be safe and anonymous. This makes insurance companies important clients as TRUSTS adheres to core values of privacy. Insurance companies are also reliable partners, as there are few alternatives to get safe, reliable, and anonymous data.

<sup>17</sup> European Data Market Monitoring Tool, IDC 2021

<sup>18</sup> Ibid.

**Financial:** European banks are strongly connected with the European Central Bank and thus have many regulations. As a result, they face increasing competition from high-tech, digitized payment companies such as PayPal, Adyen and Square, as they are not so strongly connected with the central banks.<sup>19</sup> Participants in the workshop indicated that a vertical data marketplace should also provide possibilities to host operations of fintech. Banks need data to form a risk profile, which must be done preferably via a consistent, digital way. European banks must carefully handle customer information, making the TRUSTS platform a suitable fit.

**Health care:** Participants in the workshop suggested offering a private data ecosystem that hosts data related to healthcare, biotechnology, or nanotechnology. In Europe, hospitals are mostly governmental institutions with loads of data banks. Anonymizing these data would make it safe but still attractive to other sectors and thus attractive for TRUSTS. For hospitals, it must be a safe and reliable platform. European pharmaceutical companies require data to develop medicines that suit hospitals' data. European hospitals can be seen as loyal partners and are governmental based.

**Governmental agencies:** For governmental institutions, it is required that the data is safe, reliable, and anonymised. The inclusion of government agencies should significantly enhance the prestige, social, and attractiveness of the TRUSTS data market. There is a great demand for data from government agencies, such as open data. For example, the Food and Drug Administration solves food-related diseases through data science. Therefore, the participation of government agencies should be a catalyst for the TRUSTS platform to be successful.

#### Data brokers

Another key customer segment for the TRUSTS platform is data brokers. Data brokers are “Independent traders & trade facilitators or trade agents of data Suppliers and users. They act as a matchmaker for the supply of Data-as-a-Product and demand for Data-as-a-Problem-Solution” (D7.3). Data brokers provide a data source that can enrich the TRUSTS platform by providing data harvested from different sectors. Data brokers play the dual role of data users and suppliers of data aggregated or needed by their clients. As of 2021, the Data Broker Market size was valued at USD 257.16 Bn. The data broker revenue is expected to grow by 4.5% from 2022 to 2029, reaching nearly USD 365.71 Bn.<sup>20</sup> Figure 17 shows that data brokers actively participate in the data economy across different industries and sectors. Since the data market remains unregulated and fragmented across sectors, data brokers or intermediaries would be key players in the data economy. However, care should also be taken in using data from data brokers to ensure compliance with GDPR.

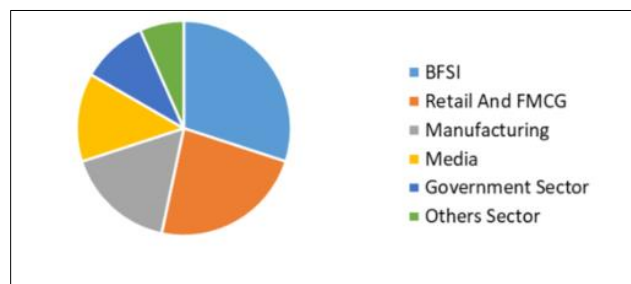


Figure 17: Data Broker Market by End-User Sector(%) in 2021<sup>21</sup>

<sup>19</sup> FinTech Club. How adyen is disrupting payment processing, 2019. URL <https://medium.com/iveyfintechclub/how-adyen-is-disrupting-payment-processing-7e0e261f0ea>.

<sup>20</sup> [Data Broker Market: Global Industry Forecast \(2022-2029\), trends, Scope \(maximizemarketresearch.com\)](https://www.maximizemarketresearch.com/research/data-broker-market/)

<sup>21</sup> Ibid.



### 2.3.2.2 Value propositions

We now discuss the offerings of the TRUSTS add-on business model option. Specific customer pains addressed by the offering are also mentioned. The workshops, interviews, and the first phase of D7.1 inform the offerings. The core premise of the add-on offerings is to envision TRUSTS providing value to broader customers that go beyond the finance and telecom industry mentioned in the base business model option. The goal is also to provide offerings not limited to data exchanges but sustain a healthy data ecosystem. The offering for the add-on business model options is listed in Table 6.

Table 6. TRUSTS add-on offerings

TRUSTS offerings	Source
Consulting services	Business model workshop, D7.1 taxonomy
Data services, e.g., cleansing, visualisation, valuation, data asset preparation	Business model Workshop, D7.1 taxonomy
Data curation: create, annotate, and store personal collection, data cleansing personal assistance, domain-specific	Business model workshop, D7.1 taxonomy
Anonymisation, risk analysis, quality check	Business model workshop, D7.1 taxonomy
Meta-search engine (advanced search)	Business model Workshop, D7.1 taxonomy
Data broker services, dedicated human broker hunting for data assets and/or sellers	Business model workshop, T7.1 Taxonomy
Provision of confidential data spaces/circles for collaboration	Business model workshop, T7.1 Taxonomy
On-demand collaboration spaces which are embedded and autonomous	Business model workshop, T7.1 Taxonomy

**Consulting Services:** Consulting services are a key offering of the TRUSTS platform. For example, based on knowledge such as the size of the enterprise, customer base, and industry growth rate, TRUSTS can provide services that align with the needs of data providers and consumers. TRUSTS can assist in aggregating relevant customer data, negotiated on a one-to-one basis with the customers. For example, TRUSTS could work with new data providers in providing services that help organisation open their data in a secure and privacy-preserved way. By providing these services, TRUSTS provides added value for its customers by reducing uncertainty in data protection that customers face and providing data governance mechanisms that data providers can utilise to ensure data compliance. TRUSTS could also consult with the data provider to address their concerns about control over the data and explore whether they are additional control or

pricing mechanisms that can be applied. Overall, consulting services could go a long way to reduce companies' uncertainty in deciding pricing, type, analysis, and potential buyers or sellers relevant to their growth. On the part of TRUSTS, additional revenue is generated in the form of a commission based on consulting services.

**Data broker services** are dedicated human broker hunting for data assets and/or sellers. This offering provides added value to customers. For example, a dedicated human broker could be valuable for customers who do not necessarily know the advanced search options. It also has the added benefit of acting as an intermediary between potential data sellers and buyers. This could remove uncertainty over the data quality since the potential data buyers and sellers can rely on the data broker in case of issues with the data.

**Data anonymisation and risk analysis** were identified in the workshop. Offering data suppliers and users the possibility to anonymise data would relieve uncertainty, e.g., risks customers may face from risk exposure, such as privacy risk and risk of hacking sensitive data. The value of the offering is not just in providing tools for anonymization or risk analysis. It lies in enabling customers to perform anonymization by themselves. By providing the possibilities for anonymization, the TRUSTS platform aligns with current business trends that place digital trust as a critical consideration for customers. For example, according to a 2021 US survey (see Figure 18), privacy was the third-factor consumers pay attention to when selecting brand choices or purchasing decisions. Thus, the possibility for anonymization implies that TRUSTS complies with privacy protection and provides a positive outlook for users considering using TRUSTS.

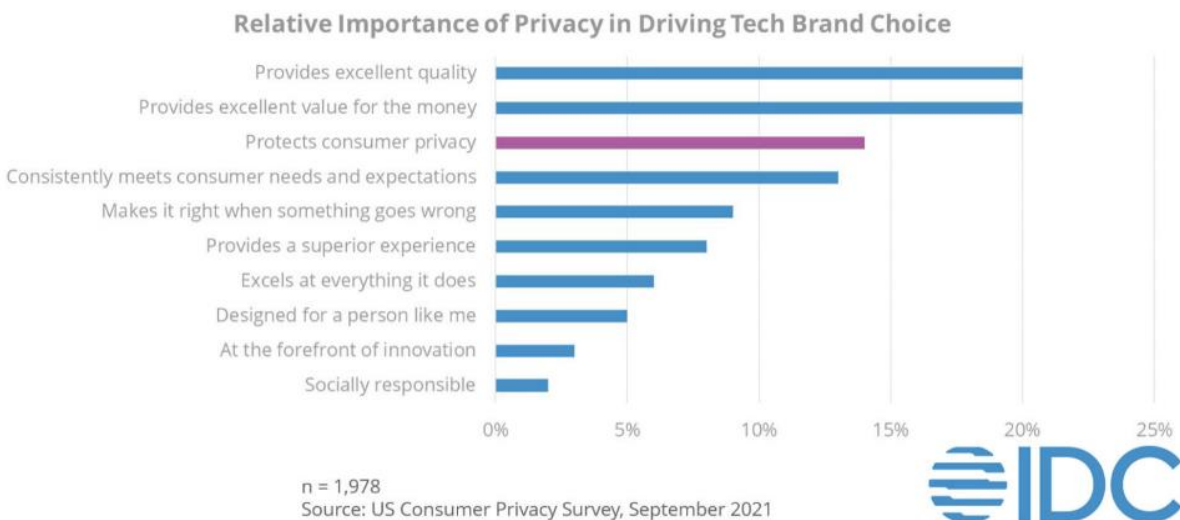
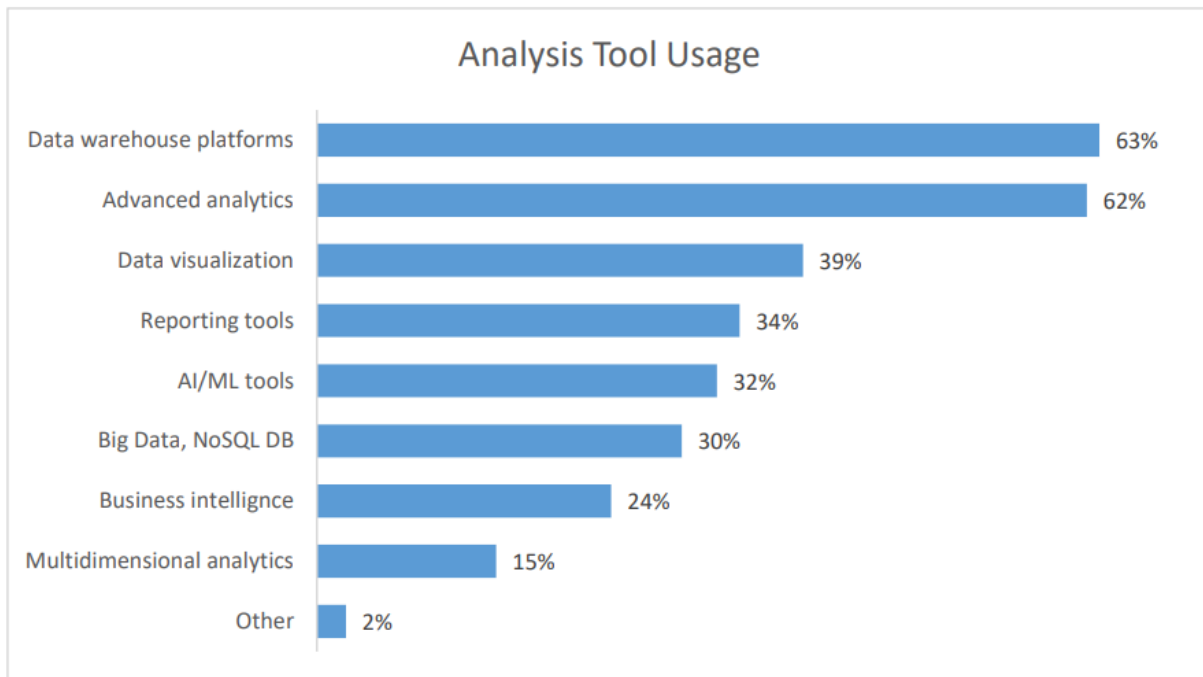


Figure 18. Importance of privacy in driving Tech Brand choice<sup>22</sup>

**Data services** are a key offering that the TRUSTS platform leverages to generate added value. For example, cleansing and visualising the data open commercialisation opportunities by providing the environment and infrastructure for customers to process data. This offering provides additional value for small businesses with insufficient resources to invest in data processing infrastructure. Small businesses are found to be reliant on marketplaces to address their data needs (Koutroumpis et al., 2020).

<sup>22</sup> US Consumer Privacy Survey, September 2021.



Figure 19. Analysis tool usage<sup>23</sup>

As seen from Figure 19, data services such as advanced analytics and data visualisation are among the top three analyses companies require. Such analysis provides insights into various aspects, e.g., decision-making and planning, which are valuable for companies. IDC indicates that the usage of data analysis tools is likely to grow as companies grow.<sup>24</sup> Small enterprises lacking the resources and tools to develop in-house data analysis are potential TRUSTS customers for this offering. Besides small enterprises, sectors such as professional and consulting services, retail and wholesale, and transport have increasing data consumers.<sup>25</sup>

**Confidential data spaces/circles for collaboration** allow companies to engage in collaborative interactions. Collaboration is particularly relevant in the context of data-driven innovations. This offering by the TRUSTS platform was considered relevant by participants in the workshop. Besides, trusted data spaces for collaboration can also benefit TRUSTS customers. For example, a survey by IDC estimates that more than 30% of organizations (public/private) are actively searching for and developing new products and services reliant on shared data and services.<sup>26</sup> Such offerings provide added value to TRUSTS customers beyond data sharing. For example, customers could find collaborators on the platform to kick-start projects that can little be leveraged to make TRUSTS visible. Such offerings align with current trends in platform companies that typically become more competitive and attractive for customers through providing multiple services. A case in point is Amazon which ties together its customers through different offerings such as amazon prime, cloud computing services, logic, and consumer electronics<sup>27</sup>. Apple uses a similar strategy as well, where it provides innovative services intending to increasingly expand its

<sup>23</sup> European Data Market Study Survey, 2021.

<sup>24</sup> Ibid.

<sup>25</sup> European Data Market Monitoring Tool, IDC 2021.

<sup>26</sup> FutureScope: Worldwide Future of Industry Ecosystems 2021

<sup>27</sup> [Digital Ecosystems 2.0: climbing to the next level | McKinsey](#)

ecosystems beyond its core offering of a device. Thus, by providing a confidential data space for collaboration, TRUSTS stands a chance to grow beyond its core offering of data exchanges, thus setting the ground for an ecosystem of actors collaborating on different interests based on data.

**On-demand collaboration spaces that are embedded and autonomous.** These spaces are of value to non-subscribers that may use them for a period to experiment with the services offered. This act as a trial ground for new customers who could be converted to active user of TRUSTS. This means that once a customer experiments with the space and sees it valuable, a later subscription is possible. Thus, by providing the space for collaboration, customers do not necessarily have to pay the total cost of subscribing to the platform. This is also valuable from the TRUSTS platform perspective, as initially sceptical customers could be converted to regular customers after experimenting with the on-demand space. This could be a springboard for gathering new customer ideas and feedback.

### **2.3.2.3 Customer relationships and channels**

The customer relationships and channels of the base and add-on business channels remain the same. This is because the TRUSTS platform and project-related communication remained the essential medium through which TRUSTS interacts with stakeholders and other audiences. For example, TRUSTS has a dedicated website, active social media presence, and connectors, all intended to facilitate the delivery of its base and add-on offerings.

### **2.3.2.4 Key activities**

The TRUSTS operator must focus on **continuing platform research and development** to realise add-on business models. As with any business, it will be essential for the operator of TRUSTS to continuously seek to enhance and optimize its operations. This may involve gathering customer and data provider feedback and testing new features and functionality. As stated in the value propositions, for example, TRUST can extend its offerings by providing consulting services. This can help to build long-term and personalized assistance for data providers and consumers, thus better supporting their needs. Thus, to keep users engaged in the data marketplace, it will be necessary to provide frequent updates and new features.

Another essential point in the advanced stage is **building and maintaining a community**. In order to foster a sense of collaboration and engagement, the TRUSTS operator may wish to cultivate a community of data providers, consumers, and third-party providers. This may involve creating forums or other online spaces where users can share insights and knowledge and hosting events or meetups. A robust community can assist a business in building brand recognition and loyalty. By interacting with customers and other stakeholders via a community platform, a business can foster a sense of connection and belonging, resulting in repeat business and positive word-of-mouth advertising. Second, a community can provide a company with valuable feedback and insights. By actively listening to and engaging with community members' needs and concerns, a company can gain a deeper understanding of its customers and make more informed decisions regarding product development and other crucial business activities. A community can also provide a variety of customer support and service-related benefits. For instance, the TRUSTS operator can leverage its community to provide more efficient customer support, handle inquiries, and resolve issues. Overall, establishing and sustaining a community can be necessary for a business to cultivate strong relationships with its customers and other stakeholders.

### **2.3.2.5 Key resources**

As earlier mentioned in the base business model option, the continuity of TRUSTS after project life hinges on the existence of a TRUSTS operating company. Like the base business model option, the operating company is expected to provide resources in different domains, such as marketing, financing and other

core functions needed to operate correctly. TRUSTS also need a proper function platform architecture to sustain its operations. The aim of the architecture should address all aspects related to enhancing privacy, data sovereignty, and data anonymisation, which are essential aspects that make TRUSTS compliant with EU regulations.

### 2.3.2.6 Key partners

As mentioned earlier in the base business model, TRUSTS' key partners can be grouped into four categories: suppliers, investors, collaborators, and others. The key categories of partners are identified in the base. Because the TRUSTS platform requires inputs across multiple entities to ensure the proper delivery of its value propositions, partnering with a broader scope of actors is essential. For example, developing and providing a solution based on data requires inputs like competencies from data solution providers and third parties.

The importance of **data solution providers** can be seen in the context where TRUSTS is not just limited to exchanging data items but also providing data solutions. For example, data solution providers offer consultative development and/or operations of comprehensive, highly customised data solutions related to data UCs linked to the TRUSTS infrastructure. Solution providers also play the indirect role of attracting new data suppliers and data buyers through the solutions.

**Federated data markets** are essential partners for TRUSTS since they would utilise the TRUSTS interoperability solutions developed to connect with the TRUSTS platform. **Federated data service providers** are third-party providers that create and monetise data services, such as enrichment, analytics, and visualisation, which are connected as service modules via APIs to the TRUSTS platform and provisioned on the TRUSTS Platform. Such advanced data services help to unlock or increase the use-case-specific value of data for data suppliers (e.g., data and meta-data quality assurance) and data asset buyers (e.g., data enrichment and advanced analytics).

**Associations and initiatives.** Data-sharing associations such as GAIA-X and IDSA are among the essential partners of TRUSTS. TRUSTS would connect with potential data providers and consumers by accessing and joining their networks. In addition, complying with the state-of-the-art standards of these associations will be a great selling point. For example, IDSA is a valuable association for TRUSTS through benefiting from insights related to data spaces, ensuring data sovereignty for data providers. This benefits TRUSTS since it can leverage the standards, components and tools developed by IDS to ease the work of data suppliers.

**Research and academy.** Research projects will benefit from exercising interoperability solutions within data markets. In addition, academic communities can also be great partners in increasing awareness of data exchange activities.

**Investors:** Investors are key partners in any business as they provide funding. TRUSTS can take a variety of approaches to recruit potential investors. First, they can participate in various fundraising events within the EU. One way to do this is to use the European Fundraising Association (EFA) and its members to find out about the schedule of significant fundraising conferences in the EU countries during the next few months. In addition, TRUSTS can also take the initiative to participate in several start-up-investor meetings that are widely known in Europe. Figure 20 shows the prominent investors active in the European region in recent years.

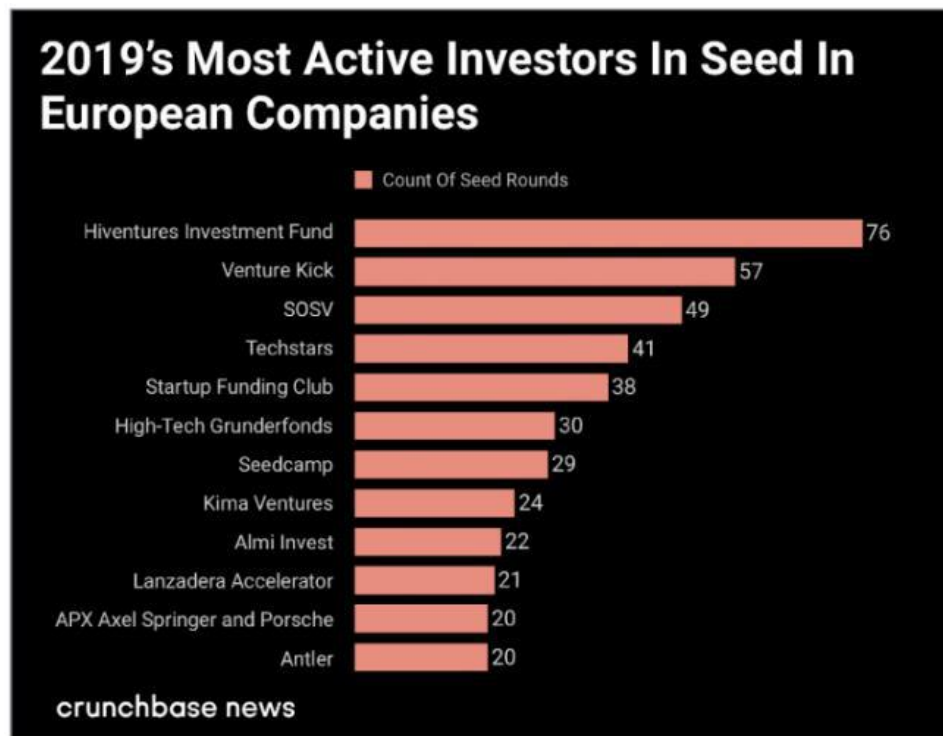


Figure 20: Main investors currently active in the European region (Teare & Kunthara, 2020)

**EU and policymakers.** As a regulator and policymaker, the European Union wants the data platform to adhere to all applicable regulations and provide data holders with control over their data and its future use. The EU also wants to drive economic growth and create jobs by investing in data marketplaces. In the TRUSTS project. Investors (including the EU) are interested in profit, a competitive advantage, and transparency in the service to know what they are investing in and receive a higher market share. Furthermore, the EU wants to remove barriers that hinder innovation that relies on data. These values are in line with the TRUSTS platform.

#### 2.3.2.7 Cost structure

Besides the costs mentioned in the base business model option, additional costs that largely arise from delivering additional value propositions would be incurred. Particularly in **quality and assurance (QA)**, TRUSTS has to ensure that the quality of additional services it provides is of quality. This cost would arise as new resources are expected to be utilised to fulfil customer demands for particular offerings. For example, a customer requires consultative services. In some instances, this will require costs such as assigning dedicated personnel to provide the offering. These activities need to be checked for quality. Generally, quality assurance identifies or prevents errors and problems related to services and the customer, aiming to improve product quality. It is also noteworthy that QA can save money in terms of legal exposure for the platform. Moreover, the interdependencies between platform components imply that left unresolved issues related to quality can become complex, creating a cost for the platform over time. Since QA is a process that adds value to the platform and positively impacts the brand reputation while preventing high financial costs, it is crucial to have QA employees in the company.

**Customer service support costs.** An additional cost is also incurred for TRUSTS to fulfil the additional demands of offering the add-on business model option. Service support can be done in two ways: using Chatbots and personal support. Chatbots have become an integral part of service providers. Using this

technology, TRUSTS provide quick solutions to customers without any effort. AI technology enables pre-defined answers to already known troubleshooting problems or asked questions to reduce overall effort, cost, and time. Since the TRUSTS platform will likely be in its early phase, support costs might gradually grow over time based on new services added. Personal Support requires initially trained employees depending on the product and customer requirements. Personal Support leads to customer feedback which increases overall customer satisfaction. Since TRUSTS is entering the market, it requires platform support for new clients. For example, in workshops 1 and 2, participants indicated the need to support customers for static and real-time datasets.

### 2.3.2.8 Revenue structure

The additional offerings in the add-on business model option allow TRUSTS to generate additional revenue. TRUSTS platforms generate revenue from various sources, e.g., from promotion and ranking of data assets, Trading (transaction fee), Ecosystem access (membership), Data listing and licensing, data listing, sponsored search, brokerage fee, trading fee, data asset sales, service fee, and advertisement. Below four revenue-generating streams are discussed.

TRUSTS should ask for **transaction fees** to trade data on the platform. The transaction fee for the TRUSTS platform is like what is done in stock trading platforms such as NASDAQ, which provides a platform for companies to raise capital in exchange for stock; the TRUSTS platform would do the same but for data.

**Listing price:** To gain access to the platform and help sellers' setup, TRUSTS incur costs and should ask for a listing fee. For example, providers that want their data to be visible and gain more visibility in the advanced search could pay an additional listing fee. For example, each company might need multiple listings overtime on TRUSTS based on the datasets provided to the platform. Multiple listings will generate more revenue for TRUSTS. For example, NASDAQ generates almost 20% of its revenue from fees such as creating a stock listing. Since data suppliers could list diverse datasets, TRUSTS can rely on multiple listings from companies.

**Subscription model:** Another revenue source for TRUSTS is a subscription. Data sellers are paying a listing fee as described above, and, on the other hand, buyers must pay a subscription to gain access to the trading platform and pricing info here.

**The revenue sharing model** describes how revenue is shared with actors, e.g., data marketplace operators. This can range from fixed (absolute or %) and sliding scale (absolute or %). Fixed means a fixed percentage apportioned to partners irrespective of the amount generated from the revenue streams.

## 2.3.3 Market Readiness Level (MRL)

This report reflects on Market Readiness Level (MRL)<sup>28</sup> to measure the commercialisation readiness of technology innovation, including platform developments. MRL is developed by swforum.eu to: (1) evaluate the present condition of the project, (2) analyse project shortcomings, and (3) prepare the next stages. This MRL is quite common to apply in EU projects, for example, in Access2eic.eu, Cyberwatching.eu. The general overview of the MRL is described in Table 7.

<sup>28</sup> [https://swforum.eu/sites/default/files/2021-05/SWForum\\_MTRL\\_Webinar\\_26.05.2021.pdf](https://swforum.eu/sites/default/files/2021-05/SWForum_MTRL_Webinar_26.05.2021.pdf), accessed on December 20, 2022.

Table 7 Market Readiness Level (MRL) description<sup>29</sup>

MRL	Description	Phase
0	Hunch You perceive a need within a market, and something ignites.	Ideation
1	Basic Research You can now describe the need(s) but have no evidence.	
2	Needs formulation You articulate the need(s) using a customer/user story.	
3	Needs validation You have an initial “offering”; stakeholders like your slideware.	Testing
4	Small-scale stakeholder campaign Run a campaign with stakeholders (“closed” beta – 50 friendly stakeholders).	
5	Large-scale early adopter campaign Run a campaign with early adopters (“open” beta – 100 intended customers).	
6	Proof of traction Sales match 100 paying customers.	Traction
7	Proof of satisfaction A happy team and happy customers give evidence of progress.	
8	Proof of scalability A stable sales pipeline and a strong market understanding allow revenue projections.	Scaling
9	Proof of stability KPIs surpassed and predictable growth	

Reflecting on the description above, the TRUSTS project can be categorised in MRL level 5: Large scale early adopter campaign. We have run campaigns and engagement activities with many early adopters, including potential data providers, data consumers, and data marketplace operators. TRUSTS WP5 has conducted three trial cycles based on TRUSTS Minimum Viable Product (MVP) and UCs demonstration. According to the business model reflection, a critical step after this is to build an operating company for TRUSTS. In doing so, TRUSTS can start commercial activities with real users to reach proof of traction (at least 100 actual data asset transactions with enough onboarded data providers and data consumers).

## 2.4 Risks and Recommendations

This section provides insights into risks and recommendations that are likely to affect the feasibility and viability of the TRUSTS platform. It is essential to consider that while the TRUSTS platform evolves, the risks may also change. However, key risks and recommendations are listed below in this early phase.

### Risks

- TRUSTS as a data marketplace is characterised by the notion of network effects which means that for the platform to take off and scale in size, it needs a critical number of users (data providers and consumers) on both sides of the platform. This means TRUSTS might have to sustain several years while substantial cost is incurred by marketing and promotion activities needed to attract

<sup>29</sup> Source: swforum.eu



users to the platform. There is thus a risk that while services offered by TRUSTS are deemed valuable, TRUSTS is not going to generate any revenue to cover its operations.

- One of the implicit business model assumptions is that TRUSTS users would rely on the platform to complete transactions. This means users would not bypass the platform to conduct transactions with data sellers once relevant datasets or potential sellers have been identified. Thus, without clear services that enable users to stick to the platform, TRUSTS runs the risk of being used merely as a medium to search and discover datasets. This reduces opportunities to generate revenue from commission or brokerage services for TRUSTS.

## Recommendations

This section provides the key recommendations for the commercialisation of the TRUSTS platform. The recommendations broadly touch on the feasibility and viability of the TRUST platform. The recommendations are listed below.

- Regarding pricing, it is recommended to make access to the platform free for initial users to incentivise usage upon which transactions fee and commissions can be built. Therefore, the advice is to create an economically favourable environment for data providers by subsidizing them. More data providers will result in a larger variety of data and lure more consumers to the platform. From then, it becomes easier to rely on the brand name that has been built and expand the customer size.
- From the perspective of economic feasibility, a transaction fee is advised. For every transaction made, a percentage will be paid to the TRUSTS platform. In this way, the revenue streams become more robust as the platform grows. Next to this transaction fee, a membership fee is recommended. A membership will function as a gatekeeping to guarantee the quality of data and helps to keep track of the users on the platform.
- TRUSTS should focus on an initial niche of offerings rather than seeking to provide an entire range of offerings in the early phase. For instance, by starting with facilitating data exchanges, TRUSTS establishes the trust needed to incentive new customers to enrol on the platform. Once trust has been established, engaging in new offerings and widening its partnerships becomes feasible. TRUSTS should consider a staged approach to scale the ecosystem. In the first step, TRUSTS emphasises its offerings and leverages insights from its UCs to propel the platform with initial data sets. Feedback from the initial consumers of TRUSTS offerings should provide insights into new offerings needed to enrich the platform. Such an approach solves the risk of over-investments in features and solutions on the platform that are not attractive to initial users. This strategy is used by social media platforms where content creators, based on the feedback from initial users attracted to the platform, refine and grow the platform. Once TRUSTS has established its reputation and gained insights into the feedback of its initial services, the next step is to promote its visibility. This involves leveraging insights from the initial users to promote the benefits each user group gains from the platform and the pains the offering resolves. For small and micro finances, promoting the benefit of providing an environment for SMEs to analyse and process their data is an example of TRUSTS increasing its visibility targeting SMEs.
- TRUSTS should develop a partnership program. Partnership programs represent a common mechanism to achieve the adoption of standards. Platform owners offer several levels of partnership to attract users. For instance, it is common for digital platforms to offer three levels of partnership, named "Bronze", "Silver", "Gold", or similar. Each type of stakeholder will be required to meet different criteria to reach a level which creates differentiation and competition



among participants in the partnership program. The resulting heterogeneity of participants enriches the ecosystem by encouraging companies to position differently.

- TRUSTS should capitalise on its anonymisation tool. This is a valuable incentive for actors to share data as consumers increasingly consider privacy as a key part of their buying decisions. So, a key part of the business model should be able to demonstrate to TRUSTS platform users how their data is anonymised. The guidelines for anonymisation should be easy to use both at the level of individual users and companies. This means that privacy preservation should serve as a core value proposition for the platform. Ensuring certification mechanisms are available to build trust on the platform without allowing users to doubt the credibility of the metadata available.
- A platform business typically entails huge investment costs, especially in marketing and gaining market momentum. Investment is necessary for the starting phase to make the platform and its ecosystem flourish and evolve. This requires TRUSTS to adopt a business strategy of long-term return on investment. For example, setting up a data quality control panel, subsidizing data providers, and keeping the platform up and running are examples of investments necessary for building up the reputation and attraction of users. In the long term, these investments will likely pay out as TRUSTS will collect more transaction fees as the user base grows and the platform matures.

### 3 Part B: Outlook to the Future - TRUSTS as a Federated Data Marketplace

As stated in Section 2 - Introduction, this section will elaborate on TRUSTS' long-term vision as a federated data marketplace. This vision is long-term, which means that it goes beyond the current technical work delivered in the project lifetime. This section consists of nine subsections (Figure 21).

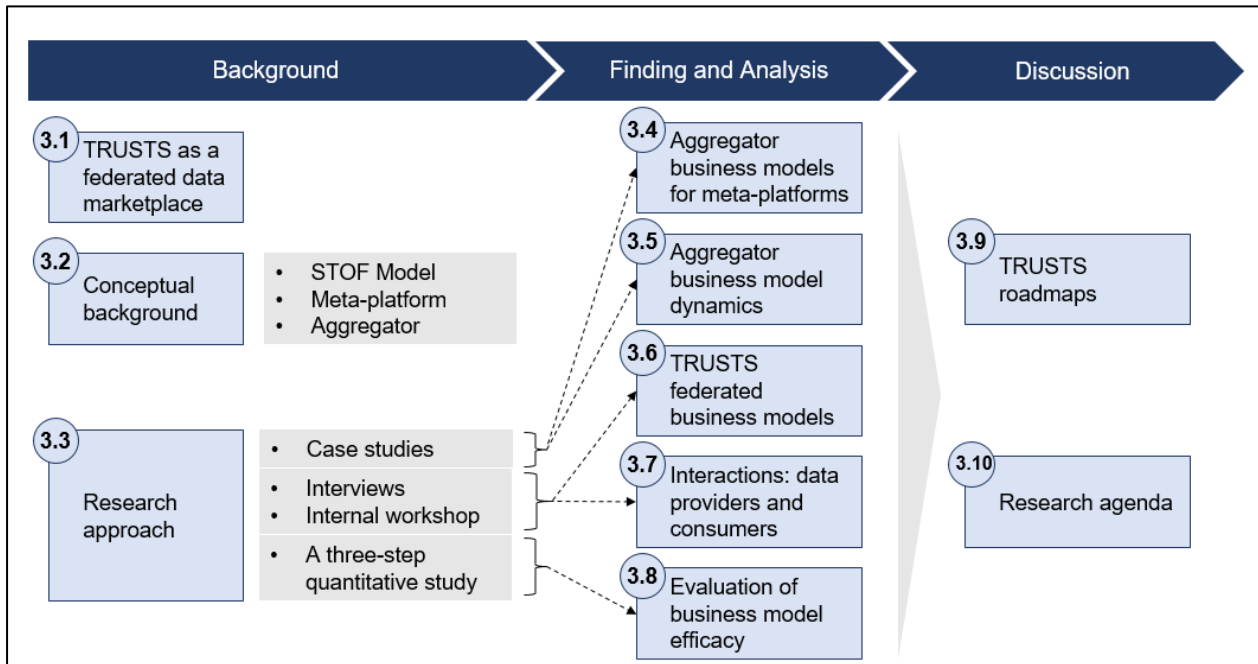


Figure 21. The overview of subsections of Part B

Subsection “TRUSTS as a Federated Data Marketplace: Rationale” explains the rationale of TRUSTS as a federator of data marketplaces, which aligns with TRUSTS' long-term vision as stated in the DoA. Subsection 3.2 discusses the theoretical background that will serve as a guide for the business model analysis. Subsection 3.3 describes the research methodology followed, consisting of three groups of methods:

- 1) case studies,
- 2) interviews and an internal workshop,
- 3) a three-step quantitative study.

The case studies were used to conceptually examine aggregator business models for meta-platforms (subsection 3.4) and their dynamics (subsection 3.5). The interviews and the internal workshop were employed to specify the aggregator business models of meta-platforms in the context of TRUSTS (subsection 3.6). We also reflect on the empirical study finding to reveal the potential interactions between data providers and consumers (subsection 3.7). Next, The three-step quantitative study was utilised to evaluate the federated data marketplace on value creation criteria of trust, perceived risks, and willingness to share data (subsection 3.8). In subsection 3.9, we provide TRUSTS roadmaps towards a federated data marketplace. In addition, we provide research agendas for scientific communities in subsection 3.10.

### 3.1 TRUSTS as a Federated Data Marketplace: Rationale

Reflecting on the TRUSTS rationale in the DoA, the TRUSTS Consortium identified the **fragmentation challenges** of data marketplace initiatives to fulfil the European Digital Single Market in the following three aspects:

1. Different national projects have different **scopes**, in terms of both technology development and addressed **industry domains**.
2. Research projects at European level address specific aspects of data market-enabling technologies, but do not explicitly address the integration and interoperability of business-focused national platforms.
3. Commercial data markets provided by private organisations are currently predominantly service providers rather than **scalable data markets**.

Literature on Data Economy also highlights the same issue of fragmentation. Data as an exchange commodity requires context to be valuable to data consumers (Aaltonen et al., 2021). Data assets as an exchange commodity are highly context-dependent. Hence, a strong need for specialising in data marketplaces arises (Santiago & Laoutaris, 2022). Further, as data providers have concerns over data sovereignty, they prefer data marketplaces confined to specific UCs. Moreover, as data trading and sharing often have to comply with local regulations, data marketplaces often focus on a specific nation (e.g., German Mobility Data Marketplace) or even a city (e.g., Amsterdam Data Exchange). Therefore, it is expected that the current fragmentation of the data platform industry will likely sustain itself in the future, resulting in costly lock-in effects and data discovery challenges (Santiago & Laoutaris, 2022).

Due to fragmentation, data marketplaces do not create network effects for data providers and consumers, which explains why the data economy does not take off as expected. To overcome the fragmentation challenges, a detailed analysis can be accessed in D7.1 "Sustainable business model for TRUSTS data marketplace I", which reveals the importance of one of TRUSTS' roles in the future data economy: to act as a federated data marketplace.

*"TRUSTS is a meta-platform with a simple hub & spoke model (1:n) that coordinates and integrates different data marketplaces' resources and solutions (e.g., data listing) via centralised efforts to organise collective actions by enforcing common policies, standards, and infrastructures" (TRUSTS D7.1, 2021, p. 21).*

This section elaborates on the business model implications of TRUSTS' long-term vision as a federated data marketplace. Figure 22 illustrates the positioning of this section compared to the previous ones. Taking a more pragmatic approach (i.e., by reflecting on the desirability, feasibility, and viability aspect of business models based on the technical work realised in TRUSTS), the TRUSTS "base" and "add-on" business models have previously been discussed in section 2. In this section, on the other hand, more theoretical exercises are considered, mainly through "speculative engagement" (Hovorka & Peter, 2021a, 2021b): preparing the future by speculatively theorising the upcoming scenarios. In this way, the section illuminates the business model that the TRUSTS platform may evolve towards to fulfil the goal of federating fragmented data marketplaces.

	TRUSTS “Base” Business Models	TRUSTS “Add-ons” Business Models	TRUSTS “Federated” Business Models
<b>Vision</b>	A data marketplace		A federated data marketplace
<b>Approach</b>	Pragmatic		Theoretically-informed analysis
<b>Report</b>	Chapter 2		Chapter 3

Figure 22. Balancing TRUSTS as a data marketplace vs a federator

## 3.2 Conceptual Background

This subsection discusses the conceptual background to develop TRUSTS federator business models, consisting of:

- 1) a baseline framework for understanding business models (i.e. the STOF model),
- 2) platform-to-platform openness via a meta-platform,
- 3) aggregator business models,
- 4) connecting the STOF model with aggregator business models.

### 3.2.1 A Business Model Framework: The STOF model

Bouwman et al. (2008) provide the STOF model specifically made to fit with the business model of Information Communication and Technology (ICT)-enabled business. The STOF model consists of Service, Technology, Organisation, and Finance domains.

The STOF model fits this part of the deliverable as it focuses on designing ICT-enabled businesses with an emphasis on data marketplace federation. Moreover, as we intend to reveal (and design) the business models for a federated data marketplace, including its evolutionary paths, we need a framework that enables dynamic interdependencies of business model components. Hence, the STOF model is appropriate because it provides a correlation between each component - unlike the business model canvas model, which provides only a static representation of a business. Thus, this second part of the deliverable will use the STOF model as a framework to analyse and create TRUSTS federator business models.

**The service domain** explains the business' offering to the users in a specific market segment. The service design is the central aspect of this model. Service design focus on value creation. Most ICT-enabled businesses start by deciding the specific value to be offered to the end-users, then decide which technical requirement, organisation, and financial resources are needed. **The technical domain** explains the

technical components utilised in the business model. Technology has a central role in facilitating the service delivery process. **The organisation domain** explains the configuration of actors and resources to realise the value. Finally, **the finance domain** explains the revenue-generating mechanism.

### 3.2.2 Platform-To-Platform Openness via a Meta-Platform

To develop business models for TRUSTS as a federator (which interrelates and is interoperable with existing data marketplaces), literature from Platform-To-Platform Openness (PTPO) was drawn. PTPO is suitable because it deals with "the extent to which a platform is interoperable with other platforms" (Mosterd et al., 2021, p. 1). One example of PTPO is *an application* bridge connecting platforms (Hilbolling et al., 2020). Another type of PTPO that is suitable with the previous federator definition (subsection 3.1)—a simple hub & spoke model (1:n)—is a **meta-platform**: an overarching platform that connects two (or more) platforms, thereby interconnecting their respective platform ecosystems (Mosterd et al., 2021). In all, a meta-platform, in turn, also has an ecosystem composed of multiple sub-ecosystems (e.g., Wang, 2021).

An example of a *meta-platform* is Trivago, which federates digital *platform participants* (e.g., Expedia, Booking, or Airbnb) in the tourism sector. Such platform participants benefit from Trivago as a first discovery channel, hence exposing their platforms to larger user bases (Perelygina et al., 2022). Thus, meta-platforms generally have a core characteristic of the need for participating platforms and thus cannot exist in a stand-alone nature (Lagutin et al., 2019). They must coordinate with multiple platform elements, such as platform core services or technical infrastructure (Soursos et al., 2016). In addition, meta-platforms need to consider other relevant stakeholders (such as end-users and third-party complementor of platform participants) to exercise value creation. In conclusion, this deliverable uses meta-platform characteristics when defining a federated data marketplace.

### 3.2.3 Aggregator Business Models for a Meta-Platform

Meta-platforms have a fundamental characteristic: employing **aggregator business models** (Floetgen et al., 2021). These aggregator business models, therefore, are the foundation of this federated data marketplace.

According to Zhu et al. (2001), information aggregation is collecting different information from various sources and analysing the collected information to provide value to the right users. The definition of right users means that user groups value the aggregated information more than any user group. The actors performing these activities are defined as **aggregators**. Böhm et al. (2011) explain aggregators as intermediaries who collect existing services or products to create value-added services or products and provide them to the end consumers.

As explained by Zhu et al. (2001), three main types of aggregator business models exist. The first one is comparison aggregation, where the aggregators act as the entity to help users to get more narrowed-down search results by giving the users side-by-side comparisons. This is the most common type of aggregator. Trivago, Scopus, and Google Shopping fall within this category. The second one is relationship aggregations. Most internet users have multiple accounts, even within the same sectors, e.g., having multiple banking accounts from multiple banks. A relationship aggregator helps users to manage these multiple accounts by providing users with a single contact point (in conventional business) or a single sign-on mechanism. Emma, a UK-based money management app that enables users to manage different

financial accounts and subscriptions within a single app, falls in this category. The last type is intra-organisational aggregators. In this type, the aggregators help employees to find relevant information from different departments. This deliverable mainly focuses on the **comparison** and **relationship aggregators** because the intra-organisational one focuses merely on a single organisation.

### 3.2.4 Connecting the STOF Model with Aggregator Business Models

The STOF model is a generic framework that needs specification. Therefore, a connection of the STOF model with the aggregator business models is made to draw options for developing TRUSTS federated business models. Table 8 clarifies this connection by presenting the STOF domains as table headings and the aggregator business models as specifications.

**The service domain** consists of service aggregation and composition. O'Sullivan et al. (2002) describe that *aggregation service* combines (and to some extent compares) multiple services of the same type. In contrast, *composition service* combines multiple services as complementary services to add value to the core aggregation services.

**The technology domain** can be divided into service integration and orchestration (Kohlborn et al., 2009; Peltz, 2003). The *service integration* coordinates multiple services, organisations, and applications to enable information-sharing capabilities—meanwhile, *service orchestration* focus on controlling the execution of business processes through web service interactions.

**The organisation domain** can be classified into aggregation without (or with) partnership or with ownership (Madnick & Siegel, 2008). In the *aggregation without partnership*, aggregator extract information from unsuspecting aggregatees. Meanwhile, *aggregation with partnership* forms bilateral partnerships of varying degrees between aggregators and aggregatees. Finally, major aggregatees (or a Consortium of aggregatees) own the aggregators in the *aggregation with ownership*.

**The finance domain** can be divided into two sub-domain. These are financially independent or dependent aggregators (Madnick & Siegel, 2008). Connecting with the previous elaboration in the organisation domain, the aggregator tends to finance their business independently for aggregation with and without partnership. While for the aggregation with ownership, the aggregator tends to be dependently financed by the owner of the aggregator, e.g., dominating aggregatee or Consortium that invests in the aggregator.

The STOF model and the aggregator business model connection are being utilised later when developing TRUSTS federator business models in subsection 3.6.

Table 8. Connecting the STOF model with aggregator business models

Service domain	Technology domain	Organisational domain	Finance domain
<ul style="list-style-type: none"> <li>Service aggregation</li> <li>Service composition</li> </ul>	<ul style="list-style-type: none"> <li>Service integration</li> <li>Service orchestration</li> </ul>	<ul style="list-style-type: none"> <li>Aggregation without partnership</li> <li>Aggregation with partnership</li> <li>Aggregation with ownership</li> </ul>	<ul style="list-style-type: none"> <li>Financially independent aggregator</li> <li>Financially dependent aggregator</li> </ul>

### 3.3 Research Approach

This subsection explains the empirical research approach to develop TRUSTS federated business models.

The empirical approach consists of three groups:

- 1) case studies,
- 2) interviews and an internal workshop,
- 3) a three-step quantitative study.

The case studies were used to qualitatively investigate aggregator business models for meta-platforms (subsection 3.4) and their dynamics (subsection 3.5). The interviews and the internal workshop will be used to contextualise aggregator business models for TRUSTS (Subsection 3.6). The three-step quantitative study will be used to assess the efficacy of the federator business models (subsection 3.8).

The first group of empirical research (i.e., case studies) is needed due to a lack of insight into aggregator business model patterns. Distil patterns are essential to identify the business model archetypes of such aggregators. In contrast, these archetypes are essential to know the generalised, high-level blueprint that portrays the distinguished business model components of aggregators (Piccoli & Pigni, 2013). The other two groups of empirical works are also essential, as the current understanding of the aggregator business models cannot be directly translated into the data marketplace context. This is because data marketplaces are principally distinct from “conventional” digital platforms (e.g., owing to the nature of data as an experience good and its non-rival quality).

#### 3.3.1 Case Studies: A Cross-Case Analysis

We conducted case studies concerning the existing (meta-)platforms exercising aggregator business models. In selecting cases, we used the following selection criteria:

- The business models of the (meta-)platforms constitute the comparison and relationship aggregators (see subsection 3.2.3), and
- The (meta-)platforms have been established, meaning they have passed the conceptual stage, been publicly launched, and gained users.

We look for (meta-)platforms through various channels from the selection criteria above. We selected 11 (meta-)platforms that employ aggregator business models from varying industries. These (meta-)platforms are Trivago, Google, Feedly, Indeed, Kimo, Flipboard, DiscoverCars, Yidio, PriceGrabber, LinkedIn, and Carvago.

We analysed the cases using the STOF model (see Appendix I — (Meta-)Platforms Employing Aggregator Business Models). Afterwards, we conducted a cross-case comparison analysis of existing aggregators to derive business model archetypes (subsection 3.4).

#### 3.3.2 Semi-structured Interviews

After deriving aggregator business model archetypes for meta-platform (subsection 3.4), we intended to contextualise aggregator business models in the case of data marketplace meta-platforms (Subsection 3.6). We did this contextualisation because we wanted to specify TRUSTS federated business models



(instead of merely using generic terms such as *service aggregation* or *composition* presented in subsection 2.2.4). To do so, we conducted an exploratory approach with semi-structured interviews.

An inductive qualitative approach is common when studying a new phenomenon (Sekaran & Bougie, 2016). We need flexibility when conducting this research because meta-platforms are not yet a well-defined and widely accepted concept. Hence, we employed semi-structured interviews as a primary data collection method to enable flexible follow-up and probing questions (Edwards & Holland, 2013). We selected a non-probability sampling strategy, so-called judgment sampling, to select interview participants we considered experts (Sekaran & Bougie, 2016). We adopted this strategy since we investigated a novel phenomenon that only a few people are familiar with (Etikan et al., 2016). We engaged with a representative of 1) meta-platform experts and 2) data sharing consultants. We believe these two groups have sufficient knowledge to speculate and discuss the (future) business models of meta-platform aggregators. We used the following criteria to identify participants: 1) familiarity with meta-platforms and data marketplaces (i.e., knowledge of, experience with, or consideration of), 2) experience in decision-making processes, especially business models, and 3) proficiency in English.

Thirty-one participants [I-01 to I-31] were interviewed, consisting of 25 (internal or external) data sharing consultants and six meta-platform experts (see Table 9). These consultants promote and engage with business data sharing on behalf of their respective organisations; the meta-platform experts are currently involved in interoperable data marketplace innovation projects. Between July 2021 and June 2022, online interviews were conducted using Microsoft Teams. The interviews lasted, on average, 45 minutes.

Table 9. Overview of participants of our 31 semi-structured interviews<sup>30</sup>

ID	Category	Job description
I-01	Meta-platform expert	Director of innovation
I-02	Data sharing consultant	Security solution manager
I-03	Data sharing consultant	Product owner of a data platform
I-04	Data sharing consultant	Head of Standard Business Reporting
I-05	Data sharing consultant	Project manager
I-06	Data sharing consultant	Commercial director
I-07	Data sharing consultant	Chief data officer
I-08	Data sharing consultant	Technical innovation manager
I-09	Data sharing consultant	Data protection specialist
I-10	Data sharing consultant	Head of architecture, innovation, and tech.
I-11	Data sharing consultant	Senior strategy manager
I-12	Data sharing consultant	Product owner
I-13	Data sharing consultant	Risk manager
I-14	Data sharing consultant	Business consultant
I-15	Data sharing consultant	Associate director
I-16	Meta-platform expert	Technical researcher
I-17	Meta-platform expert	Deputy studio director
I-18	Meta-platform expert	Data science director

<sup>30</sup> The eleven interviews (from I-21 to I-31) were conducted as part of a Master’s Thesis in TU Delft undertaken by van Velzen (2022), supervised by Anneke Zuiderwijk and Antragama Ewa Abbas.

van Velzen, T. (2022). *Business-to-Business data sharing via data marketplace meta-platforms: Exploring governance mechanisms to enhance data sovereignty* Delft University of Technology. Delft, the Netherlands. <http://resolver.tudelft.nl/uuid:f6e34396-8038-47dc-a92a-ce4a6fd3e027>

ID	Category	Job description
I-19	Meta-platform expert	Project manager
I-20	Meta-platform expert	Project manager
I-21	Data sharing consultant	Data sharing and digital identity consultant
I-22	Data sharing consultant	Date e-commerce project manager
I-23	Data sharing consultant	IT Architect
I-24	Data sharing consultant	Experienced IT and project professional
I-25	Data sharing consultant	Experienced professional in financial services and management consulting
I-26	Data sharing consultant	Senior research specialised in trusted data sharing and business ecosystem architecture
I-27	Data sharing consultant	Director of pan-European trust and data sovereignty framework
I-28	Data sharing consultant	Board member of a regional collaborative organisation, specialised in future affairs, including digital and data-related topics
I-29	Data sharing consultant	Data management expert at a global professional services firm
I-30	Data sharing consultant	Data expert and research engineer
I-31	Data sharing consultant	Developer and semantic web expert, data sharing initiatives expert

The main question asked was how a meta-platform can create value in the data marketplace context, particularly how it could benefit the three primary stakeholders of a meta-platform (data marketplace operators, providers, and consumers). Before jumping into this question, several preliminary questions were asked, such as interviewees' familiarity with data marketplaces, to set the stage. The interview protocol can be accessed in Appendix II — The Interview Protocol.

### 3.3.3 An Internal Workshop

This internal workshop refers to workshop 2, elaborated in subsection 2.2.2. This workshop was conducted to align the theoretical work on meta-platforms with the ongoing technical and user-oriented work in TRUSTS. In addition to discussing the “base” and “add-on” business models for TRUSTS a data marketplace, the business model of federation aspects was discussed. This internal (online) workshop was conducted with the internal TRUSTS Consortium on January 20, 2022, from 09:00-11:00 am. The total number of participants was 25. The workshop protocol can be accessed in Appendix III — The Workshop Protocol.

### 3.3.4 A Three-Step Quantitative Study

After creating the business models for TRUSTS as a federated data marketplace, we conducted a three-step quantitative study to evaluate the business models against relevant criteria for data providers (i.e., trust, perceived risks, and willingness to share) (see Agahari & de Reuver, 2022). These three issues determine whether the business model creates value for data providers. We focus on the data provider perspective at this stage because this role is considered the most crucial or uncertain. The federated business models enable data assets to flow from one data marketplace to others, causing high uncertainties for data providers. They cannot own and control the exchanged data, triggering fears of

knowledge spillovers, legal liabilities in case of data breaches, and reputational damage (Abbas et al., 2022). Insufficient supplier-side will eventually lead to unresolved the chicken-and-egg problem (Wortmann et al., 2022), making it hard for the federated data marketplace to bloom. Without data providers, TRUSTS will have no data assets to exchange. In extreme cases, it may also be possible that existing providers that have been registered in a particular data marketplace withdraw their participation due to a similar reason: too many uncertainties. Focusing on one perspective as a starting point will also bring an advantage to gaining a deeper insight into incentivising data providers in the federated data marketplace. If TRUSTS can attract sufficient data providers, data marketplaces and their consumers will receive value from the increased data assets available within TRUSTS. Thus, the more data assets, the better network effects.

The three-step quantitative study consisted of a:

- 1) pre-study,
- 2) measurement validation,
- 3) between-subject experiment.

*The pre-study* conducted a small-scale evaluation to determine how the data marketplace federated business models create value for data providers. Based on this indication, we could improve the research instruments for the controlled experiment. *The measurement validation* aimed to assess the validity and reliability of our measurement. We assessed the data marketplace federated business models using the proxy of data sovereignty construct. Data sovereignty is suitable as a proxy because it represents the TRUSTS core value proposition (refer to subsection 2.3.1). However, data sovereignty is still an abstract and not yet well-defined construct. Hence, we need first to test the validity and reliability of this newly developed measurement. Finally, a *between-subjects experiment* was conducted to evaluate the federated business models.

As a probe for these quantitative studies, a mock-up was created of a federating platform that provides the key functions as specified in the business model. This mock-up thus provides merely a visualisation of potential future features of TRUSTS rather than a working prototype of current features as delivered by other work packages. We discuss each of these steps in the following subsections.

#### **3.3.4.1 Pre-study**

The preliminary study conducted a small-scale evaluation to determine how federated business models in the data marketplace create value for data providers. We could improve the controlled experiment's research instruments based on this information.

##### **3.3.4.1.1 Participants**

We conducted the survey in early October 2022 by recruiting participants from the first author's internal networks (n=17). Twenty-one participants were added from the Prolific online survey crowdsourcing platform to increase the sample, resulting in a total sample of 38 participants (23 male, 15 female). Prolific is a widely-used online survey crowdsourcing platform that provides high data quality in terms of "attention, comprehension, honesty, and reliability," even compared to competitors such as Amazon Mechanical Turk and CloudResearch (Eyal et al., 2021).

Nearly 90% of participants reside in Europe. More than half of the participants are young, middle-aged adults (31-45), while one-third are young adults (17-30). Sixty per cent of participants hold a Master's degree. Most participants are working (76%), whereas most of the rest are currently on their career break to study. Over two-thirds of participants have a role in upper management. Most participants (87%) had

planned or conducted business data exchange. When asked about data marketplaces, most respondents self-reported that they were knowledgeable (>70%).

### 3.3.4.1.2 Research instruments

An online survey was developed via Qualtrics to embed the video explanation, mock-up instruction, and questionnaire. The processes of online surveys were as follows. First, we presented participants with a hypothetical scenario where users play the role of a data provider, a telecommunication company so-called TELCO. This data provider wants to exchange their data assets about Call Detail Records (CDRs), consisting of statistics such as internet usage patterns or churn rate. These CDRs can be beneficial for banks to build customer profiles for their upcoming credit card products. A video was created to explain this scenario.<sup>31</sup> Following this explanation, participants can self-interact with a (hypothetical) clickable mock-up by performing specific federation tasks.<sup>32</sup>

The mock-up was developed using a similar tool to develop the earlier TRUSTS MVP prototype: Figma.<sup>33</sup> As a starting point, the mock-up has similar features as the TRUSTS actual MVP (e.g., the flow when uploading the data assets). We also added potential features of a federating platform that TRUSTS could evolve towards, such as interaction with multiple data marketplaces, certification, and smart contract visualisation.<sup>34</sup> To test whether this developed-mock up is suitable for self-paced manner exploration, we conducted a four-evaluation cycle to improve our mock-up usability (refer to Appendix IV — Mock-up Evaluations). Figure 23. A screen example (1). Figure 23, Figure 24, and Figure 25 provide screen examples of the developed mock-up. Figure 23 illustrates the following scenario: after describing meta-data, a data provider can observe the onboarded data marketplaces participant within TRUSTS. The data provider can find information about the rating, certification status, and industry domain. After this, the data provider can select a data marketplace to upload metadata about data assets.

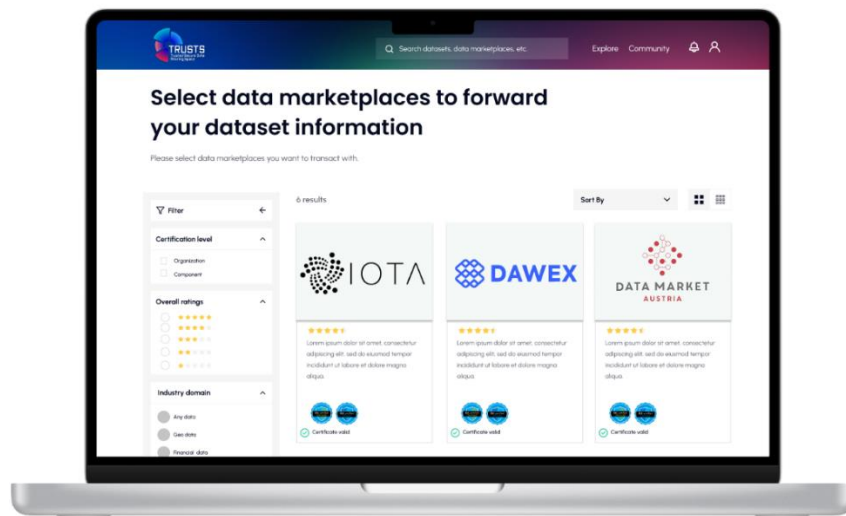


Figure 23. A screen example (1)

<sup>31</sup> <https://youtu.be/9b7iKM3BiMs> accessed on October 28, 2022.

<sup>32</sup> The mock-up can be accessed [here](#).

<sup>33</sup> <https://www.figma.com/> accessed on October 28, 2022.

<sup>34</sup> Please note that this future-oriented offerings are not incorporated in the existing TRUSTS MVP but rather to explore the federation aspects.

Figure 24 illustrates the following scenario: a data provider can see that Data Market Austria has been certified with the International Data Space Association (IDSA). This screen describes more about this certification details.

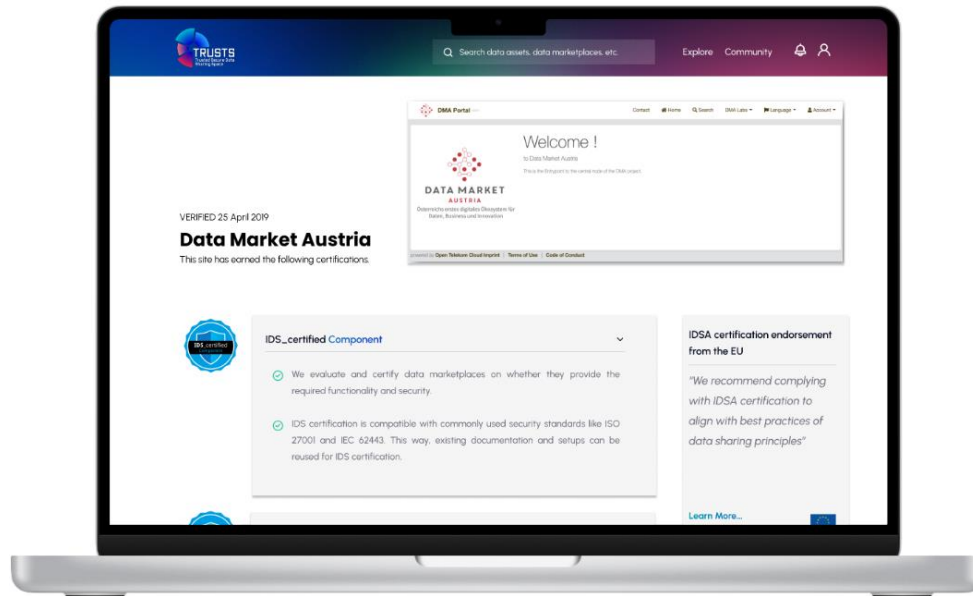


Figure 24. A screen example (2)

Figure 25 illustrates the following scenario: a data provider can see an overview of data asset usage by a data consumer, WorldwideBank, registered in Data Market Austria.

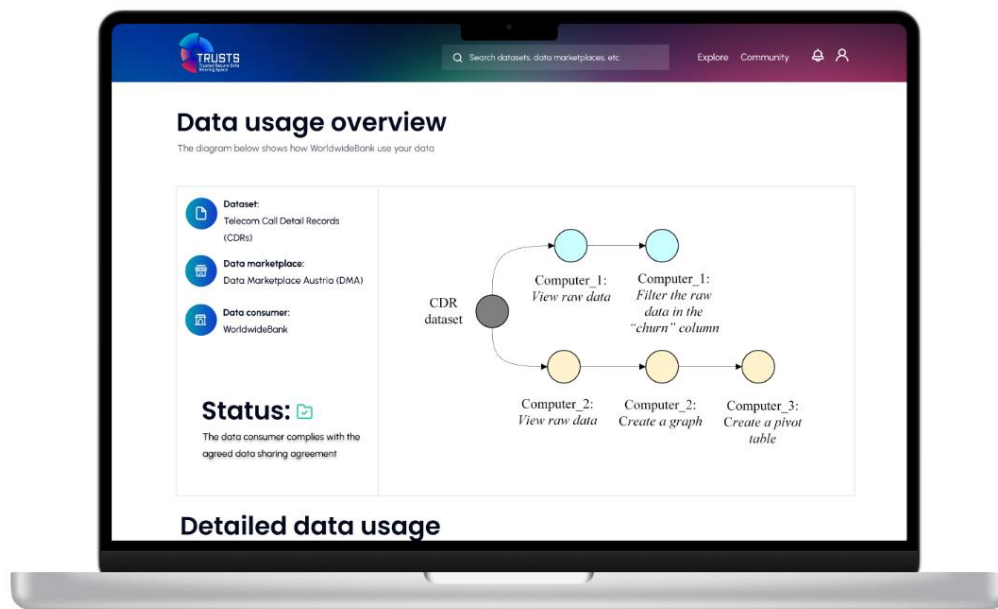


Figure 25: A screen example (3)

Finally, after self-exploring the developed mock-up, the participants were asked to complete a post-test survey to share their experiences. The questions of this post-test survey can be accessed in Appendix V — Questionnaire. It took approximately 35 minutes to complete the overall activities.

### 3.3.4.1.3 Measurement development<sup>35</sup>

As indicated in subsection 3.3.4, we employed the data sovereignty construct as a proxy to measure the efficacy of TRUSTS federated business models. However, the measurement of data sovereignty does not exist yet. Hence, we need first to define data sovereignty measurements. We did so by reflecting on the classical theory of sovereignty, data sovereignty literature, and our previous empirical study (Abbas et al., 2022) to derive data sovereignty measurement (i.e., its dimensions and indicators).

The concept of “sovereignty” is initially rooted in the political science discipline. One classical and grand theory of sovereignty is absolute monarchy (Austin, 1880). According to this theory, sovereignty is widely used in the context of ruling a state (or nation), meaning a country is sovereign because of the absolute power to *control* and impose necessary regulations on citizens (Dunning, 1896). To be able to control, states should have theories that they *own* (Nagan & Haddad, 2011), or as stated by Cohen (1927): “ownership of the land and local political sovereignty were inseparable.” (p. 9). According to Austin’s, *compliance* toward laws and regulations is central instruments for states to command citizens (Dewey, 1894); hence citizens are *responsible* for following these instruments to prevent sanctions (Austin, 1880). Austin’s view also highlights states’ freedom from foreign control, meaning states are adequately robust and *secure* to be independent.

Although the monarchy theory seems to contradict the current world situation, which also appreciates the democratic view (Laski, 2014), existing (Information System) IS literature primarily interprets data sovereignty according to Austin’s views, meaning that data providers have an absolute right to define ownership and control over exchanged data (Jarke et al., 2019; Lauf et al., 2022). Data sovereignty is still abstract and not yet a well-defined construct despite increasingly emerging. We define five dimensions of sovereign data exchange via a meta-platform for data marketplaces: Data Ownership (DO), Data Control (DC), Compliance (C), Responsibility (R), and Security (S).

Existing literature generally defines data ownership as an exclusive right (and claim) to independently decide data-related assets (Hummel, Braun, & Dabrock, 2021). Despite the ongoing debate on who should own data assets (e.g., an individual, an organisation, or a platform) (Lee et al., 2017), we focus here on the organisation as a unit of analysis because end-users of a meta-platform is in the organisational level, not individual. We define four indicators of DO: *To ensure ownership, data providers should be able to define UCs of data exchange* (Abbas et al., 2022), *express the terms of use* (Dalmolen et al., 2020), *be involved in determining (monetary) incentives* (Dalmolen et al., 2020), and *define the data type to exchange* (Abbas et al., 2022).

Control over exchanged data is among the most heavily recognised dimension of data sovereignty (Hummel, Braun, Tretter, et al., 2021). Data control generally refers to the ability of data providers to technically enforce terms of use of data exchange (Dalmolen et al., 2020). In doing so, data providers can oversee data access and usage activities (i.e., refer to data provenance). In addition, data providers should be able to determine where they can store the shared (meta-) data (e.g., on the meta-platform, on its infrastructure, or the data consumer infrastructure) (Dalmolen et al., 2020). If something happens, data

<sup>35</sup> Part of this subsection has been published in Abbas, A. E., Ofe, H., Zuiderwijk, A., & de Reuver, M. (2022). Preparing Future Business Data Sharing via a Meta-Platform for Data Marketplaces: Exploring Antecedents and Consequences of Data Sovereignty 35th Bled eConference - Digital Restructuring and Human (Re-)Action, Bled, Slovenia.



providers can withdraw their (meta-)data for a meta-platform and data marketplace participants (Lauf et al., 2022). Hence, we propose the following indicators for DC: *to ensure control, data providers should be able to a) technically enforce the term of use, b) exercise data provenance, c) select data storage, and d) withdraw (meta-)data.*

Another critical data sovereignty dimension relates to compliance. As data exchange is subject to specific regulations, data providers should (C): *a) receive information from a meta-platform about the applicability of laws and regulations for sharing business data (Abbas et al., 2022), b) receive sufficient (technical) procedures to respond to those laws and regulations (Abbas et al., 2022), and c) be able to adequate dispute mechanisms to handle conflicts (if any, with data consumers) (Hummel, Braun, Tretter, et al., 2021).*

One distinguishing dimension of data sovereignty due to the context novelty is responsibility division, primarily because of the complex constellations of data marketplaces via a meta-platform. As our previous study reveals (Abbas et al., 2022), it should be clear who is responsible for what to ensure sovereign data exchange. Hence, we propose the following indicators for R: *to ensure clarity about responsibility, data providers should be informed about a) responsibility division between a meta-platform and data marketplace participants, b) how to select trustworthy data marketplace participants, and c) who is responsible for any data misuses.*

Finally, we opt to include an essential component of data sovereignty: security. As security is large and complex (e.g., it can be about the platform protection itself or focus more on protecting business data), we focus on generic and non-functional indicators for this dimension. Thus, we propose the indicators of S as follows (Hummel, Braun, Tretter, et al., 2021): *to ensure security, data providers should receive sufficient a) protection mechanisms, b) up-to-date security features, and c) security commitment from a meta-platform.* In summary, we will use these five data sovereignty dimensions to evaluate the efficacy of TRUSTS business models.

Because the measurement of data sovereignty does not yet exist, we developed the questionnaire questions based on data sovereignty dimensions and indicators defined above. For example, in the data control dimension (DC), we ask the following question for the first indicator (DC\_1): *I believe I can technically enforce data access and usage policies for the sensitive data that I would share through the meta-platform.*

To evaluate the business models against relevant criteria for data providers: trust, perceived risks, and willingness to exchange business data, we draw from the existing measurement developed by Venkatesh et al. (2011), Agahari and de Reuver (2022), and Pavlo (2003), respectively. Participants answered the questions on a 5-point Likert scale.

#### **3.3.4.1.4 Data analysis**

Following the guidelines by Hair et al. (2017), we evaluated the internal consistency reliability (i.e., composite reliability, Cronbach’s alpha), indicator reliability (outer loadings), convergent validity (AVE), discriminant validity (cross-loadings, Fornell-Larcker criterion, HTMT statistics) of the dimension instruments by using SmartPLS 4. We then calculated the means of each dimension to observe the efficacy of the federated data marketplace offerings to data sovereignty.

#### **3.3.4.2 Measurement validation**

This second step validated the measurement of data sovereignty as a construct as a dependent variable to influence three business model criteria: trust, perceived risks, and willingness to exchange data. We employed a balanced sample to distribute our study evenly to male and female participants. We applied



the below criteria to select our sample to select experienced workers with the pre-assumption that they have experienced business data sharing on behalf of their organisations:

1. Fluent language: English
2. Employment Status: Full-time
3. Working hours: Regular 9-5
4. Leadership/position of power/supervisory duties: Yes
5. Management experience: Yes
6. Approval rate: Minimum Approval Rate: 75, Maximum Approval Rate: 100

The total number of participants was 92. Generally, we employed the same procedure as before to validate the measurement and analyse the data. In this stage, however, we added more analysis to examine the overall structural model (Hair et al., 2017). The updated measure based on the reflection from the previous step can be seen in Appendix VI — The Updated Measurement.

### **3.3.4.3 Between-subject experiment**

We aimed to conduct a large-scale, between-subject 2x2 factorial experiment to confirm the findings from the previous steps (n=360). In this step, we aimed to use a representative sample based on United Kingdom residents. We developed four prototype versions that combine the presence of certification and smart contracts. To further confirm the importance of data sovereignty, we examined the nomological net of data sovereignty to three core issues in business data exchange: trust (Pettenpohl et al., 2022), perceived risks (Martin et al., 2021), and willingness to share data (Opriel et al., 2021).

## **3.4 Aggregator Business Models<sup>36</sup>**

We conducted desk research to descriptively discuss (meta-)platforms employing aggregator business models (refer to Appendix II — The Interview Protocol). After that, we discuss the cross-case comparison analysis of existing aggregators in the following subsection.

### **3.4.1 Cross-Case Comparison Analysis of Existing Aggregators**

This section compares existing aggregators and develops business model archetypes.

#### **3.4.1.1 The intended value of aggregators**

Our case study shows that although most aggregator business models operate in different industries, they provide many values to platform participants (aggregates) and their users. Platform participants get value from aggregator business models because aggregators help users to collect information from various sources in one platform location. This benefits users because they can reduce the time needed to find the

<sup>36</sup> This subsection is based on a Master’s Thesis in TU Delft undertaken by Artala (2022), supervised by Mark de Reuver and Anragama Ewa Abbas as part of the TRUSTS project.

Artala, B. R. (2022). *Data Marketplace Aggregator: a study towards designing Aggregator Business Models for data marketplaces* Delft University of Technology. Delft. <http://resolver.tudelft.nl/uuid:f64bd56e-a4b7-4fea-8382-ddbef6318fd2>

desired product based on their preferences. Having to cycle and jump to different websites is a time-consuming and tedious process, and in some cases, the result might not fully satisfy users. Thus, aggregators help as an advisor by giving recommendations. For aggregatees, they benefit from the aggregator's promotion, brand awareness, and user reach.

In some cases, e.g., in the case of Google and Scopus, aggregatees have the urgency to push their product to the aggregator because not pushing their product to the aggregator means losing the competition with other aggregatees. Aggregatees might also lose their opportunity for a higher site reach. This is because Google and Scopus have a high amount of user-base and most users use these aggregators as a starting point to look for services and information.

The case studies confirm the characteristics of services offered by aggregators. Some aggregators focus on their core offering by providing service comparison capabilities (service aggregation), while some add various complementary services besides comparison (service composition).

Some aggregators focus only on service aggregation capabilities, which are service comparison and information collection. These aggregators focus on comparing different service alternatives from different websites and recommending a specific service (and information). In the case of Yidio, the platform's primary value is to recommend where to watch a specific movie. However, users must still visit the respective websites to watch the selected movies separately. In a more physical-services-centric industry, like DiscoverCars and PriceGrabber, the platforms only help users compare product alternatives from different providers. However, the platforms do not accommodate transactions or payments. To complete the payment, users must visit the website or pay for the service offline (e.g., pay for car rental service directly to the car rental during the car handover).

Aggregators can also offer service composition offerings by building complementary services on top of their service aggregation. The platforms provide complementary services and service comparison offerings in more rich-feature aggregators like Feedly, Scopus, Trivago, and LinkedIn. For example, in the case of Feedly, the platform not only helps users find the most recent news and articles about a particular topic but also enables the users to share the news to the user's respective social media, such as Reddit and Twitter. Users can also experience the same service and features of Reddit and Twitter within Feedly (for example, reading Twitter timelines, posting tweets, and managing Reddit threads). In another case, like Scopus, the platform not only helps users find the desired publications but also enables the users to read the publications within the platform, analyse the publications' impacts, and store and manage the publications with Scopus's developed reference manager (Mendeley). Not only acting as a database, but Scopus also acts as a store containing thousands of academic publishers. Users can buy, rent, and subscribe to certain publications from certain publishers through Scopus.

#### **3.4.1.2 Value enabling technology – Information crawler and Application Programming Interface (API)**

According to Bouwman et al. (2008), the intended value puts requirements on the technical functionalities of the business model. The intended value defines the technical architecture and technical functionalities of business models. From the previous discussion, one value offered by aggregators is to put the aggregated services under one location. To provide the "one location" value, aggregators translate this into a technical architecture as a platform. Some aggregators build platforms in the form of a site (e.g., Scopus, Kimo, Carvago, Google, PriceGrabber, DiscoverCars) and mobile applications (e.g., Trivago, Feedly, Flipboard, LinkedIn).

Towards the other intended value, the aggregated service (including post-aggregation analysis in the form of recommendation), aggregators apply different technical architectures to collect information and services. From our case study, aggregators typically deploy either an information crawler or an API.

Some aggregators use information crawling technology by deploying AI bots or RSS readers to gather publicly available information on the internet. Yidio uses its own developed AI bot to keep monitoring information on movies published on streaming sites. Feedly uses Feedly Fetcher as an RSS reader to keep pulling news and articles from various sites. From our study, it can be seen that aggregators implementing information crawler technology tend to focus their offerings on service aggregation. They focus on offering a compact platform to help users find the desired services, thus focusing on the core aggregation service without adding many complementary features.

Besides information crawlers, aggregators can also deploy APIs. From our case study, aggregators develop API to accommodate various organisational processes and coordinate the information exchange procedure between two or more platforms. They can periodically exchange information, push and pull contents and information at any time. In many cases, for example, in the case of Trivago, the utilisation of API Trivago FastConnect between Trivago and its aggregatees enables Trivago to add complementary features, such as payment procedure within the Trivago site. In the Scopus case, the API lets Scopus exchange various publications files seamlessly, thus enabling Scopus to create its reference manager as a one-stop-shop referencing solution.

#### **3.4.1.3 Technical architecture and technological functionalities**

Using an information crawler restricts the aggregator only to collect information from publicly available sources. Information crawlers cannot extract some not publicly available. It can also be a tedious process on the aggregatees side to provide this unique information to the aggregators. Aggregators utilising information crawlers as their technical architecture tend to rely only on their capabilities to gather information and services. That being the case, aggregators with information crawlers can only perform service orchestration because only one entity (aggregators) performs the entire value delivery process to the consumers. Aggregatees face limitations to also take action in this ecosystem due to the limited information gathered by the information crawlers.

Conversely, API enables aggregators and aggregatees to play an active role in the entire value delivery process. Trivago Express Booking API enables Trivago to acquire special information not published online from aggregatees, while at the same time, aggregatees can provide information to Trivago. For example, aggregatees can periodically update the number of rooms available in a particular hotel through the API. This information cannot be extracted if aggregators only utilise information crawlers. Additionally, Trivago FastConnect API accommodates the transaction and payment process between users, Trivago, and aggregatees. API enables aggregators to perform service choreography and service integration.

From the above study, we can derive several understandings towards the relationship between the service domain and technology domain, specifically between the intended value, technical architecture, technical functionalities, and delivered value. As Bouwman et al. (2008) stated, intended value puts requirements on technical architecture. Technical architecture defines technical functionalities, which determine the delivered value to the users. Aggregators intended to utilise information crawler as its technical architecture can only implement limited technical functionalities such as service orchestration because the aggregator only processes the entire aggregation service. While for aggregators implementing API technical architecture, the API enables both aggregator and aggregatees to play an active role towards delivering the service, thus enabling collaborative technical functionalities such as service orchestration and service integration. Based on the previous case study, we now understand the concept of information

crawler and API as aggregator's technical architecture. The information crawler and API realise the technical functionalities of service orchestration, choreography, and integration.

#### **3.4.1.4 *Partnership and embedded technology between aggregators and aggregatees***

In the previous part, we presented technology architecture embedded in aggregators. Aggregators can use API that enables service choreography or crawler to realise service orchestration. Bouwman et al. (2008) present that value activities between actors put requirements on the technical architecture. Thus, we believe there lies a relationship between the embedded technology of aggregators and the partnership that aggregators establish. In this part, we will describe the relationship in more detail.

In providing the aggregated information to the platform, some aggregators proactively collaborate with other platform participants (aggregatees) to access not publicly available information. The established collaboration also lets aggregatees push information and data to aggregators. Throughout our case study, it can be seen that Trivago partners with hotel owners, various booking sites, and travel agencies so that Trivago can gain special access to pull information from its partners (e.g., number of available rooms). Scopus also establishes collaboration with publishers to gain access and ownership of the publications and pull the publications' metadata into the Scopus platform. We classify this type of collaboration as aggregators with a high degree of the network.

In our study, aggregators that implement a high degree of network implement integration through API to accommodate information sharing and integrate their platform with their partners' platform. API integration is needed because the aggregatees own the information that the aggregators need (Because most of this information is not publicly available online). Thus, aggregatees need to grant access to aggregators and push the information to the Aggregators.

Some aggregators can provide aggregated content while establishing no partnership with the aggregatees. Yidio can provide information about movies and streaming sites without partnering with the respective movie owners. Kimo can also provide various online learning within its platform without establishing any partnership with its aggregatees.

Aggregators with a low degree of network use information crawling technology such as AI bots and RSS readers. Most of the information aggregated by these aggregators is publicly available online. Using a crawler is enough to gather this information. Aggregators can rely only on the crawler to search for data and information publicly available on the internet; thus, no prior partnership needs to be established.

### **3.4.2 Aggregator Business Models Archetypes**

From the previous section, we obtain several understandings from the case study we conduct towards various existing aggregators. There are patterns and trends towards different business model domains of aggregators. This part will summarise our findings and derive business models of aggregator archetypes.

#### **3.4.2.1 *Services of aggregators***

The main differentiator of aggregator business models with other businesses lies in the ability of the aggregators to collect various substituting and complementing services under one location, which can be understood as service aggregation and service composition. Service aggregation means aggregators provide values by comparing services with other substitute services from various internet sources. Service composition means aggregators add complementary services on top of the online comparison functions.

These two requirements are classified under the service domain in the STOF model. For example, although providing similar hotel booking services, Trivago as an aggregator, compare hotel bookings from various online booking sites, while Booking.com, which is not an aggregator, only provide hotel bookings from its hotel partners.

As a result, we believe that the service domain is the main focal point of aggregators. These two components in the service domain, service composition and service aggregation, are the main focal point of aggregator business models because these two are the business activities that directly provide value to the users. Thus, we focus on deeper analysis and understanding the pattern of the service domain of aggregators.

For example, Kimo, Yidio, and PriceGrabber compare different substituting services. Kimo compares and collects online learning materials. Yidio compares different movies. PriceGrabber compares different online sales for physical products. They focus on providing consumers with suggestions to select services.

In the case of Trivago, Feedly, and Scopus, they also add various complementary features on top of their aggregation services. Trivago adds payment features on top of its hotel aggregation, Feedly adds features that enable users to use other social media within the platform on top of its news aggregation, and Scopus adds an in-platform reference manager on top of its publication aggregation.

From the above findings, although similarly providing aggregated content and post-aggregation analysis in one location, we discovered that from these 11 cases, the way aggregators offer the service is different. Some aggregators only focus on service aggregation offerings, while others add complementary features. We present the variables concerning **the service domain** of aggregators:

- 1 Core service aggregators: they focus on providing the core service of aggregators, which is to compare services from various online sources. Their main value lies in the capabilities of the aggregator to provide suggestions and recommendations to choose services, typically substituting services. Thus, this type of aggregator focuses on providing service aggregation.
- 2 Multiple services aggregators: instead of providing only aggregation service, this aggregator adds complementary features on top of its core service offering. The complementary feature can be in the form of additional services within the platform, e.g., payment features, services manager, in-platform reader, and integration with other platforms. The value is that the service consumers can be benefited from a wide range of features without having to leave the platform. Thus, this type of aggregator adds service composition on top of the service aggregation.

### **3.4.2.2 Technology and organisation to deliver the services**

Generally, the service domain puts requirements to generate the technology domain, organisational domain, and finance domain. From this, we understand that the technology and organisation domains act as tools to realise and deliver the service domain to the consumers. As services are the essential components for aggregators, we believe aggregators constitute different organisational and technology arrangements to deliver the services. Thus, we dive deeper to analyse how aggregators deliver services with their technology and organisation domain.

To realise services, some aggregators may be obliged to establish a partnership with their aggregatees, while some aggregators can establish limited to no partnership with their aggregatees, thus explaining the organisational domain defined by the value. Additionally, aggregators can embed either API or crawler as its technology to realise the value, thus explaining the technology domain to realise the value.

Bouwman et al. (2008) state that a direct relationship exists between technology and organisational domains. Our case study also confirms their statements and shows a relationship between the technical architecture the aggregator uses and the organisational arrangement the aggregator established.

In our study, aggregators using information crawling technology establish no partnership with their aggregatees. Kimo, Yidio, and Carvago can extract the information directly using crawlers or AI bots. The information is publicly available on various online sources; thus, no prior partnership must be established for the aggregators to realise their services. Crawler only lets aggregators pull information from the aggregatees, but aggregatees cannot push information to the aggregators. Thus, the value-delivering process can only be provided by a single entity (service orchestration), the aggregator.

Aggregators with API technology establish a partnership with their aggregatees. Various forms of partnership are realised; in some cases, the aggregators are owned by the aggregatee (aggregation with ownership). With the partnership, aggregators can pull special information directly from the aggregatees. This information is typically not available in public. Unlike crawlers, API enables aggregatees also to push information to the aggregators. Thus, the value-delivering process is collaborative. Both actors, aggregators and aggregatees, engage in the value-delivering process, thus arranging a service choreography.

That being the case, from the 11 aggregator cases, we discover a distinguished pattern in **the technology-organisation domain**. The differences in the pattern are as follows:

- 1 Low degree of network: aggregator with no established partnership with its aggregatees. This aggregator typically uses information crawlers such as RSS readers and AI bots to gather information. The information they gathered is typically information publicly available on the aggregatees' website. Only the aggregator can engage in the value-delivering process (service orchestration).
- 2 High degree of network: aggregator has established a partnership with its aggregatees. In some cases, the aggregatees own and invest in the aggregator, thus establishing ownership. The partnership enables aggregators and aggregatees to collaboratively pull and push information between the organisations. Thus, an API is typically implemented to coordinate the information exchange (service choreography).

From the explanation above, it can be seen that throughout the 11 cases we analysed, the most distinguished pattern lies between two variables, which are the services domain (single and multiple services) and the technology-organisation domain (high degree of network with API and low degree of network with crawler). These two variables are explained as follows:

- 1 **Service Offerings**: explains the services available within the aggregator platform. Some aggregator provides services comparison and complementary services, such as an in-platform reader, payment portal, content re-sharing mechanism, social media integration, and in-platform content manager. In contrast, some aggregators focus only on providing content comparison or content aggregation without offering complementary services.
- 2 **Degree of Network**: explains the degree of partnership the aggregator established with aggregatees. A low degree of a network means the aggregator conducts a limited-to-no partnership mechanism to gather product information. A high network degree means the aggregator collaborates extensively with aggregatees to pull information. Aggregators with a low degree of network typically use AI bots or RSS readers to aggregate information. Aggregators with a high degree of network typically use API to coordinate between aggregators and aggregatees.

Based on these variables, four business models are derived as follows:



		Degree of Network (Enabling Technology)	
		Low (Information Crawler)	High (API)
Service Offerings	Multiple Services	<b>Advance Search Engine</b> (Feedly, Google)	<b>One-stop-shop</b> (Scopus, LinkedIn)
	Core Service	<b>Search Engine</b> (Yidio, Kimo)	<b>Comparison Sites</b> (PriceGrabber, Trivago, Discover Cars, Flipboard)

Figure 26. Four business model archetypes of aggregator business models of meta-platforms

To conclude, this subsection reveals business model archetypes for (meta-) platforms that exercise aggregator business models: search engines, advanced search engines, comparison sites, and one-stop-shop.

### 3.5 Aggregator Business Model Dynamics<sup>37</sup>

The previous elaboration shows that aggregators possess a specific aggregator business model. This aggregator business model corresponds to specific characteristics of the aggregator that differentiate one aggregator from the others. However, it is further discovered that in exercising the business model, aggregators tend not to stay in a single business model. They also change their business model to other types of aggregators. Therefore, this subsection describes the dynamics of aggregator business models based on four illustrative cases.

#### 3.5.1 Trivago Business Model Dynamics

Trivago started its business in 2005 as a search engine site focusing on hotel search features by comparing different accommodation alternatives from various online sources. After several years of development, Trivago introduced Trivago FastConnect. This enabled existing booking and hotel sites to integrate with Trivago. At that time, Trivago's main service was only to recommend users in finding the ideal hotel based on the users' criteria. Nevertheless, Trivago FastConnect enabled Trivago to only aggregate from trusted sources. Data were pulled directly from the trusted booking site aggregatees. Trivago then redirected the users to the booking sites to complete the transactions, so payment was not made on the Trivago website.

However, as can be seen from Trivago's latest publication on the Trivago Developers site, Trivago now offers Trivago Express Booking API that enables users to make direct bookings within the Trivago platform (Trivago, 2021). This API allows users to pay within the Trivago platform. As a result, Trivago compares different accommodation alternatives and manages accommodation booking and payment.

Based on that prior study on the Trivago business model in the past few years, the Trivago business model also changed after introducing the new service (payment within Trivago) and additional API integration

<sup>37</sup> This subsection is based on a Master's Thesis in TU Delft undertaken by Artala (2022), supervised by Mark de Reuver and Antragama Ewa Abbas as part of the TRUSTS project.



(Trivago Express Booking) with the hotel owners and booking platforms. Trivago first shifted its business model to a comparison shop model. Trivago still focuses on service aggregation in the accommodation industry, but instead of comparing different accommodations from online sources, Trivago integrates with its hotel aggregatees to also let the aggregatee push the information to Trivago. Later, Trivago shifted its business model to become a one-stop-shop model as now the platform also offers additional services (service composition), which is the payment features. As a one-stop shop, Trivago enables users to arrange accommodation bookings from a single platform without leaving the platform to finalise the booking.

	Low Degree of Network (Information Crawler)	High Degree of Network (API)
Multiple Services	Advanced Search Engine -	One-stop-shop Trivago (Express Booking Introduction)
Core Service	Search Engine Trivago (launch version)	Comparison Sites Trivago (FastConnect introduction)

Figure 27. Trivago business model dynamics

### 3.5.2 Google Business Model Dynamics

Google started its business as a search engine focusing only on service aggregation by providing helpful information based on the search criteria. Google functions as a platform that helps users to find information from the text that is publicly accessible from various online sources.

Towards its development, Google constantly adds additional services beyond search engines to find texts from online sources. In 2012, Google launched a complementary service called Google Knowledge Graph (Singhal, 2012). This feature lets users instantly get the most relevant information from the search queries without leaving the google sites. In the previous version of Google, users must visit the respective sites to get the relevant information for the queries. For example, when a user queries "Ajax Amsterdam", Google will instantly display relevant information about Ajax Amsterdam Football Club. Thus, Google also adds service composition in this version. Users must visit different websites to get such information in the earlier version.

In the current version of Google, we recognise that Google Knowledge Features are extended to a greater function. In the current version, Google collaborates with various organisations, platforms and sites to provide more reliable information from trusted sources. For example, if the user types a query of "Covid-19 in Germany", Google will display relevant information about Covid-19 in Germany, such as the number of positive cases and the number of recovered patients. This data is sourced from various sources, such as official government sites, World Health Organization databases, or university sites. As most of this data might not be publicly online (especially in a crawlable text format), Google uses Knowledge Graph Search API to integrate with these different platforms and pull the information directly from the sources (Google, 2021).

Based on the above explanation, it can be argued that Google changed its business model to comply with its additional new services. During its launch, Google only had one function to search for text from various sites, and because Google can offer this service by utilising crawling technology, thus it can be classified as a Search Engine Aggregator. In 2012, Google started to offer more features by adding complementary

services like Knowledge Graph that enabled users to find relevant information without leaving google's sites; the business models of Google shifted to become a single portal. In its latest version, as Google collaborates with different platform owners to provide the information, its business model shifted again to the One-stop-shop aggregator.

	Low Degree of Network (Information Crawler)	High Degree of Network (API)
Multiple Services	Advance Search Engine Google (Knowledge Graph API)	One-stop-shop Google (Latest version)
Core Service	Search Engine Google (launch version)	Comparison Sites -

Figure 28. Google business model dynamics

### 3.5.3 Feedly Business Model Dynamics

In its early establishment, Feedly started as a browser extension that used RSS readers and focused on collecting articles and news from various sites according to users' favourite topics (Lowensohn, 2008; Crunchbase, 2021). During this time, Feedly's main service was to collect news and articles from online news publishers and blog posts. Feedly's first version was a web browser extension that displayed different news titles and heading from various online news publishers. Feedly then redirected users to publisher sites (Lowensohn, 2008). Thus, Feedly focused on *service aggregation* during its first establishment.

Feedly then introduces its sites and application (Feedly, 2012). During this time, additional complementary services were added, like sharing mechanisms to other social media and automated curated looks based on user preferences. Feedly still utilised its RSS reader to aggregate online articles during this time.

In the latest version of Feedly, the platform provides complementary features such as social media integration. Feedly enables the user to adopt twitter features within the platform. Feedly now includes tweets (post updates made by Twitter users) to the user feeds. Feedly also allows users to tweet (update posts via Twitter) and retweet (re-posting updates from other Twitter users) within the Feedly platform. Similarly to the Twitter-Feedly integration, Feedly also established integration with Reddit. This integration also enables users to receive automated feeds that include Reddit posts and make a Reddit post within the Feedly platform. As a result, Feedly users can enjoy the benefit of other social media platforms without having to leave the platform.

	Low Degree of Network (Information Crawler)	High Degree of Network (API)
Multiple Services	Single Portal Feedly (website version)	One-stop-shop Feedly (latest version)
Core Service	Search Engine Feedly (browser extension version)	Comparison Sites -

Figure 29. Feedly business model dynamics

That being the case, Feedly shifted its business model. At first, Feedly started only to offer browser extensions to find news and articles on different topics. During this time, Feedly's business model was a *search engine* aggregator. Later, Feedly added a new offering to collect online news and articles from news publishers and share news and curated looks on its newly launched websites. Most news publishers publish articles with a standardised RSS format so that Feedly can pull the content of the articles with RSS reader technology, so although introducing new features offering, there is still no integration needed. During this time, the Feedly business model was an *advanced search engine*. In the current version of Feedly, as more services are added, Feedly established API integration with other platforms such as Reddit, Twitter, and YouTube (Feedly, 2021). The integration lets Feedly collaborate with its social media aggregatees by exchanging information and features. As a result, the Feedly business model is now classified as a *one-stop-shop* aggregator.

### 3.5.4 Indeed Business Model Dynamics

During its launch in 2005, Indeed started its business as a platform that helped users find relevant job listings by gathering job listings from various job portal websites (Arrington, 2005). Like Google, Indeed uses web crawlers to provide recommendations on job listings, so no integration is needed to gather information from other platforms. Users will be redirected to the job site to complete the application process.

In 2011, Indeed launched Indeed Apply to extend its function as a job application portal. Indeed Apply is a complementary feature that enables users to apply for job application directly within the Indeed sites. Employers can now create job listings within the Indeed platform and manage their employer pages. Within the same year, indeed also added a resume search feature for employers to make job applicant search processes easier (Zappe, 2011; Sternberg, 2011). The Indeed Apply integrates Indeed Apply API to exchange information between Indeed and Employers own platform (Indeed, 2021).

Indeed current version extends the platform function beyond the job or applicant searching platform. In mid-2021, Indeed launched the Indeed Hiring Platform, a platform for employers to arrange hiring processes within the Indeed platform, from posting the job, searching, selecting applicants, and conducting online tests to the interview process via the platform's video conferencing features (Indeed, 2021).

	Low Degree of Network (Information Crawler)	High Degree of Network (API)
Multiple Services	Advanced Search Engine -	One-stop-shop Indeed (latest version)
Core Service	Search Engine Indeed (launch version)	Comparison Sites Indeed (post Indeed Apply introduction)

Figure 30. Indeed business model dynamics

In the case of Indeed, the platform also shifted its business models. In its first launch in 2005, as the platform focused solely on finding relevant job searches with web crawlers, Indeed started as a *search engine* aggregator focusing on *service aggregation* of job listings. The introduction of Indeed Apply shifts Indeed's business model to *comparison sites*, as the Indeed Apply feature needs integration through

Indeed Apply API and ATS (Applicant Tracking System) with the job sites. Although at this state, Indeed still solely focus on service aggregation. Later, In the current version, the platform provides the Indeed Hiring Platform that adds additional features to the platform beyond finding job listings. Indeed now has multiple features and integration with different platforms, so the business model has changed to a *one-stop-shop* aggregator.

This Subsection identifies two pathways of aggregator business model dynamics. (Meta-)platforms operators typically start as search engines. They either evolve into advanced search engines by adding additional services or transform into comparison sites by partnering with other platforms. Finally, they aim to exercise the one-stop-shop business model. These archetypes and dynamics are developed by (meta-)platforms beyond the data economy sector. As a next step, we design meta-platform business models for the data economy. At the end of the document, we can then reflect on whether and how data marketplace meta-platforms differ from other digital meta-platforms.

### 3.6 TRUSTS Federated Business Models<sup>38</sup>

The starting point for the business model is the aggregator elements derived from the existing literature (section 3.2). Next, we map these to the four archetypes identified in the desk research (section 3.4). To detail the business models, we conduct semi-structured interviews and internal workshops to identify business model components that compose the aggregator business model elements (embedded with a specific archetype). We also map these business activities with TRUSTS Functional Requirements (FRs) and components (Cs) according to the deliverables D2.3 “Industry specific requirements analysis, definition of the vertical E2E data marketplace functionality and use cases definition II” (TRUSTS, 2021a) and D3.10 “Platform Status Report II” (TRUSTS, 2021c)(refer to Table 4). **We do so to show how TRUSTS has made a significant attempt by realising some key features of (log-term-vision) federation aspects of data marketplaces.** In addition, this approach enables us to create a road map that provides tangible actions to scale up the TRUSTS platform to realise a federation vision, thus eliminating fragmentation that constrains the data economy growth.

Table 10. TRUSTS federated business models

Domain	Aggregator element	Business model component	Archetypes <sup>39</sup>				Illustrative TRUSTS FRs and Components
			1	2	3	4	
Service	Service aggregation	Data assets catalogue in a single location	x	x	x	x	FR5: C5, C12, C18
		Personalised search and recommendation			x	x	FR6: C4
		User rating			x	x	FR33B: C5, C11, C17

<sup>38</sup> Part of this subsection has been published in Abbas, A. E., Ofe, H., Zuiderwijk, A. M. G., & de Reuver, M. (2023). Toward Business Models for a Meta-Platform: Exploring Value Creation in the Case of Data Marketplaces. The 56th Hawaii International Conference on System Sciences (HICSS), Honolulu, the United States.

<sup>39</sup> Archetype 1= Search engine; Archetype 2= Advanced search engine; Archetype 3= Comparison site; Archetype 4= One-stop-shop.

Domain	Aggregator element	Business model component	Archetypes <sup>39</sup>				Illustrative TRUSTS FRs and Components
			1	2	3	4	
		Data asset pricing benchmarks			x	x	Beyond the project
	Service composition	Data management services (e.g., cleansing, visualisation, quality check)		x		x	Beyond the project
		Training		x		x	Beyond the project
		Storage and computing power		x		x	Beyond the project
		Sandboxes to experiment with data		x		x	Beyond the project
		Advanced data analysis: - data analysis and classification based on machine learning				x	FR42: C1, C19
		Data protection: - anonymisation - cryptography and secure protocol - privacy protection				x x x	FRs 38-41: C1, C19, C23, C24, C24
		Purchasing and billing				x	FR15: C24
		Compliance checking support				x	Beyond the project
		Certification				x	Beyond the project
Technology	Platform Crawler (AI Bots or RSS Reader)	Crawler as a framework to enable data asset library collection	x	x			N/A
	Platform API	API as a framework to enable data assets catalogue aggregation			x	x	FR2: C14, C15, C16
		End-to-end decentralise transaction			x	x	FR29: C1, C5, C12
Organisation	Aggregation with partnership or ownership	TRUSTS can join or establish a data marketplace Consortium (partnership)			x	x	Reflected in FR2
	TRUSTS operating company	TRUSTS running as a profitable company	x	x	x	x	Refer to possible commercialisation options
Finance	Aggregators independentl	Revenue streams: Ecosystem access	x	x	x	x	FR3: C5, C12, C24

Domain	Aggregator element	Business model component	Archetypes <sup>39</sup>				Illustrative TRUSTS FRs and Components
			1	2	3	4	
	y finance their business operation	(membership), Data listing, sponsored search, brokerage fee, trading (transaction fee), data asset sales, service fee, and advertisement.					
		Third-party revenue sharing model: Fixed (absolute or %) or sliding scale (absolute or %).	x	x	x	x	Beyond the project

### 3.6.1 The Service Domain

Reflecting on subsection 3.2, the service domain of TRUSTS federated business models will be divided into *service aggregation* and *composition*.

#### 3.6.1.1 Service aggregation

The most basic service aggregation can be found in all business model archetypes by providing a data assets catalogue in a single location. Data asset catalogues were discussed in the workshop (most participants gave a ‘yes’ mark to this service as a baseline to be a federator). In the interview, interviewees illustrated the need for data catalogues which help discoverability and searchability aspects:

“So the minimum feature, I think, is not far, is quite close, within reach. And I think it has to do with, yes, with discovery, definitely.” [I-16]

“I think for the searchability to know what data is where it [a meta-platform] can help.” [I-03]

This service creates value for data providers by increasing the chance of being found by data consumers. Data consumers can reduce their time searching to find suitable data assets without registering in multiple markets. This multi-homing can help prevent vendor lock-in and enable data portability, triggering the required network effects for the data marketplace to flourish. Having a data assets catalogue in a single location is in line with TRUSTS FR; for example, FR 5, “the system should provide rich search mechanisms across all federated nodes for available datasets and services,” is realised by C5 platform Interface (CKAN), C12 Corporate Interface (CKAN), and C18 Broker and Metadata Storage.

The more advanced service aggregations are a) personalised search and recommendation, b) user ratings, and c) data asset pricing benchmarks. These services best suit the *comparison* and *one-stop-shop* archetypes as they need API integrations with data marketplace participants.

An interviewee illustrated the need for personalised search and recommendation [I-20].

“Search, you need a search facility. Of course, end-users could search. Recommendation engine is recommended.”

The workshop also validated service needs because most participants agree that this offering should be included in a long-term vision of meta-platforms exercising aggregator business models. The recommender will give more accurate predictions to data consumers, which also, in turn, will benefit data providers to disseminate their data assets better. This positive cycle will trigger transactions in meta-platforms. At this stage, TRUSTS has incorporated this service as stated in FR6 “The system should be able to provide datasets and services recommendations to its’ users pertaining to their profile and needs,” which is realised by the C4 recommender.

Going forward to discuss the next service, a participant illustrated the needs of user rating schemas [I-19]:

“OK, now we have like multiple data markets, and then you expect to have some rating. Because in [a project], for example, I have this rating mechanism. In [another project], I have another rating mechanism. There is this somehow need to be aligned, right?”

The workshop also confirmed the service of user ratings, as it creates value for data consumers to get indications of data quality. TRUSTS has also incorporated user rating schemas as stated in FR33B “the system should provide reputation/rating schemes concerning available datasets and services.” This FR is fulfilled by C5 Platform Interface (CKAN), C11 Mapping Builder, and C17 - Business Support Services.

Another discussed service aggregation is data asset pricing benchmarks, as illustrated by I-05:

“So I would just like to know what the deal is for a platform like that? Is it when you say monitoring incentives, is there going to be a way for data buyers to be able to possibly pick the best price? You know, compare services and understand which data market is best to work with.”

The workshop discussed the value of data asset pricing benchmarks, mainly to help data providers assess their data value; and for data consumers to see whether the offered pricing is appropriate. This service is not explicitly developed within the scope of the TRUSTS project—as the pricing issues have been discussed a lot in the literature (see review by Abbas et al., 2021), and TRUSTS can later choose and implement the already developed service.

### 3.6.1.2 Service composition

Potential service composition includes a) data management services (e.g., cleansing, visualisation, quality check), b) training, c) storage and computational resources, and d) sandboxes to experiment data. These services can be introduced as complementary services supporting the core aggregation services. A meta-platform operator can independently provide these services. Hence, these service composition best suit the *advanced search engine* and *one-stop-shop* archetypes. For TRUSTS, these service compositions can be executed beyond the project's scope because it needs an operating company.

Data management services are discussed within the TRUSTS workshop. The idea is to help providers to clean, visualise, or check the demand for offered data assets. Data management services can be self-performed by data providers themselves. I-10 suggested:

“Management of your data that you, as a provider, that you know or have an idea, at least, where your data is residing or know if there are any demands of your data on the different platforms, what the difference that you have insights in the usage or potential use. I get so statistic, let's say.”

Another option is to have a meta-platform do the services on behalf of data provider organisations. The latter form is close to the consulting service. I-11 gave an illustration of the promotion activities:



“So you would like to OK if someone else takes care of promoting its basically then you OK that's something you may not want to do yourself that in that sense it's also helping to advertise that it's available and to see what the interest is there.”

Another service composition is training for users. According to the workshop, training for users is essential to enhance their understanding of the value of data exchange, including how to engage with data exchange activities that comply with relevant laws and regulations. A participant from the interview also illustrated the need for such training [I-03]:

“You need to show people that you can do good with data, and the more difficult. So, you set it up (training).”

Although more formal training can be established when TRUSTS has its operator, the project has made the first significant attempt to create TRUSTS social micro-learning, which is publicly available.

According to the workshop, another service composition is providing computing resources. Thus, data providers and consumers can concentrate on matching their data assets and needs rather than addressing infrastructure complexities. For data marketplace operators, providing computing resources means optimising the utilities of their infrastructure by renting the. In line with this workshop discussion, a participant in an interview illustrated his view about computing resources [I-17]:

“Computing resources probably can be exchanged. Things like that, there is someone who has a lot of computational resources like GPU stuff that they just put it online and then on [a data market] you use, you rent this infrastructure, then you rent those datasets.”

Another service composition that belongs to the *advanced search engine* is sandbox environments (or programming ecosystems). This service enables data consumers to experiment with data assets. Consequently, data consumers can assess the value of data samples: whether those assets are suitable to answer their data needs or not.

“Programming ecosystem, maybe a development ecosystem where these kinds of experiments are also possible. And then also we are in the future machine learning models can be exchanged.” [I-17]

A critical discussion in the workshop was how exactly a meta-platform operator could provide this service. Is the sandbox environment only suitable for public data? What kind of data assets can be experimented with (e.g., sample vs synthetic data)? These types of questions need further examination.

On the other hand, several service compositions depend on technical and organisational integration, best suited to the *one-stop-shop*. These are a) advanced data analysis, b) data protection mechanisms (e.g., anonymisation), c) purchasing and billing, d) compliance checking support) and d) user ratings.

One participant illustrated service composition for advanced data analysis via aggregation to increase data value [I-15]:

“I think if you have multiple datasets, well, at least you can enrich the data. And let's say due to enrich the data. You can increase the value of the data towards customers. That could be worthwhile to explore.”

TRUSTS enables third parties (e.g., software companies) to provide this advanced data analysis (e.g., classification based on machine learning) by employing C1 Dataspace Connector and C19 App Store. Having these components, three UCs have successfully integrated within the TRUSTS meta-platform. These UCs refer to smart big-data sharing and analytics of AML compliance (UC1), agile marketing through data correlation (UC2), and data acquisition to improve customer support services (UC3). Therefore,

TRUSTS fulfils its FR 42 “the system should incorporate well-established ML algorithms that can be used by the TRUSTS customers for data analysis and classification.”

Moving now to consider data protection mechanisms, a participant discussed anonymisation [I-31]:

“So we add some kind of noise on data. Let's say I would like to share my data with another company, but I will not share all of whatever is related to personal information. Yeah. So I can hide all of this information, or I can do some kind of anonymisation on all this data. Then I can share it.”

Another interviewee illustrated the cryptography and secure protocol aspects [I-16]:

“How do you ensure that they do not just resell it to someone else? So here is where an extra layer, let's say, kind of an extra layer of security, has usage control, has to be built around assets so that they be, for example, transmitted in some encrypted form. And this encryption requires both a key that the consumer has and a rotating key that the producer issues for every axis. And that way, the producer knows exactly how many times it was accessed. So this kind of encrypted data container exists.”

Participant I-5 also emphasised the issues of privacy protection:

“Privacy has to be assured to the data marketplace. You know that whatever they share with the platform is going through a secure tunnel. So security in terms of data transportation and, you know, exchange of data from one micro PC or another until the buyer is really important.”

Data protection mechanisms were also discussed in the workshop. It is no doubt that data protection is a key prerequisite in data exchange. An important point discussed was that some context-specific protections (such as Homomorphic Encryption) must be tailored to specificity UCs and scenarios. Therefore, similar to the elaboration in service composition to advanced data analysis, opening up context-specific protections would help a meta-platform to leverage its protection portfolio.

TRUSTS has made a significant move to achieve the federation vision by providing some less context-specific data protection mechanisms. TRUSTS explicitly defines FRs 38-41 to incorporate privacy protection and ensure anonymisation. Many components fulfil these FRs, for example, C21 Vocabulary Services, C22 Distributed Authorisation Component, C23 Automated Certificate Management Environment (ACME), and C24 Smart Contract Execution.

Another service composition relates to purchasing and billing. For example, interviewee I-16 illustrated this service:

“So it would be in my ideal world, whatever process is necessary for payment is also machine-readable. So if some new customers, let's say you want to now harvest this [provider] data, [provider] hypothetical data set to just go to the data set, you get a machine-readable thing that you can plug into your computer to connect to them and a machine-readable thing that you can put into let's say, your finance software so that it knows, OK, every time you do a search you have to send these guys one euro cent, and every time you download something, you have to send these guys one.”

The workshop also discussed purchasing and billing. This service composition helps to prevent end-users from performing transactions beyond meta-platforms. Transacting data assets beyond the provided environment will harm end-users, as meta-platforms can provide no support or help. To reduce development in non-core capabilities, a meta-platform could consider partnering with existing payment solutions (e.g., PayPal). In the context of TRUSTS, TRUSTS implements C24 Smart Contract Execution to

fulfil FR15 “the system should provide the ability to connect to billing mechanisms for enabling consumers to pay providers according to the agreed smart contract.”

Some participants expressed the need to have compliance-checking support for service composition. If a meta-platform federates data marketplaces from different areas, a meta-platform needs to understand the compliance and legal contexts for such areas: different work rules depend on specific areas, and translating diverse legal instruments between countries is difficult.

“And it is a really big blocking thing for this because if you want to do it Europe, you still have those translations between all the different legal stuff between countries... So how are you going to handle them?... and it is really difficult to get in place.” [I-08]

In extreme cases where a meta-platform is interoperable with data marketplaces outside the European Union, some regulations, like the General Data Protection Regulation (GDPR), may not be applicable. Hence, users may face difficulties understanding what they can (and cannot) do with the data.

“...but that is difficult then to even translate that to a third party and trust them to understand what they can and cannot do something with the data.” [I-13]

The workshop discussed the possibility of having this type of compliance-checking support. TRUSTS can consider this service composition in the operationalised stage. Having compliance-checking mechanisms will reduce the uncertainties of end-users.

Finally, onboarding certification also became another important service composition. Onboarding certification can confirm (data marketplace participants, data providers, or consumers) compliance with organisational and technical pre-conditions.

“As a rule, you have two things that you would like to certify if you want to have it completely, or as far as possible, conclusive is the piece of software. Not every party is going to write its own software to participate in such a marketplace. But they just use a product that is available and they install it. That is the most important. If the software is properly configured in that sense, you already have a lot of that confidence. Then comes the question, can you trust that organisation yourself? The organisation where it is deployed, or a service provider that is linked to that consumer or that marketplace that provides that service for you to set up that connection, that it is certified. That is the next step.” [I-24]

According to the workshop discussion, compliance checking supports can be provided beyond the project when TRUSTS has an operating company, and onboarding certification can be provided by utilising the international data space (IDSA) certification mechanism.

### 3.6.2 The Technology and Organisation domain

As discussed in the cross-case analysis (8.4.1.2 Technology and organisation to deliver the services), the technology and organisation domains influence each other and tend to have similar patterns. If a meta-platform chooses to use platform crawlers (AI bots or RSS readers) as a technological backbone, the meta-platform does not have to form a partnership with existing data marketplaces. On the other hand, if a meta-platform employs Application Programming Interfaces (APIs), then the meta-platform needs to form a partnership with data marketplaces.

The aggregator element for the (advanced) search engine archetype is platform crawlers (AI bots or RSS readers). These crawlers are a framework to enable data asset library collection without the need to establish a partnership with data marketplace participants. The participant I-16 illustrates:

“That means that you can use, I don't know, you can put connect your automatic AI-based crawler into my marketplace and run it on my premises and get all whatever your crawler does.”

In practice, TRUSTS aims to provide Application Programming Interfaces (APIs) by partnering with existing data marketplaces. The API development to enable interoperable with data marketplaces is reflected in FR2 “the system should provide APIs that enable its interoperability/federation with other industrial marketplaces and external sources.” TRUSTS has specific tasks that discuss these interoperable API solutions, resulting in three novel components: C14 Data Exchange TRUSTS Component, C15 - Data Exchange Client Component, and C16 Registry of Data markets. Building APIs are also in line with participant views, for example [I-08]:

“Yep. So there is more than one is the standardisation of the marketplace, so you got one marketplace to find everything, and the second one is the standardisation of the APIs to eventually get that data.”

Another interviewee illustrates how this federated option can consolidate data marketplace participants via partnership [I-07]:

“Yes, for me, it will be great to have one trusted partner. So if this meta-data platform will be able to consolidate more data markets and put it under one umbrella like you mentioned”

By doing so, TRUSTS can provide a one-stop-shop and end-to-end workflows of data exchange (FR37).

Another crucial element in the organisation domain is the need to have an operating company. This deliverable refers to task 7.5, which discusses the commercialisation options to realise this vision. Among others, the options considered are investment (e.g., an internal partner takes over) or the second iteration of research project investment.

### 3.6.3 The Finance Domain

Reflecting on the key result from D7.1, regardless of the business model archetypes, according to D7.1, a meta-platform can get revenue from ecosystem access (membership), data listing, sponsored search, brokerage fee, trading (transaction fee), data asset sales, service fee, or advertisement. The workshop discussed this option, leading to the selection of the subscription model as a starting point (for simplicity purposes, which often use in the early phase of the product). Subscriptions can lower the entry barriers because data consumers can have plenty of options to select data assets according to their needs. Therefore, data consumers can maximise their explorations in this trial phase instead of trying once in the one-time payment method and never returning. In addition, subscriptions allow data providers to give predictive revenue projections. The workshop pointed out two mechanisms for attracting users. First, a meta-platform can provide a trial period. After this, a meta-platform can start to charge from the second transaction. Second, a meta-platform can offer free databases to potential users to try out the market. At the moment, TRUSTS starts by implementing the subscription services (FR30) by implementing C5 Platform Interface (CKAN), C12 Corporate Interface (CKAN), and C24 Smart Contract Execution.

The revenue-sharing mechanisms between a meta-platform and data marketplace participants can be exercised and empirically proven in the long-term vision. At this stage, TRUSTS can divide the revenue with

data marketplace participants using fixed (absolute or %) or sliding scale (absolute or %) (refer back to deliverable D7.1). To what extent these proposed mechanisms are effective is of interest to further research.

### 3.6.4 TRUSTS Business Model Dynamics

Since the beginning of the project, TRUSTS has had the vision to create a federated data marketplace based on International Data Space (IDS) and Data Market Austria (DMA). TRUSTS then build APIs to enable data marketplace interoperability. Hence it always aims, at least, to be a comparison site (archetype 3). TRUSTS also provide many composition services beyond the mere service aggregations (refer to Table 10), reflecting the idea that TRUSTS will move towards the one-stop shop. Therefore, the TRUSTS functionalities and developments illustrate how the project has made significant contributions to realise the long-term vision of the federation (which never existed before). In the long term, TRUSTS could thus evolve into a one-stop shop (Figure 31).

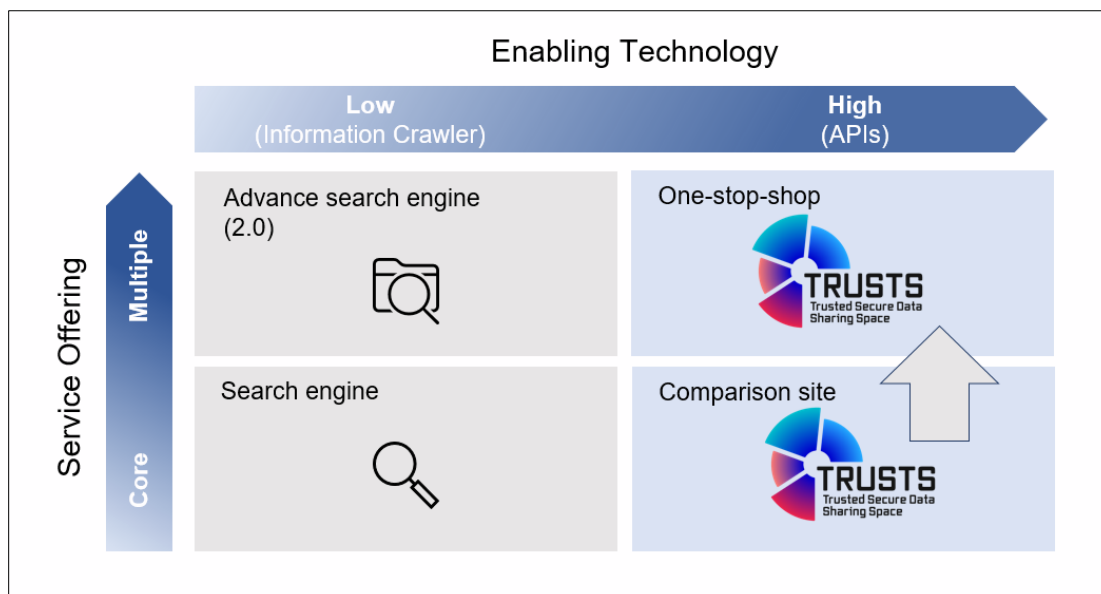


Figure 31. TRUSTS business model dynamics

The business model of TRUSTS is scalable towards adding more federation functions than it has already. In this way, the activities identified can be put on a roadmap to the next evolutions of the TRUSTS business model (refer to Table 10).

## 3.7 The Interaction Between Data Providers and Consumers

When aiming for the one-stop-shop form, a question often arises, how exactly do data providers and consumers interact through this federation? Considering the two perspectives of data providers and consumers, four possible scenarios can be derived from TRUSTS as a federator of data marketplaces (Figure 32).

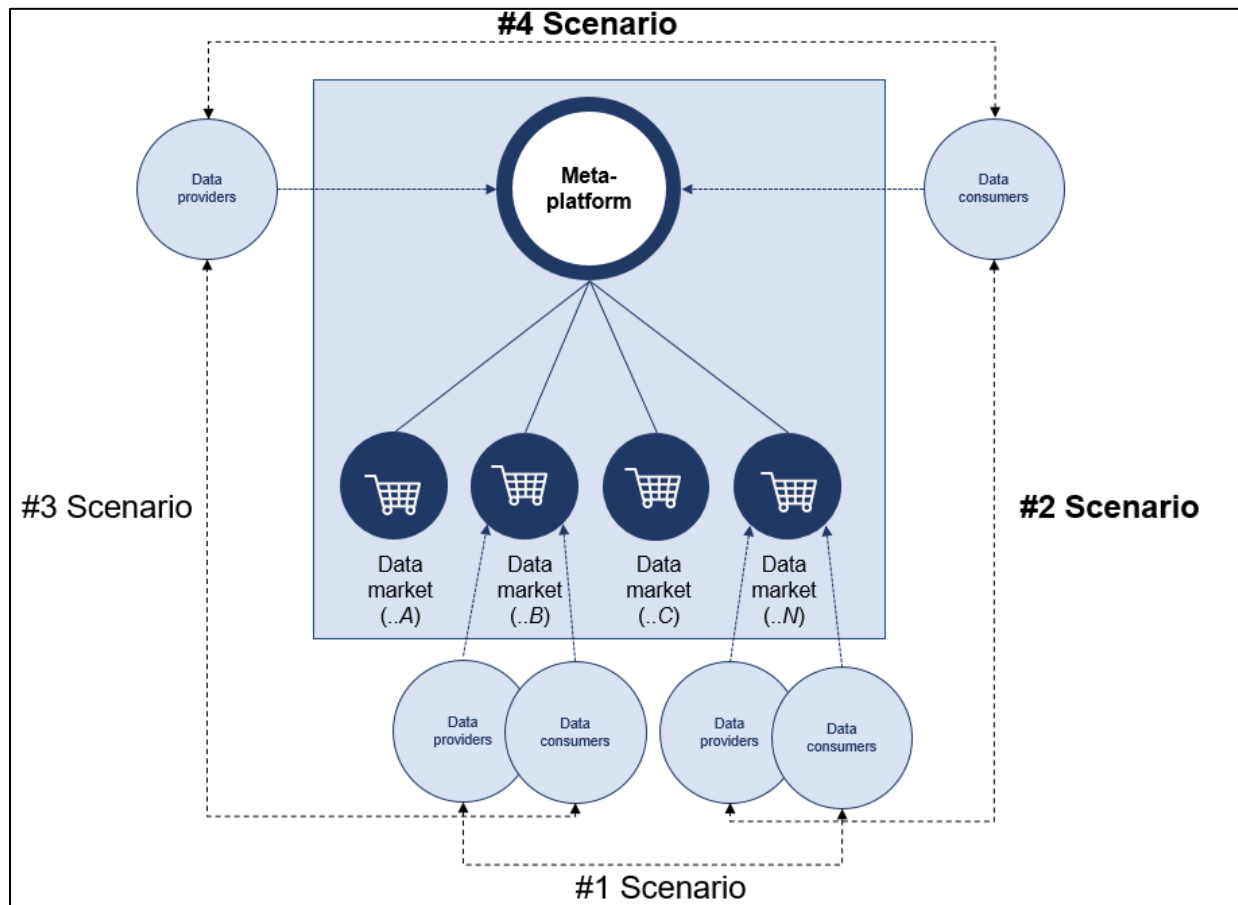


Figure 32. Four possible user interaction scenarios

These scenarios can be derived from where data providers (or consumers) are originally registered (refer to Figure 33):

1. **The first scenario:** A data provider is already registered in a data marketplace. It can share business data with a consumer registered in another data marketplace (and vice-versa).
2. **The second scenario:** A data consumer joins TRUSTS to look for data providers registered in data marketplace participants. This is comparable to the Trivago case: end users look for accommodations on multiple travel platforms (like Expedia, Booking, or Airbnb).
3. **The third scenario:** A data provider joins TRUSTS to be accessible to many data consumers registered in data marketplace participants. This is comparable to the Mirai meta-search case<sup>40</sup>: a hotel joins this meta-platform to be visible to multiple travel platforms (like Expedia, Booking, or Airbnb).
4. **The fourth scenario:** Data providers and consumers are registered directly via TRUSTS. This is the case when a meta-platform play a hybrid role.

<sup>40</sup> <https://www.mirai.com/what-we-do/metasearch-connectivity/>, accessed on September 23, 2022

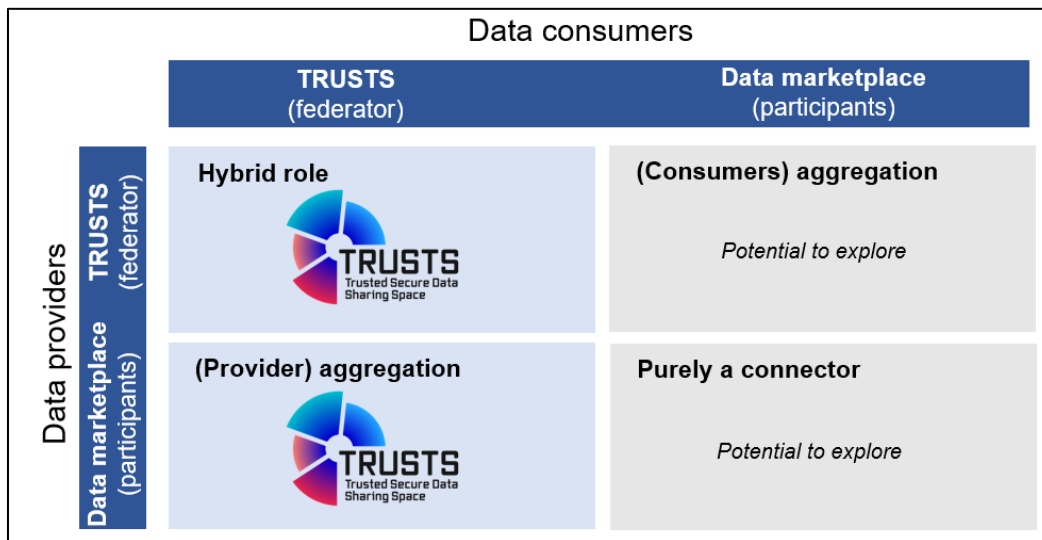


Figure 33. TRUSTS existing user interactions.

At this stage, TRUSTS plays **the hybrid role** (scenario #4) by also acting as a data marketplace (see elaboration in subsection 2.3); TRUSTS also plays the (provider) aggregation role (scenario #2) by enabling data consumers to join directly to TRUSTS and looks for data assets provided in other marketplaces, such as European Open Science Cloud (EOSC) (refer to D3.6 Data Marketplaces with Interoperability Solutions III) (TRUSTS, 2022). In the future, TRUSTS can also complement these positioning by exploring the consumer aggregation role (scenario #3) or act as a pure connector that bridges marketplaces (scenario #1).

### 3.8 Evaluating Value Creation of a Federated Data Marketplace

Large quantitative studies were conducted to evaluate the federated data marketplace on value creation criteria of trust, perceived risks, and willingness to share data. The federated data marketplace does not directly influence trust, risks and willingness to share. Instead, we consider that the federated marketplace features affect five key areas regarding data providers: data ownership, data control, responsibility, compliance, and security. In turn, these five dimensions affect trust, risks and willingness to share, see Figure 34.

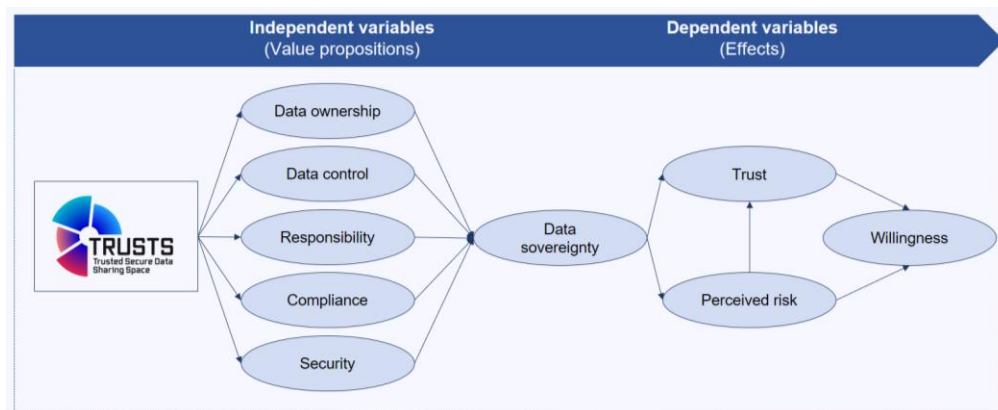


Figure 34. The impact of value creation of a federated data marketplace



Five dimensions represent five significant challenges in European Data Economy (Fassnacht et al., 2023; Scaria et al., 2018). Altogether, these dimensions can also form one recent prerequisite in the European Data Economy: Data sovereignty (refer to Data Act). Data sovereignty has always been a central consideration in the TRUSTS development, as our building block is based on the International Data Space (IDS) standards which value data sovereignty highly. We are now turning to discuss the dimensions mentioned above. Each dimension has sub-dimensions that will act as measurements (or questions) in our quantitative survey.

In the end, we want to measure the TRUSTS federation business model impacts on three critical variables in business data sharing: 1) trust, 2) perceived risks, and 3) willingness to share data (see Agahari & de Reuver, 2022). These three items, for example, trust, have been the primary goal that guides our project development:

“TRUSTS will ensure **trust** in the concept of data markets as a whole via its focus on developing a platform based on the experience of two large national projects while allowing the integration and adoption of future....” TRUSTS DoA.

### 3.8.1 Result: Pre-study (Step 1)<sup>41</sup>

As explained in subsection 3.3.4.1, we conducted a pre-test to gain confidence about the newly developed measures of data sovereignty. We conducted the analysis following the guidelines elaborated in 3.3.4.1.3.

The *internal consistency reliability* for each dimension is established. The Cronbach’s alpha and Composite Reliability (CR) score for each dimension are > 0.7, except for the dimension of responsibility (R): 0.664 and 0.671, respectively. Nevertheless, a score between 0.6 and 0.7 is acceptable for exploratory research and newly developed instruments (Hair et al., 2017). The *indicator reliability* for each indicator is generally confirmed, as the outer loading ( $\lambda$ ) for each indicator is mostly > 0.7, except for DO\_1 (0.647), DO\_3 (0.674), and R\_2 (0.666). Again, this value is acceptable for exploratory research (Hulland, 1999). However, we analysed these three indicators to check whether the removal of these indicators can improve the CR and Average Variance Extracted (AVE). We dropped R\_2 as it made CR of Responsibility dimension (R) above the threshold. The *convergent validity* is OK as The AVE for all dimensions is higher than 0.5. The *discriminant validity* also indicates good results. The cross-loading factors are appropriate: relevant indicators possess the highest loading value for the assigned dimension. The Fornell-Larcker Criterion demonstrates a positive outcome: a dimension shares more significant variance with its associated indicators than any other dimension. Heterotrait-monotrait ratio (HTMT) statistic is < 0.9 for all dimension.

Overall, the aggregated mean in each dimension leaning to scale of 3 to 4: participants somehow agree that federation offerings positively impact the data sovereignty dimension: Data Ownership (DO) = 3.855, Data Control (DC) = 3.914, Compliance (C) = 3.723, Responsibility (R) = 3.75, Security (S) = 3.877. The underlying datasets can be accessed here.<sup>42</sup>

This pre-study indicates that federated data marketplace offerings can potentially diminish the data sovereignty concerns of data providers. The pre-study findings also assure that this research direction is worth pursuing and continuing.

<sup>41</sup> Part of this subsection has been submitted for publication and is under review.

<sup>42</sup> <https://doi.org/10.4121/21763361>

### 3.8.2 Result: Measurement Validation (Step 2)

We employed a Hierarchical Component Model (HCM) to assess the impact of data sovereignty as a proxy to trust, perceived risks, and willingness to share business data. We employed the HCM to reduce the complexity caused by too many path model relationships. Our HCM is type 2: reflective-formative model. This model is commonly used to observe multi-dimensional constructs. We employed a standard approach to validate the instrument: a joint two-stage approach (Ringle et al., 2012). To do so, we first need to evaluate all of the indicators. Using the same procedure as the previous step, we removed R\_1, R\_4, and TDC\_3 to achieve the validity and reliability of the measurement. After that, we created a latent composite score for each data sovereignty construct, resulting in the below model (Figure 35).

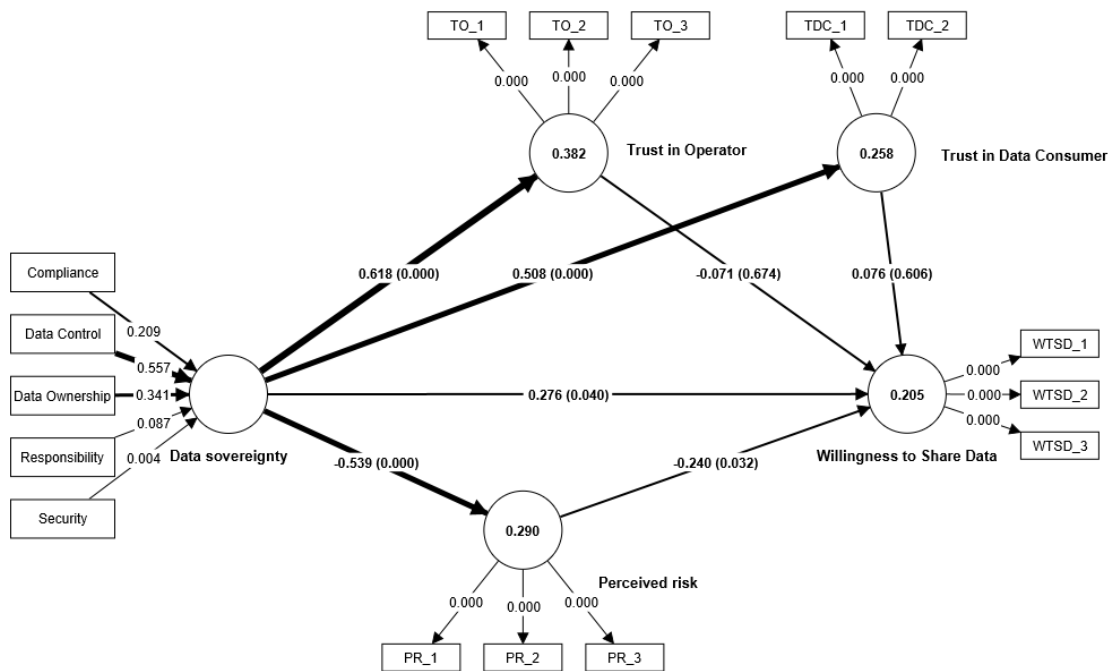


Figure 35. The nomological net model

The arrow between the construct represents path coefficients a p-value. The number on the construct represents  $R^2$ . Moreover, the arrow from data sovereignty dimensions to the data sovereignty construct represents a weighting score.

The statistical result can be seen in for path coefficients can be seen in Table 11. Generally, the result statistically confirms that federated data marketplaces' offerings enable sovereign data exchange. Data sovereignty, in turn, do impact trust, perceived risk, and willingness to share data.

Table 11. Path coefficients

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (O/STDEV)	P values
Data sovereignty -> Perceived risk	-0.539	-0.548	0.074	7.303	0
Data sovereignty -> Trust in Data Consumer	0.508	0.536	0.087	5.852	0

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (O/STDEV)	P values
Data sovereignty -> Trust in Operator	0.618	0.633	0.079	7.841	0
Data sovereignty -> Willingness to Share Data	0.276	0.283	0.135	2.05	0.04
Perceived risk -> Willingness to Share Data	-0.24	-0.235	0.112	2.139	0.032
Trust in Data Consumer -> Willingness to Share Data	0.076	0.062	0.147	0.515	0.606
Trust in Operator -> Willingness to Share Data	-0.071	-0.069	0.169	0.421	0.674

Table 12 present the overview of  $R^2$ . The table indicates that data sovereignty does (partially) contribute to and influence trust, perceived risk, and willingness to share data. The underlying datasets can be accessed here.<sup>43</sup>

Table 12.  $R^2$  overview

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (O/STDEV)	P values
Perceived risk	0.29	0.306	0.079	3.658	0
Trust in Data Consumer	0.258	0.295	0.09	2.863	0.004
Trust in Operator	0.382	0.407	0.098	3.917	0
Willingness to Share Data	0.205	0.243	0.083	2.469	0.014

Regarding the complete experimental study, we got an administrative delay due to compliance checking of Prolific (for almost three months). Although Step 2 is already sufficient to statistically confirm the value creation of a federated data marketplace, we still want to confirm it using a representative sample to strengthen the validity further. We plan to report the experimental study after the project completion date by aiming to submit the analysis to a top-tier journal in the information system field. We will acknowledge TRUSTS in the publication and cross-reference it with this deliverable.

### 3.9 TRUSTS Roadmaps Towards a Federated Data Marketplace

We present a roadmap in Figure 36 to fully achieve the TRUSTS long-term vision to realise a federated data marketplace, dividing it into three clusters: *must-do*, *start-soon*, and *do-later* initiatives. Several TRUSTS features align with the empirical analysis, providing a solid basis for federation. In the long run, we provide a roadmap for scale-up purposes to fully realise the federated vision (Figure 36).

<sup>43</sup> <https://doi.org/10.4121/21763361>

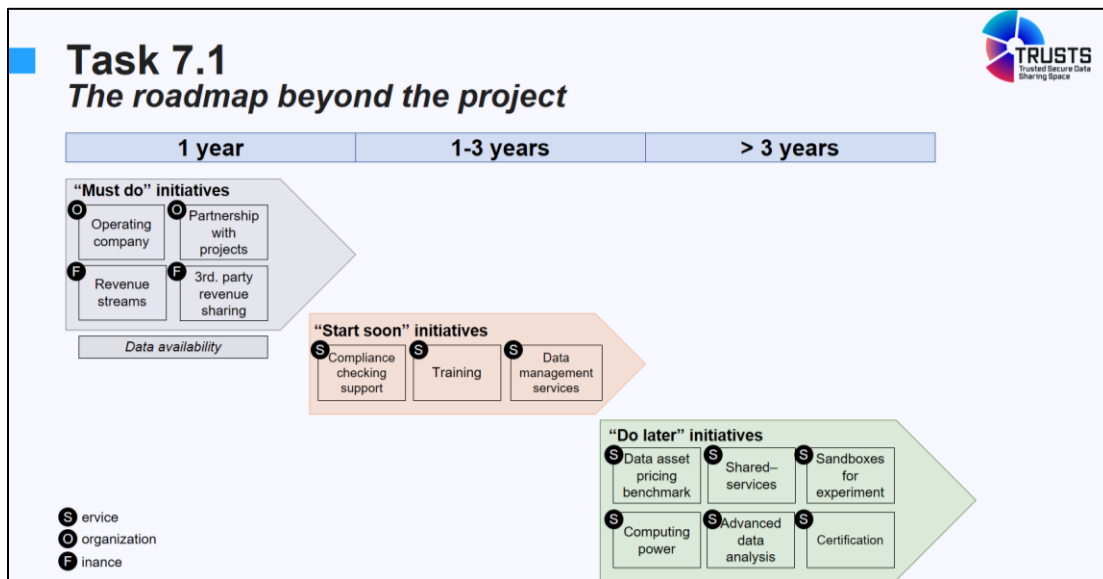


Figure 36. A long-term roadmap from data marketplace to federation.

The most important **“must do”** initiative is to explore the area in the organisation and finance domain next year (because TRUSTS is technologically ready to be the one-stop shop). For the organisation domain, TRUSTS must build an operating company while, at the same time, inviting more operationalised data-related projects (and initiatives) to onboard in the federation. With an operating company, TRUSTS should generate revenue and divide it fairly with data marketplace participants. The must-do initiatives also ensure data availability, meaning TRUSTS has enough data assets to share.

We must keep promoting TRUSTS as a federator of data marketplaces, as its value propositions provide significance to users. Nevertheless, the governance of such a federator needs to be clearly defined. For example, limit TRUSTS dominance (e.g., by defining what TRUSTS can and cannot do), provide fair revenue-sharing mechanisms, align membership schemas, and promote shared ownership and decision makings. TRUSTS also need to emphasise the significance of the TRUSTS interoperability solution and data space connector. These components align with the EU's vision to create a single data market by 2030 and will be in demand for the following years.

To reach more federation participants, TRUSTS should go beyond data marketplaces (e.g., data ecosystem-related projects and participants). Because, at the moment, data marketplaces are generally still in the development phase; hence they are afraid of losing Unique Selling Propositions (USPs). Moreover, the federation will raise extra costs because of the increased complexity and cost of technology integration TRUSTS should also consider the contextual factors of data sharing. TRUSTS can first aim for less sensitive key industries or more highly sensitive ones by demonstrating TRUSTS' data protection capability.

The **“start soon”** initiatives focus on more supporting services such as compliance checking supports, training, and data management services (or consulting). This is because data providers and consumers lack the capabilities to share their data (e.g., assessing data value, ensuring data quality, and building UCs. This is in line with the finding in D7.1, that call for a more “intimate” relationship with data providers and consumers: value propositions that offer a solution instead of raw data trading, the need for strong customer relationships to attract customers, and technical sales support. Iterating the current TRUSTS

platform with MVP products focusing on federation aspects (beyond searchability) will demonstrate better the one-stop-shop TRUSTS capabilities.

Finally, TRUSTS can work on “do later” initiatives that provide more sophisticated and complex services, such as data asset pricing benchmarks, shared services, and sandboxes for experiments. TRUSTS can also explore the consumer aggregation role (scenario #3) or act as a pure connector that bridges marketplaces (scenario #1). Many components of TRUSTS (e.g., recommender, smart contract) and UCs are significant, so they can also be commercialised independently.

### 3.10 Future Research for Scientific Communities<sup>44</sup>

In this section, we started by analysing existing aggregator business models in domains other than data markets. By conducting interviews and workshops, we specified these business models in the context of the data economy. Subsequently, we demonstrated that these specified business models contain value-creating elements that positively contribute to data provider trust, risk perceptions and willingness to share. To the best of our knowledge, this is the first academic study that developed meta-platform or aggregator business models specifically for the data economy. By showing that the developed business models contribute to value creation from the data provider perspective, our work provides an essential basis for understanding the business models of meta-platforms in a data economy context.

Considering the pioneering character of our work, many open questions can be posed for subsequent scientific enquiry:

1. Business models
  - a. What data products and services should data marketplaces create and make available to data providers and consumers (e.g., curated datasets, data-driven insights, analytics modules, smart services)?
  - b. How are data marketplace business models distinct from similar concepts of data spaces, data platforms, or data collaborative?
  - c. What are the critical success factors of commercially viable data marketplaces?
  - d. How can data marketplace participants benefit from current business models?
  - e. How do data providers and consumers perceive the costs and benefits of exchanging data products through data marketplaces?
  - f. What transformation path must organisations undergo to reach a sufficient degree of maturity for hosting or joining a data marketplace?
  - g. How do contextual characteristics of industries (or business sectors) affect the desired value propositions of data providers and consumers?
  - h. How do emerging technologies (e.g., blockchain-based architecture, privacy-preserving technologies) affect the perceived value of data providers and consumers?
  - i. What new tensions arise when applying emerging technologies to data marketplaces?
2. Governance

<sup>44</sup> Part of this subsection has been published in:

- Abbas, A. E., Agahari, W., Van de Ven, M., Zuiderwijk, A., & de Reuver, M. (2021). Business Data Sharing through Data Marketplaces: A Systematic Literature Review 34th Bled eConference - Digital Support from Crisis to Progressive Change, Online.
- de Reuver, M., Ofe, H., Agahari, W., Abbas, A. E., & Zuiderwijk, A. M. G. (2022). The Openness of Data Platforms: A Research Agenda. First ACM Data Economy Workshop, Rome, Italy.

- a. How do actors interact in data marketplaces?
  - b. How can centralised and decentralised approaches to governance be balanced?
  - c. How do governance mechanisms (formal and informal) help different stakeholders achieve particular outcomes (e.g., willingness to participate in data marketplaces)?
  - d. Considering the increasing demand for interoperability between data marketplaces, what are the reasons (not) to open up data marketplaces to other marketplaces?
  - e. Can governance mechanisms be substituted by emerging technological paradigms (e.g., smart contracts, federated learning)?
  - f. How is the design of data marketplaces intertwined with the emergence of business ecosystems, and how can we govern data marketplaces to reach the desired outcomes?
3. Specific federation aspects
- a. What is platform-to-platform openness in the context of data platforms?
  - b. How do we distinguish meta-platforms, forking, and platform interoperability?
  - c. What are business models for meta-platforms?
  - d. What are the reasons (not) to open up platforms to other platforms?
  - e. How are new data platforms invited to participate in platform-to-platform openness?
  - f. How many data platforms should ideally be included to reach optimum network effects?
  - g. How can a consensus-based structure of governance be maintained? How can governance hierarchy and decentralisation be balanced?
  - h. How to divide roles and decision rights between platform integrators and platform participants?
  - i. How can conflicts between data platform providers be managed and resolved?
  - j. How does platform-to-platform openness affect data owners' and consumers' intentions to participate in data platforms?
3. Societal concerns
- a. How do societal/external implications of platform openness (e.g. privacy, safety) affect platform openness decisions?
  - b. Do negative implications of data platform openness affect the perceived legitimacy of data platform providers?
  - c. What is the role of legitimacy tensions in deciding upon data platform openness?
  - d. How do societal implications of data marketplaces (e.g., data privacy, confidentiality, ownership, or sovereignty) affect the willingness to participate in data marketplaces?
  - e. How can we leverage digital responsibility on data marketplaces, and what implications do societal goals have for their design?
  - f. How can we design and manage data marketplaces that create successful ecosystems instead of digital superstars?
  - g. How to conceptualise or measure the societal implications of data marketplaces?

## 4 Conclusion

The D7.2 deliverable presents and evaluates business model alternatives for the TRUSTS platform. The earlier deliverable D7.1, which provided taxonomies of business models for data marketplaces based on existing cases, served as the foundation for this deliverable. In D7.2, new business models tailored to the context of TRUSTS are designed. The business model canvas and stress-testing method were utilized. We utilized workshops and interviews with internal and external project stakeholders to generate and evaluate ideas. Quantitative studies via surveys were conducted with prospective users to assess part of the offerings of the business models.

Two primary scenarios are considered for the business models created and evaluated in D7.2:

- TRUSTS as a data marketplace: This scenario assumes that the data marketplace operates within the current data economy landscape. This is elaborated through a base business model, which consists of the bare minimum of elements required for a profitable business. Additionally, an add-on business model with additional value-adding offerings is developed. The business models were created and evaluated based on internal workshops and interviews. Close collaboration with the other work packages and use case leaders ensured that the business model corresponded to the TRUSTS-developed work.
- TRUSTS is a data marketplace federator. This scenario assumes that TRUSTS will evolve into a federator of an ecosystem of data marketplaces. The analysis in Part B shows a clear path to realising a federated data marketplace in a business-viable fashion. In today’s fragmented data economy, providers and consumers of data struggle to find each other complementary services. Federation is a meaningful way to resolve this fragmentation, thus promoting a single data market while respecting the diversity of data marketplaces in sectors and geographical areas. Starting from analysing aggregator business models in other domains, a detailed business model was created for the specific context of data marketplaces. The proposed offerings positively contribute to trust, alleviate risks, and ultimately improve the willingness of data providers to utilise a federated data marketplace. D7.2 provides essential evidence of the business viability and feasibility of realising the long-term vision of the data marketplace federation. The TRUSTS project realised key features for such data marketplace (e.g., data exchange TRUSTS Component, data exchange client component, registry of data markets). The roadmap provides tangible actions to pursue scaling up the TRUSTS platform to realise a federation vision, thus eliminating fragmentation that constrains the data economy growth. In this way, TRUSTS provides significant inroads to realise the vision of a diverse and inclusive single market for data.

In conclusion, the work informs a future operator of the TRUSTS platform of the various business model options, scenarios, and recommendations for implementing the business model.



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## 6 Appendices

The Appendices consist of six sections, mainly to provide details about the empirical studies T7.1 conducted, especially for Part B. Appendix 1 describes (meta-)platforms employing aggregator business models (approach #1). We describe the business models using the STOF model. Appendix 2 describes the interview protocol (approach #2), and Appendix 3 discusses the workshop protocol (approach #3), Appendix 4 presents the mock-up evaluations and task descriptions (approach #4). Finally, Appendix 5 discussed questionnaire questions (approach #5).

### 6.1 Appendix I — (Meta-)Platforms Employing Aggregator Business Models<sup>45</sup>

Appendix 1 describes a case study analysis of meta-platforms employing aggregator business models. The framework of the TRUSTS analysis is offered using the STOF model.

#### 6.1.1 Trivago Business Models<sup>46</sup>

##### 6.1.1.1 *Service domain*

Trivago is an accommodation platform that helps users find and compare accommodation prices (e.g., hotel room prices) from various websites. Trivago compiles accommodation offers from more than 5 million hotels worldwide and 300 accommodation platforms such as booking.com, Expedia, or hotels.com (Trivago, 2021). Trivago shows the accommodation selection results based on the location asked by the users in the search bar. Trivago then shows several alternative hotels and prices, along with prices from different booking websites. In addition to the aggregation service by comparing accommodation alternatives, Trivago also provides users with aggregated hotel ratings. These hotel ratings are sourced from various other booking websites. Trivago also shows an extended overview of the accommodation, such as property information, amenities provided, photos, and price trend graphs. The above descriptions explain the *service aggregation* offered by Trivago.

In addition to aggregation services offered by Trivago, users can continue the transaction and payment directly within Trivago’s platform. Although the hotel vouchers are provided by other accommodation platforms (accommodation aggregatees), users can make payments within the Trivago platform. Although, this feature works only for several accommodation aggregatees. This in-platform payment feature is considered a *service composition*.

##### 6.1.1.2 *Technology domain*

Trivago collects accommodation information from various accommodation aggregatees such as accommodation platforms and hotel websites. To integrate these different websites, Trivago established its APIs, Trivago FastConnect.

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<sup>45</sup> This appendix is based on a Master’s Thesis in TU Delft undertaken by Artala (2022), supervised by Mark de Reuver and Anragama Ewa Abbas as part of the TRUSTS project.

<sup>46</sup> <https://www.trivago.com/>



Trivago FastConnect allows hotel websites and booking platform reservation systems to provide information related to the bookings directly to Trivago in a real-time manner. Trivago FastConnect enables Trivago to directly enquire about accommodation availability, live price information, and future listed room prices from hotel websites and booking platforms whenever the users make search requests (Trivago, 2021). The FastConnect enables Trivago to gain access to unique information not publicly available, like future prices of the room and room availability

In addition to FastConnect, Trivago also introduced Trivago Express Booking, an API to enable Trivago to integrate payment and transaction procedures with the corresponding accommodation aggregators (Trivago, 2021). With Trivago Express Booking, Trivago lets users finish the transaction and payment within Trivago’s site. Thus, Trivago displays and compares hotel prices and provides direct payment, thanks to the Express Booking API.

#### **6.1.1.3 Organisation domain**

Although started as an independent aggregator, Trivago was acquired by a significant accommodation aggregator, Expedia, in 2013 (Jacobs, 2012). Expedia invested 477 million euros on top of 43 million euros of common Expedia stock to further fund the development of Trivago. From this, we can classify the partnership as Dominant Aggregator owning the Aggregators. Upon the acquisition, the Trivago management team insisted they keep neutrality towards other accommodation platforms (Jacobs, 2012). However, based on the author’s experience with the platform, Trivago provides special treatment, such as direct payment, to several platforms, primarily if the corresponding platform is owned or partially owned (i.e., through investment) by Expedia.

Through FastConnect and Trivago Express Booking, Trivago partners with many accommodation aggregators, such as booking platforms, hotels, and travel agents. This helps Trivago as the Aggregators can provide unique information related to the accommodations, and Trivago helps the platforms by promoting the platforms to increase awareness, reaches and transactions (Trivago, 2021). If more internet users use Trivago to find accommodations, there will be more urgency for the booking platforms or hotel owners to collaborate with Trivago because internet users can easily find their platform through Trivago.

#### **6.1.1.4 Finance domain**

Trivago implements two advertisement payment models, CPC (Cost-per-click) and CPA (Cost-per-acquisition). CPC means the website owners pay fees according to their bid whenever users visit the websites through Trivago. While for CPA, the website owners pay fees based on the percentage of the transactions whenever a booking is made as a result of the Trivago recommendation through its platform (Trivago, 2021). Trivago receives revenues mainly from these payment models.

### **6.1.2 Scopus Business Models<sup>47</sup>**

#### **6.1.2.1 Service domain**

Scopus is a journal database aggregator that covers more than 25,000 academic titles, 210,000 books, and over 9,8 million conference papers compiled from more than 5000 publishers. Most of these publishers also operate their online channels. Scopus acts as an academic papers repository by sourcing academic papers from these publishers’ online repositories and compiling them under one location.

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<sup>47</sup> <https://www.scopus.com/home.uri>

Scopus delivers value to its target market, which are researchers, students, and organisations, through three central values: search, discover, and analyse. Users can search relevant papers from this repository, refine the search results, discover relevant papers, and assess the citations and other information related to the papers (i.e., authors, publishers, h-index, citation, publications date, publishers (Elsevier, 2020). This is mainly the core service of Scopus, which we can classify as *service aggregation*.

In addition to that, Scopus allows its users to read papers within its platform and manage references through its platform. That being the case, Scopus provides an all-in-one solution for academic publications services, ranging from paper discovery solutions, papers and references manager, publications trend and information analysis, to publications evaluator.

#### **6.1.2.2 Technology domain**

As an aggregator, Scopus sources and collects papers from various publishers operating their platform and gathers the sourced content into a single repository. Scopus sources the data through e-Feeds, e.g., PDF and XML, from the publishers' websites (Elsevier, 2020).

To provide the values as described in the previous service domain section, Scopus enables integration with other platforms and websites through Scopus's APIs. Scopus APIs enabled Scopus and other publication sites (publication aggregatees) to extract the papers' metadata from publishers' websites and platforms (Elsevier, 2021). These APIs also enable publishers to deliver the metadata of the papers to Scopus, enabling users to discover the paper through the Scopus site and platform.

The Scopus API also enabled the publications aggregatee to directly integrate digital publication files (typically in PDF format) so that users can access and read the paper directly within the Scopus site.

From the above descriptions, it can be derived that Scopus API enables Scopus to conduct service choreography and integration.

#### **6.1.2.3 Organisation domain**

Elsevier owns Scopus. Elsevier manages and develops the Scopus platform and business. Scopus collaborates with publishers to generate content (scholarly papers) on its platform. Publishers pay fees in various formats to be included in the Scopus repository. Elsevier (2020) states that through the partnership, the platform owns a content delivery agreement with publishers that authorises Scopus to store, distribute, sell and index papers from the publishers to Scopus's platform. The publishers deliver the content in the form of both digital and print formats.

Additionally, to ensure the quality of the content within the platform, Scopus works with Scopus Content and Advisory Board (CSAB). CSAB is a group of international librarians and researchers responsible for reviewing the papers sourced by Scopus (Elsevier, 2020). That being the case, Scopus maintain *aggregation with a partnership with partial collaboration*.

#### **6.1.2.4 Finance domain**

Elsevier as the owner of Scopus, maintain *financial independence* by maintaining revenues from subscriptions and books/articles sales. Users are given several choices according to their needs. Scopus offers themed journal subscriptions (access to specific research areas), comprehensive access subscriptions (full access to Scopus libraries), bundles, or pay-per-view. Scopus also offers sales of their books and papers collection through their platform (Elsevier, 2021).



### 6.1.3 Google Business Models<sup>48</sup>

#### 6.1.3.1 Service domain

Google is a platform to search and find information publicly available on the internet. Google enables users to find, show, and compare information from various websites. Google's central value is providing users with the most relevant and reliable information. Based on this, Google acts as an aggregator that gathers information from different websites and puts it in one location on Google's platform.

In Google's first establishment, the value of Google is through *service aggregation* by aggregating information in a single location or acting as a search engine. Google helps internet users find desired information or websites for a specific topic. Later, Google aggregated information and analysed it (e.g., livestock prices, currency, weather forecast, COVID-19 up-to-date data, price comparison), thus providing *composition services* to users. These composition services are gathered from various trusted sources to eliminate false information.

#### 6.1.3.2 Technology domain

To realise the core service of aggregating information to users, Google processes information from billions of web pages available on the internet. During a search query, Google performs a series of information analyses. As stated by Google (2021), this analysis includes crawling, indexing, and serving. Crawling is a process of finding webpages that exist on the internet. With the help of web crawlers, Googlebot (an automated bot that searches for new pages on the internet), Google constantly finds and visits new pages. After the page discovery process, Google starts to index the page. Indexing is analysing the page content and storing the information gathered in the Google repository. When a user requests a search query, Google will serve the information from this repository. Based on many factors, Google will rank the most relevant result to the users. For the website owners, a sitemap needs to be organised by the web admins to enable the content of the website to be reached and analysed by the Googlebot. These entire processes can be classified as *service choreography*. In the entire business process, Google acts as the only entity performing the value activities to deliver service to users.

However, besides the above explanation, Google also develops various APIs to help Aggregatees receive various benefits from the aggregation service. For example, Google Analytics Data API enables Aggregatees to provide unique information about their site (i.e., site traffic information) to Google while simultaneously enabling Google to provide metrics and reports regarding the Aggregatee website compared to other similar sites. Some API also enables Google to exchange information with Aggregatees and jointly execute several business processes (i.e., Storage Transfer API, Workflow Executions API, Network Management API). Through this API, Google also enables *service choreography* and *service integration*.

#### 6.1.3.3 Organisation domain

The company (Google LLC) is the business model developer and operator of the platform. Google is owned by Alphabet Inc, a technology conglomerate created from the restructuring of Google.

In generating the content (information and pages available from Google search results), Google does not need to collaborate with aggregatees to get authorisation or licenses to deliver the search results. This is because Google gathers publicly available information through Googlebot. Instead, most companies and website owners are competing so that their content and pages can be shown on the first page of Google search results and easily reached by Google users.

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<sup>48</sup> <https://www.google.com/>

Although Google does not need to gather information for the users, some information needs to be collected from trusted and reliable sources, i.e., the number of Covid-19 cases in a particular country. To provide trusted information, Google collaborates with various organisations, i.e., WHO, EDCD, and Governmental Bodies, by sharing information regarding the number of Covid-19 cases. An API was jointly developed between the parties to enable real-time information sharing between various organisations (Dong E et al., 2022).

Based on the above explanation, Google is adopting an aggregation with partnership collaboration in their business. We also assume that Google adopts all three partnership models in their business, depending on the information Google intends to collect. For example, Google allied with various official organisations to publish Covid-19 cases. Google also partially collaborates with, e.g., Wikipedia to publish general information on a particular topic.

#### **6.1.3.4 Finance domain**

For the Google users that use Google as a search engine platform, a free-to-use model is implemented by Google. This helps Google to gain customer and user bases. The number of users accessing Google is the platform's main competitive advantage, as Google's revenues come from Google Ads. More users visiting Google means the platform is attractive for companies to promote their products (this includes content, information, digital products, services, and physical products). Through Google Ads, companies and website owners pay fees to advertise their pages, content, and products on Google's website. Google also lets the advertisers bid specific fees to make the advertisers' content and products show in a more prominent location (such as first in Google search results, displayed on the first page, and appearing more frequently). Thus, Google maintains an *independent financial* model for not relying on any aggregatees business financial means.

### **6.1.4 Feedly Business Models<sup>49</sup>**

#### **6.1.4.1 Service domain**

Feedly is a platform that gathers online news, articles, and other forms of information (including audio and video-based information) published by various publishers such as news publishers, blogs, Medium articles, Podcast hosts, Reddit posts, Tweets, and YouTube videos into one single platform. According to Feedly (2021), as stated on its website, Feedly's primary value is its ability to collect a million of information available on the internet and narrow down the information with the most relevant information based on the user's favourite topics. Feedly uses an AI-based assistant called Leo that helps filter information and recommends articles to the user (Feedly, 2021). This feature saves users time from moving to different sites to search for news and articles.

In the company's first establishment in 2008, Feedly focused only on collecting and filtering publicly available online news and articles for users (Feedly, 2021). After more than a decade of development, Feedly also pushes news and articles, podcasts, videos, tweets, blog posts, and Reddit posts (Feedly, 2021).

Based on the above explanation, it can be seen that Feedly's core service is to collect various news and articles in one location, thus offering *aggregation service* to news readers. On top of that, Feedly also offers additional complementary features, for example, integration with Slack, auto-sharing capabilities to

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<sup>49</sup> <https://feedly.com/>

various enterprise software, and integration with various sales platforms. Therefore, Feedly offers not only service aggregation but also *service composition*.

#### **6.1.4.2 Technology domain**

Feedly pulls content from various online sources (news publishers, blogs, Medium) by grabbing RSS through Feedly Fetcher. When publishing news or articles, Feedly Fetcher will pull the headline, text, images, and other information on that RSS to Feedly's Cloud (Feedly, 2021). Feedly AI, Leo, will refine the collected RSS and push the indexed information to the user based on user preferences (Feedly, 2021). Users can then read the most relevant news and articles based on Leo's recommendation.

Feedly also gather articles and other information from other sources such as Twitter, Reddit, YouTube, Medium, and other podcast hosts. Feedly Fetcher cannot pull this information directly from the sites, as most of this information is not published in RSS. According to Feedly (2021). The Feedly Fetcher enables Feedly to realise *service orchestration*.

Feedly implements API integration with YouTube, Twitter, Reddit, and some podcast sites. Through the Feedly API, this integration enables Feedly to pull information from these websites if the users grant access to integrate their account, enabling the sites to provide information and data to Feedly. Through this, Feedly can provide services such as displaying YouTube videos, enabling users to post on Reddit, and tweeting within the Feedly site. These services cannot be enabled if Feedly depends only on its information crawler (Feedly Fetcher). The API enables Feedly to realise *service choreography*.

#### **6.1.4.3 Organisation domain**

In gathering publicly available online articles, there is no formal arrangement between Feedly and news providers in delivering the content to the platform. Most news articles from the mainstream media and blogs use RSS format to publish their content. Thus, Feedly can always pull the content directly without any arrangement between parties, with the help of Feedly Fetcher. Therefore, for most online articles, Feedly implements *aggregation without a partnership* relationship with aggregatees.

In pulling other forms of content, such as YouTube videos, Reddit posts, Tweets, and podcasts, Feedly has to collaborate with these content providers to provide users with these non-article content. It is because some content might not be available publicly (i.e., protected tweet, exclusive Reddit thread) or the format of the content itself cannot be extracted easily like RSS (e.g., YouTube videos, podcast audio file). Thus, Feedly forms an aggregation partnership to extract these contents to the platform.

Through Feedly official blog posts, Feedly announces its integration with Reddit, YouTube, and Twitter (Feedly, 2021) so that Feedly users can use the same services from these platforms within the Feedly platform (i.e., watching YouTube videos through Feedly, posting tweets from Feedly, read Reddit thread from Feedly). Based on this, it can be assumed that *Feedly establishes aggregation with partnership in partial collaboration* with its content providers (content aggregatees). The content providers benefited from having more reach, readers, and visits as a promotion from Feedly. The more news providers, the more Feedly attract users, thus increasing the network effects.

#### **6.1.4.4 Finance domain**

Feedly gains revenues from premium subscriptions in Pro, Pro+, and Enterprise subscriptions. The Pro and Pro+ are intended for individuals and professionals that want to utilise Feedly features fully. The Enterprise subscriptions are targeted at companies and developers that also want to utilise Feedly API. Feedly also offers a freemium membership that offers the same benefit as the Pro subscriptions but with fewer articles sources and integration with other platforms. The free version users will also periodically receive ads on

the platform. Feedly receives revenues from these Ads. The content providers receive no direct monetary benefit from Feedly, but receive more readers, reaches, and brand awareness from Feedly, therefore, more revenues for the content providers. Feedly aggregatees did not invest, thus Feedly maintaining financial independence.

### 6.1.5 Kimo Business Models<sup>50</sup>

#### 6.1.5.1 Service domain

Kimo is an online learning platform that gathers various online learning materials and courses from various sites, such as YouTube, Coursera, Udemy, and Medium articles. Kimo currently offers computer science-related subjects such as AI, Blockchain, Cybersecurity and Cloud Computing. The users will select the desired topic based on prior subjects, and then the platform will help to refine the search results and find the most relevant courses. Users will then be redirected to the website offering the selected courses. If the user decides to watch a YouTube video course, Kimo allows users to watch YouTube platform within the platform. Kimo also offers the user a direction on where to start studying a particular subject and recommends the next study materials. In the case of Kimo, the core service of the business still lies only in gathering online learning materials, thus only providing *service aggregation*.

#### 6.1.5.2 Technology domain

In gathering the metadata of the courses from other online learning courses, Kimo crawls free online learning content from various sites (Kimo, 2021). As Kimo provides customised recommendations based on user behaviour (AI Mentor), Kimo also uses AI to automate finding the most relevant courses (Kimo, 2021). This process can be regarded as *service orchestration*.

#### 6.1.5.3 Organisation domain

Since the company is still new, limited information explicitly mentions Kimo's collaboration with another platform owner. However, from the technology domain, where Kimo relies on its AI and crawler to aggregate online learning materials, it can be assumed that no partnership is established with Aggregatees. Most of the online learning materials Kimo collect are also publicly available online; thus, no prior partnership is needed to collect these materials (*aggregation without partnership*)

#### 6.1.5.4 Finance Domain

The platform is still in early development. Users pay no fees to gain full features of the platform.

### 6.1.6 Flipboard Business Models

#### 6.1.6.1 Service domain

Flipboard is a news-publishing platform that gathers online news and articles from various news sources covering a wide range of content, from technology, business, social issues, and travel, to lifestyle (Flipboard, 2021). Flipboard's differentiation from other similar news platform is the platform UI/UX that mimic the experience of reading a magazine. As in magazines, Flipboard helps users go through different articles and sources based on the user's behaviour on the platform, reducing the user's time to find other

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<sup>50</sup> <https://www.kimo.ai/>

articles on the same topic. Other feature includes articles re-sharing through social media. As the co-founder and CEO of Flipboard, Mike McCue, stated, he envisioned one place to bring together users' favourite news sources (Flipboard, 2021). Thus Flipboard's offering is *service aggregation* for news and articles.

#### **6.1.6.2 Technology domain**

Flipboard uses Flipboard API to integrate the Flipboard platform with the publisher's platform. This API enables Flipboard to extract metadata and the RSS of the articles from the publishers to the Flipboard platform while simultaneously enabling publishers to manage their articles directly through the Flipboard platform, i.e., managing publication schedules and formats (Flipboard, 2021). Unlike any other news portal, Flipboard only extracts the RSS of submitted articles from its partners while neglecting the unsubmitted articles; thus, Flipboard partners play an active role in also delivering news and articles through Flipboard API. With this API, Flipboard enables *service choreography* and service integration with its publishers and partners.

#### **6.1.6.3 Organisation domain**

According to Flipboard (2021), Flipboard only publishes and displays articles if the corresponding publishing partners submit the articles. Although if the publishers might publish an article through a different platform and this article was not submitted to Flipboard, Flipboard will not publish the article. As stated in its Q&A section, to become a Flipboard partner, the publisher must first apply to Flipboard. A specific qualification must be met until Flipboard allows the publisher to submit its articles. Articles submitted by partners will also be checked upon publication. Albeit complicated publishing procedure, Flipboard maintain neutrality by providing no fees to any publishers. Through this, Flipboard establishes *aggregation with a partnership* with its aggregatees and maintains *equal collaboration*.

#### **6.1.6.4 Finance domain**

From news readers to publishers, Flipboard users can use all of the features for free. When using Flipboard, the platform will constantly display Ads within the platform. We believe that it is how Flipboard gathers revenue and finances its operation. Additionally, Flipboard offers a monthly membership to remove the Ads on the platform.

### **6.1.7 DiscoverCars Business Models<sup>51</sup>**

#### **6.1.7.1 Service domain**

Discover Cars is a platform that helps users find and compare car-rental deals from various online car-rental websites available in more than 145 countries (Discover Cars, 2021). Discover cars mainly provide *aggregation services* for the car rental industry. The platform shows the available cars provided by online car rental websites in a specific region and recommends the lowest to highest prices for users. Discover Cars provides price, car type, pick-up location, provider reviews, and insurance coverage. For transactions and payment matters, when users decide to book a car, the platform will provide a link to visit the respective provider's site and proceed to payment on that site.

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<sup>51</sup> <https://www.discovercars.com/>

#### **6.1.7.2 Technology domain**

Discover Cars develops its API to exchange information related to the car rental procedure. The API integration allows Discover Cars to pull real-time information directly from the providers' site and enables the car providers to directly receive booking from the Discover Cars site. (Discover Cars, 2021; TravelPayouts, 2021). Information regarding the rented cars, for example, related to car availability, is not typically published online by car rental aggregators. At the same time, car availability is crucial information for the user. Thus, the API of DiscoverCars lets car rental owners provide real-time information regarding car availability.

#### **6.1.7.3 Organisation Domain**

Discover Car Hire LTD is the company that owns and manages the platform. The company collaborates with many online car rental providers through affiliate programs to provide users with car rentals. The affiliates will get free access to DiscoverCars API and integration with DiscoverCars API. DiscoverCars also helps existing, and future car rental owners create and publish their rental websites.

#### **6.1.7.4 Finance domain**

From using the platform until proceeding to payment, the renters pay no fees to Discover Cars. The online car rental providers also pay no fees for using the service offered by Discover Cars (API, Affiliates features, Promotional Program). However, when a payment from the user is finalised, the rental car providers will receive a 30% commission from the transaction's profits, and the platform will receive a 70% commission (Discover Cars, 2021).

### **6.1.8 Yidio Business Models<sup>52</sup>**

#### **6.1.8.1 Service domain**

Yidio is a movie-streaming site that recommends users watch movies, tv-series, cartoons, and tv-shows from mainstream streaming sites like Hulu, Netflix, Apple TV and Amazon Prime. Yidio pulls information from over 180 content providers worldwide (Yidio, 2021). In the current movie industry, most movies are either shown on limited platforms or, in many cases, only on one platform. Yidio reduces the time needed for users to find sites to watch movies by helping the users discover the site to watch the desired movies. Yidio will then redirect the user to the respective movie site. Yidio also displays the price of subscriptions (if a subscription-only platform shows the movie) and the price to rent/buy the movie from various movie streaming platforms.

#### **6.1.8.2 Technology domain**

Using its Bot, Yidio extensively monitors various mainstream streaming (information crawling) and provides updated recommendations based on user's preferences and behaviour (watchlists, watch history). Yidio extensively pulls content information from various streaming sites and puts it in the cloud. Yidio will then push the information to the users (Yidio, 2021). To watch the selected movies, because no API enables users to watch movies within the Yidio platform, users will still be redirected to the respective site via a link provided by Yidio.

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<sup>52</sup> <https://www.yidio.com/>



### **6.1.8.3 Organisation domain**

Yidio has no affiliation with other mainstream streaming platforms. As Yidio relies only on the platform Bots and crawling information mechanisms, Yidio needs no formal arrangement or collaboration with other streaming platforms to offer its services to users. However, there is a collaboration between Yidio and several mainstream streaming platforms, although this collaboration is limited to letting the platform place Ads or marketing campaigns via the Yidio website (Yidio, 2021). Based on our observation, Yidio does not distinguish its results between Yidio's marketing partners and non-partners, i.e., putting the partner's movie on top of the non-partners movie, thus no special treatment concerning the aggregation service towards its aggregatees. That being the case, Yidio keeps its neutrality towards its aggregatees and maintains *no partnership* regarding information collection and service aggregation.

### **6.1.8.4 Finance domain**

Users who access Yidio can gain full platform features by paying monthly membership fees. The content providers whose content is shown on the Yidio platform pay no fees. However, the content providers can opt to promote their sites through the Yidio platform, and Yidio will receive this as an Ads fee (Yidio, 2021). At the moment, no investment was placed by any of Yidio's aggregatees.

## **6.1.9 PriceGrabber Business Models**

### **6.1.9.1 Service domain**

PriceGrabber mainly focuses on its *aggregation service* towards online retailers. PriceGrabber is a shopping website that compares prices of particular products from different sites. PriceGrabber lets users type the desired product name from the search bar, and PriceGrabber will index the search results and shows the results by sorting them from the lowest price to the highest price, thus reducing the time needed for users to visit different sites to compare price. PriceGrabber shows a product compilation from various sites and provides information such as price, availability, and a short brief about the product specification. Users who opt to buy the product can visit the respective (aggregatees' site) through the provided link. Payment will also be made through the aggregatees website.

### **6.1.9.2 Technology domain**

PriceGrabber uses API integration, called the Catalog API, with its site's affiliates so that PriceGrabber can exchange real-time information to keep updated with the price and availability of a particular product on specific sites (Connexity, 2021). The Catalog API also enables PriceGrabber affiliates to access and send information related to the product. These could be by accessing sales metrics from PriceGrabber and providing product availability information to PriceGrabber. Affiliates can also use this API to create shopping sites and integrate them with the PriceGrabber website (Connexity, 2021).

### **6.1.9.3 Organisation domain**

Connexity is the owner and platform administrator of PriceGrabber. To receive the benefit of product promotion and product reach from the PriceGrabber platform, a merchant has to register as an affiliate with Connexity. Connexity called this affiliation Connexity Publishers Program, intended as a collaboration program for shopping site owners, store owners, or companies who want to integrate their sites with Connexity. This program gives affiliates access to Connexity Catalog API to exchange information between affiliates, including the PriceGrabber site (Connexity, 2021).



#### **6.1.9.4 Finance domain**

Users pay zero fees to access the platform. Merchants can join Connexity Publishers Program without fees, but they may opt to pay fees in the form of Ads to increase their reach in the search results. Connexity also gets money from ads and promotions for companies who want to advertise on the platform (Connexity, 2021).

### **6.1.10 LinkedIn Business Models<sup>53</sup>**

#### **6.1.10.1 Service domain**

LinkedIn is a social media platform focusing on professional networking and job searching. In this study, we would like take focus more on the job-searching services provided by LinkedIn. As a job-searching platform, LinkedIn provides users with various job listings published by various organisations through their job portal sites and other job-seeking platforms. Jobseekers can find relevant information regarding the position within the LinkedIn platform without having to leave the LinkedIn platform. For recruiters, the job application process can be done both inside and outside LinkedIn, depending on the recruiters' intended process.

#### **6.1.10.2 Technology domain**

LinkedIn collects job listings from other companies' sites and platforms through its API and collects the gathered data into the LinkedIn database. LinkedIn APIs enable this. Recruiters can post available position information while promoting the position's listing to LinkedIn through LinkedIn API. The API also enabled LinkedIn to show the same job listing information as other companies' sites or platforms (LinkedIn, 2021). For companies that opt not to integrate their platform with LinkedIn, LinkedIn will provide a link so that the users will be redirected to the respective company's sites.

#### **6.1.10.3 Organisation domain**

The company (LinkedIn Corporation) is the business model developer and operator of the platform. A company that wants to put a job-listings through LinkedIn can partner with LinkedIn by registering the company in LinkedIn and posting the job listings to LinkedIn through the API. In addition to that, LinkedIn provides LinkedIn Developer Solutions. With this program, companies who opt to integrate their platform with LinkedIn can exchange information through LinkedIn API. This includes a feature enabling recruiters to conduct the job application process through LinkedIn (LinkedIn, 2021).

#### **6.1.10.4 Finance domain**

Ads and promotion fees are the main revenues of LinkedIn. LinkedIn also has three different premium memberships that also contribute to LinkedIn fees. These memberships target three market segments: job hunters, talent hunters, and business people for networking purposes (LinkedIn, 2021). Users can use LinkedIn without paying fees, but there will be a feature limitation.

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<sup>53</sup> <https://www.linkedin.com/>

### 6.1.11 Carvago Business Models<sup>54</sup>

#### 6.1.11.1 Service domain

Carvago is a second-hand car sales aggregator. Carvago provides an all-in-one solution to buying second-hand cars. Its core service is to aggregate second-hand sales from various second-hand car sites (*service aggregation*) while also adding complementary benefits such as car inspection facilities, 6-month post-purchase insurances, and car delivery across the European region (*service composition*). Carvago acts as an advisor that represents the car buyers during the entire buying process with various car-sales owner. Buyers will first choose a specified type of car through the platform. After a selection, Carvago will recommend the buyer to various car sales sites and dealers that sell the selected car. Upon selecting the preferred dealers, Carvago will represent the buyer to visit the dealer, check the car's condition, and deliver the car to the buyer if several condition criteria are met.

#### 6.1.11.2 Technology domain

Carvago collects over 7 million ads from various car dealers but only publishes nearly 10% for the purchase. Although not mentioned clearly in the platform, it seems that Carvago uses information crawlers to gather car sales information. It is because the information published between different dealers' Ads is displayed differently, and some information is also missing, although within the same car.

#### 6.1.11.3 Organisation domain

Although Carvago specifically mentioned that Carvago only lists cars from tried and tested dealers, no prior partnership was arranged between Carvago and car dealers. Listed car dealers also receive no particular benefit from Carvago, especially towards the aggregation service of Carvago. Based on our observation, Carvago based its recommendation on price, year, and mileage. No ads from particular car dealers were also treated differently by Carvago. Thus, towards its aggregatees (car dealers), Carvago maintains neutrality.

#### 6.1.11.4 Finance domain

A buyer can access the platform freely when searching for a car on the platform. However, payment will be made after the purchase. Additionally, Carvago provides various complementary offerings, such as insurance and car inspection, in exchange for a fee. Carvago also receives no monetary benefit from car dealers.

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<sup>54</sup> <https://carvago.com/>

## 6.2 Appendix II — The Interview Protocol

This Appendix discusses the interview protocol with 31 participants to explore the business model of TRUSTS.

### 1. Opening segment

Questions about background information.

- **Question 1:** What position do you hold in this company now, and for how long have you been in this position?
- **Question 2:** Could you please tell me briefly the nature of your job?
- **Question 3:** How familiar is your organisation with business-to-business data sharing? Has your organisation known, experienced, or thought about it?
  - *[if yes, probe for]* Could you explain how your company conducts B2B data sharing?
  - *[if yes, probe for]* What is your role in decision-making about B2B data sharing?
- **Question 4:** Could you please briefly tell me about your experience in data marketplaces?

### 2. Middle segment

Questions about exploring potential value propositions and hindrances of business data sharing via a meta-platform for data marketplaces.

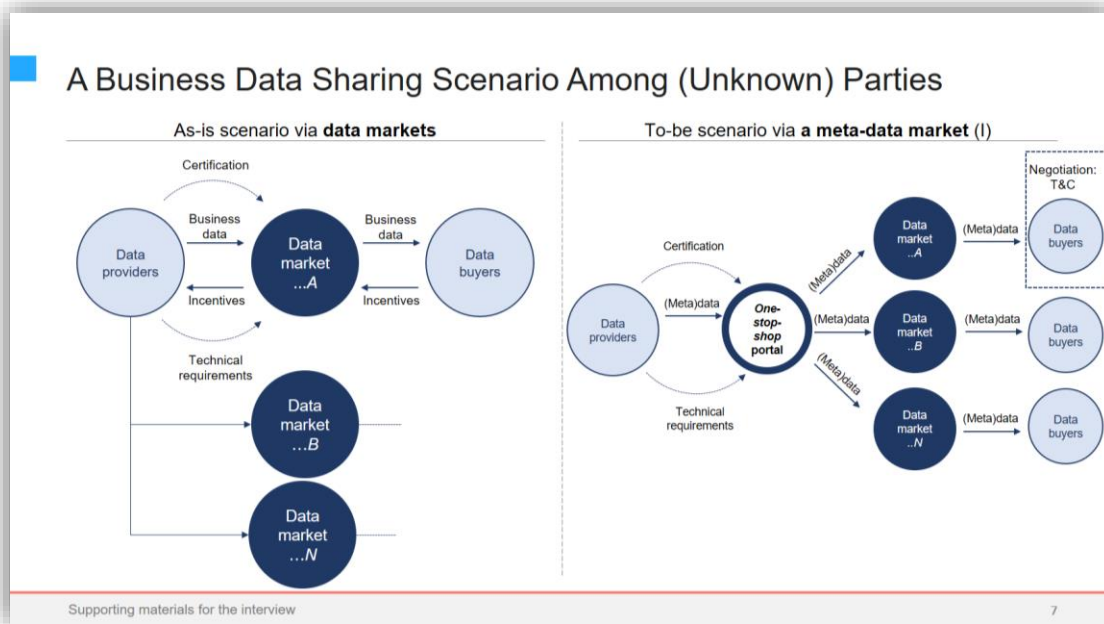


Figure 37. To-be business data sharing scenario via a meta-platform for data marketplaces

- **Question 5:** Do you have any questions related to the use case of a meta-platform for data marketplaces?
- **Question 6:** To what extent do you think a meta-platform for data marketplaces can facilitate B2B data sharing among organisations?
  - *[for greater extent, probe for]* Could you explain the reasons why it is the case?

- *[for less extent, probe for]* Could you explain why business data sharing via a meta-platform for data markets may not work?

## 6.3 Appendix III — The Workshop Protocol

Appendix 5 describes the workshop protocol (refer to section 2.2.2) to discuss intermediate findings found during the interviews, focusing on the business models of federation aspects.

### Workshop Agenda

1. TUD to host and facilitate the workshop. Welcome and meeting objectives. (5 minutes).
2. NOVA present the base business model.
3. TUD to present Miroboard 1 (created by SWC) and lead the discussion about the base business model (~25 minutes):
  - All participants are to provide feedback on the proposed base business model and indicate whether they have ideas for additional base business model components. The participants write their feedback directly on the Miroboard. Afterwards, this feedback will be discussed with all participants.
4. TUD to present Miroboard 2 and 3 (created by SWC) and lead the discussion about the business models that we have been discussing in WP7 and with the UC partners (~25 minutes):
  - All participants are to provide feedback on the proposed add-on business model and indicate whether they have ideas for additional add-on business model components. The participants write their feedback directly on the Miroboard. Afterwards, this feedback will be discussed with all participants.
5. TUD to present ideas for the federation business models, as an ‘outlook to the future, beyond the TRUSTS project (15 min.)’
  - All participants are to provide feedback on the Mentimeter
6. TUD to summarise the session’s outcomes to the workshop participants and outlook for the next steps (e.g., deliverable) (5 min.)

## 6.4 Appendix IV — Mock-up Evaluations

Appendix IV presents mock-up evaluation processes and key improvements for the mock-up usability aspects.

Table 13. Four evaluation cycles

No	Date	Setting	Goal
1	28-04-2022	24 MSc students in a hybrid class setting	We wanted to check whether participants recognised the two illustrative features of a meta-platform (certification and b) smart contract). Moreover, we wanted to get early feedback on usability aspects.
2	13-05-2022	6 PhD students in an in-person workshop	We wanted to further discuss the usability aspects in detail.
3	01-06-2022	39 practitioners working on a meta-platform for data marketplaces in an in-person workshop	We wanted to focus on discussing certification and smart contracts.
4	23-09-2022	17 (combined PhD and MSc) students in a self-paced testing	We wanted to assess the feasibility of conducting future empirical research by employing the developed porotype.

## 6.5 Appendix V — Questionnaire

### Informed consent

Welcome to our study!

You are invited to participate in a research study entitled Designing Governance Mechanisms for a Meta-Platform for Data Marketplaces: Ensuring Data Sovereignty in Sharing Sensitive Data. This study is being done by Antragama Ewa Abbas from the TU Delft, funded by the European Union’s Horizon 2020 Research and Innovation Programme, under Grant Agreement no 871481 – Trusted Secure Data Sharing Space (TRUSTS).

This research aims to evaluate the implementation of governance mechanisms for sharing sensitive data through a meta-platform for data marketplaces. We will ask you to a) watch a video, b) explore a prototype, and c) complete a post-test survey to share your experience. It will take approximately 45 minutes to complete the overall activities. You can only participate in this study by using your Desktop. The data will be used for PhD thesis, academic publications, [TRUSTS deliverables](#), and teaching activities.

Your answers in this study will remain confidential. We will minimise any risks by performing a completely anonymous survey. The raw, anonymous data will be archived in 4TU.ResearchData so it can be used for future research and learning (under the license of CC BY 4.0). It is not possible to pause the survey and return to it later, so we ask that you complete it in one attempt.

Participation in this study is entirely voluntary, and you can withdraw anytime. For any further inquiries, please contact [A.E.Abbas@tudelft.nl](mailto:A.E.Abbas@tudelft.nl)

- ☐ I consent, begin the study
- ☐ I do not consent, I do not wish to participate

Prolific ID What is your Prolific ID?

### Case description: video

Case Description: Sharing Sensitive Data Through a Meta-Platform for Data Marketplaces. Please watch this video to understand the case description: <https://youtu.be/9b7iKM3BiMs>

- ☐ Please click here to indicate that you understand the instruction

Based on the video explanation, please answer the following questions:

What is the key concept used in this research?

- ☐ A meta-platform for data marketplaces
- ☐ An interoperable data platform
- ☐ A federated data space

What is your role in this research?



- ☐ Data marketplace operator
- ☐ Third-party provider
- ☐ Data provider
- ☐ Data consumer

What are the sensitive data that you would share?

- ☐ Covid-19 trends
- ☐ Call Detail Records (CDRs)
- ☐ Climate change data

You will explore a prototype of a meta-platform for data marketplaces  
Open the prototype link and follow the task instructions: [here.](#)

Notes: you do not need any credentials to explore the prototype.

- ☐ Please click here if you have finished all the tasks

Please indicate whether you disagree or agree with the following statements. There are no wrong or correct answers. You can also go back to the prototype if you need more time for exploration.

	Strongly disagree	Somewh at disagree	Neither agree nor disagree	Somewh at agree	Strongly agree
I believe the meta-platform allows me to define relevant use cases for the sensitive data that I would share	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I believe the meta-platform allows me to define appropriate terms of use for the sensitive data that I would share, including data access and usage policies	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I believe the meta-platform allows me to decide monetary incentives (i.e., how much money to ask) for the sensitive data that I would share	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I believe the meta-platform allows me to decide the type of sensitive data that I would share	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
I believe the meta-platform provides me with sufficient information to avoid violating laws and regulations for sharing sensitive data	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I believe the meta-platform helps me to understand the content of laws and regulations for sharing sensitive data	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I believe the meta-platform provides me with procedures to respond to laws and regulations for sharing sensitive data	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I believe the meta-platform provides me with dispute mechanisms to handle conflicts (if any, with data consumers) about the sensitive data that I would share	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
I believe the meta-platform has adequate mechanisms to protect the sensitive data that I would share from being misused or stolen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I believe the security features implemented by the meta-platform are up-to-date	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
I believe the meta-platform operator is entirely committed to security protection	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I believe I can technically enforce data access and usage policies for the sensitive data that I would share through the meta-platform	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I believe I can track down the history of data access and usage for the sensitive data that I would share through the meta-platform	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I believe I can control where the shared sensitive data can be stored (i.e., on the meta-platform, on my own infrastructure, or on the data consumer infrastructure)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I believe I can easily withdraw the (description of) sensitive data from the meta-platform after sharing it	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Strongly disagree	Somewh at disagree	Neither agree nor disagree	Somewh at agree	Strongly agree
I believe the meta-platform has a clear role in facilitating sensitive data sharing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I believe the meta-platform enables me to select trustworthy participating data marketplaces to share the sensitive data	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I believe that the meta-platform takes responsibility if the sensitive data that I would share is misused or stolen.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Attention check This is an attention check. The colour test you are about to take part in is very simple. When asked for your favourite colour, you must choose "green." Based on the text you read above, what colour have you been asked to enter?

- ☐ Green
- ☐ Black
- ☐ Red
- ☐ Yellow
- ☐ White

	Strongly disagree	Somewh at disagree	Neither agree nor disagree	Somewh at agree	Strongly agree
I believe I own the sensitive data that I would share through the meta-platform	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I believe I have ownership rights over the sensitive data that I would share through the meta-platform	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I believe the data sharing agreement with other companies (i.e., data consumers) generated by the meta-platform is legally valid	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I believe I can control who can access the sensitive data that I would share through the meta-platform	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I believe I can control how data consumers use the sensitive data that I would share through the meta-platform	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Overall, I believe that sharing sensitive data through the meta-platform is safe (10)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



	Strongly disagree	Somewh at disagree	Neither agree nor disagree	Somewh at agree	Strongly agree
I expect that the meta-platform operator provides services to facilitate sharing sensitive data in my best interest	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I expect that the meta-platform operator provides access to genuine services for sharing sensitive data	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I expect that the meta-platform operator will be trustworthy in handling the description of sensitive data provided by me	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Strongly disagree	Somewh at disagree	Neither agree nor disagree	Somewh at agree	Strongly agree
I expect that data consumers will fulfil data sharing agreements to use the sensitive data that they obtain through the meta-platform	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I expect that data consumers will be honest when handling the sensitive data that they obtain through the meta-platform	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I expect that data consumers will be trustworthy in handling the sensitive data that they obtain through the meta-platform	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Strongly disagree	Somewh at disagree	Neither agree nor disagree	Somewh at agree	Strongly agree
I feel that sharing sensitive data through the meta-platform is risky	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
There will be uncertainty associated with sharing sensitive data through this meta-platform	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel that sharing sensitive data through the meta-platform will negatively affect me	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Strongly disagree	Somewh at disagree	Neither agree nor disagree	Somewh at agree	Strongly agree
I intend to share sensitive data through this meta-platform	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I predict that I will share sensitive data through this meta-platform in the future	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is likely that I will share sensitive data through this meta-platform in the near future	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Attention check 2 This is another attention check.

	Strongly disagree	Disagree	Agree	Strongly agree
I swim across the Atlantic Ocean to get to work every day	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Finally, we will ask you some questions concerning your background. In this part, please fill out the questionnaire according to your role in real life.

What is your AGE (in YEARS)? E.g., 28

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What is your gender?

- ☐ Male
- ☐ Female
- ☐ Non-binary
- ☐ Prefer not to disclose
- ☐ Prefer to self-describe:...

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In which country do you currently reside?

▼Afghanistan (1) ... Zimbabwe (1357)

What is the highest level of school you have completed or the highest degree you have received?

- ☐ Less than high school degree
- ☐ High school graduate (high school diploma or equivalent including GED)
- ☐ Some college but no degree
- ☐ Associate degree in college (2-year)
- ☐ Bachelor's degree in college (3- to 4 years)
- ☐ Master's degree
- ☐ Doctoral degree (Ph.D.)

What best describes your employment status over the last three months?

- ☐ Working full-time
- ☐ Working part-time
- ☐ Unemployed and looking for work
- ☐ A homemaker or stay-at-home parent
- ☐ Student
- ☐ Retired
- ☐ Other

Which of the following industries best describes the sector you are or were primarily working in?

- ☐ Agriculture, Food and Natural Resources
- ☐ Architecture and Construction
- ☐ Arts
- ☐ Business Management & Administration
- ☐ Education & Training
- ☐ Finance
- ☐ Government & Public Administration
- ☐ Medicine
- ☐ Hospitality & Tourism
- ☐ Information Technology
- ☐ Legal

- ☐ Policing
- ☐ Military
- ☐ Manufacturing
- ☐ Marketing & Sales
- ☐ Retail
- ☐ Science, Technology, Engineering & Mathematics
- ☐ Social Sciences
- ☐ Transportation, Distribution & Logistics
- ☐ Others, please describe here: \_\_\_\_\_
- ☐ Rather not say



Which of the following best describes your role at work?

- ☐ Upper Management
- ☐ Trained Professional
- ☐ Middle Management
- ☐ Skilled Labourer
- ☐ Junior Management
- ☐ Consultant
- ☐ Administrative Staff
- ☐ Temporary Employee
- ☐ Support Staff
- ☐ Researcher
- ☐ Student
- ☐ Self-employed/Partner

How many employees work in your organisation?

- ☐ 1-9
- ☐ 10-49
- ☐ 50-249
- ☐ More than 250

**In a real situation,** how familiar is your organisation with sharing sensitive data with other organisations (e.g., through inter-organisational information exchange, data marketplaces, etc.)?\*

- ☐ Not at all familiar
- ☐ Not so familiar (we thought or planned to do so but never actually shared sensitive data)
- ☐ Somewhat familiar (we occasionally engage in sharing sensitive data on a case-by-case basis)
- ☐ Very familiar (we share sensitive data based on pre-planned agreements)

In a real situation, does your organisation have any experience in sharing sensitive data through data marketplaces?

- ☐ Yes, our organisation has shared sensitive data through data marketplaces multiple times
- ☐ Yes, our organisation has shared sensitive data through data marketplaces once
- ☐ We know what data marketplaces are, but we have never shared sensitive data through (one of) them
- ☐ Before this survey, we had never heard of data marketplaces

Please indicate whether you disagree or agree with the following statements.

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
I generally trust other people	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I generally feel that people are reliable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I generally trust other people unless they give me a reason not to	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
Outside of this experiment, my organisation is usually willing to take risks	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Outside of this experiment, my organisation usually views risks as a challenge	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Outside of this experiment, my organisation's senior managers are willing to take risks	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Do you have any other comments and suggestions? If so, could you please write them down here?

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Thank you for taking part in this study. Please click the button below to redirect back to Prolific and register your submission.

## 6.6 Appendix VI — The Updated Measurement

Latent variable	Indicator	Question
Data sovereignty	DS_G	I believe the meta-platform enables sovereignty for the sensitive data that I would share.
Compliance	C_1	I believe the meta-platform enables me to comply with relevant laws and regulations for sharing sensitive data.
	C_2	If I would share sensitive data, I believe the meta-platform... - ...provides me with sufficient information to avoid violating laws and regulations.
	C_3	- ...enables me to understand the content of laws and regulations.
	C_4	- ... provides me with procedures to respond to laws and regulations.
	C_5	- ...provides me with dispute mechanisms to handle potential conflicts with data consumers.
Data Control	DC_1	I believe the meta-platform enables me to control the sensitive data that I would share.
	DC_2	If I would share sensitive data, I believe the meta-platform... - ...offers me technical means to enforce data usage policies.
	DC_3	- ...enables me to track down the history of data usage.
	DC_4	- ...enables me to decide where the shared sensitive data can be stored (i.e., on the meta-platform, on my own infrastructure, or on the data consumer infrastructure).
	DC_5	- ...enables me to easily withdraw the description of sensitive data from the meta-platform after sharing it.
Data ownership	DO_1	I believe the meta-platform enables me to... - ...define appropriate terms of use for the sensitive data that I would share.
	DO_2	- ...define how much money I receive for the sensitive data that I would share.
	DO_3	- ...decide about the type of sensitive data that I would share.
	DO_4	- ...decide which data marketplace receives the description of the sensitive data that I would share.
Disposition to Trust	DT_1	In a new business relationship, I have to be careful until I see the evidence of a firm's trustworthiness
	DT_2	I remain cautious with new business partners until they prove that they are trustworthy
	DT_3	I feel nervous about a business deal unless both parties sign a formal written agreement
Perceived Risk	PR_1	I feel that sharing sensitive data through the meta-platform is risky.
	PR_2	There will be uncertainty associated with sharing sensitive data through this meta-platform.
	PR_3	I feel that sharing sensitive data through the meta-platform will negatively affect me.
Risk Propensity	RP_1	Outside of this experiment, my organisation is usually willing to take risks.
	RP_2	Outside of this experiment, my organisation usually views risks as a challenge.
	RP_3	My organisation's senior managers are willing to take risks.
Responsibility	R_1	I believe the meta-platform...

Latent variable	Indicator	Question
		- takes responsibility for supporting data providers.
	R_2	- ...responsibly selects data marketplace participants that adhere to data exchange standards.
	R_3	- ...clearly divides responsibilities between the meta-platform and the data marketplace participants.
	R_4	- ...takes responsibility if the sensitive data that I would share is misused or stolen.
Security	S_1	I believe the meta-platform... - enables me to securely share my sensitive data.
	S_2	- ... prevents the disclosure of my sensitive data that I would share to unauthorised parties.
	S_3	- ...prevents the alteration of my sensitive data that I would share by unauthorised parties.
	S_4	- ...enables me to execute data-sharing transactions without system failures.
	S_5	- ...implements up-to-date security features.
Trust in Data Consumer	TDC_1	I expect that the meta-platform operator provides services to facilitate sharing sensitive data in my best interest.
	TDC_2	I expect that the meta-platform operator provides access to genuine services for sharing sensitive data.
	TDC_3	I expect that the meta-platform operator will be trustworthy in handling the description of sensitive data provided by me.
Trust in Operator	TO_1	I expect that data consumers will fulfil data sharing agreements to use the sensitive data that they obtain through the meta-platform.
	TO_2	I expect that data consumers will be honest when handling the sensitive data that they obtain through the meta-platform.
	TO_3	I expect that data consumers will be trustworthy in handling the sensitive data that they obtain through the meta-platform.
Willingness to Share Data	WTSD_1	I intend to share sensitive data through this meta-platform
	WTSD_2	I predict that I will share sensitive data through this meta-platform in the future
	WTSD_3	It is likely that I will share sensitive data through this meta-platform in the near future