TRUSTS
Trusted Secure Data Sharing Space

D7.8 Business plan and Implementation action plan II

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TRUSTS Trusted Secure Data Sharing Space

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Glossary of terms and abbreviations used

Abbreviation / Term	Description
AGPL	Affero General License
AI	Artificial Intelligence
API(s)	Application Programming Interface
CA	Consortium Agreement
CAPEX	Capital expenditures
CC	Creative Commons
CCPA	California Consumer Privacy Act
CKAN	Comprehensive Knowledge Archive Network
CRM	Customer Relationship Management
EOSC	European Open Science Cloud
EU	European Union
GA	Grant Agreement
GAIA-X	Project for the development of an efficient and competitive, secure, and trustworthy federation of data infrastructure and service providers for Europe, which is supported by representatives of business, science and administration from Germany and France, together with other European partners.
GDPR	General Data Protection Regulation
GPL	General Public License
IDSA	International Data Spaces Association
IoT	Internet of Things
IP	Intellectual Protection
IPR	Intellectual property Rights
KER	Key Exploitable Results
LGPL	Lesser General Public License
MIT	Massachusetts Institute of Technology
ML	Machine Learning
MSMBs	Micro and Small & Medium Business (es)

OTT	Over the top
PIMS	Personal Information Management Systems
SMEs	Small Medium Business (s)
TRL	Technology readiness level
TRUSTS	Trusted Secure Data Sharing Space
UC	Use Case
USA	United States of America

Executive Summary

This document details the final market assessment of the TRUSTS Secure Data Sharing Space (TRUSTS) solution, and it is an evolution of the initial market assessment (D7.7) that was submitted in month 18. It aims at summing up the initial analysis that was developed, including:

- additional elements of demand characterization,
- details regarding the go-to-market of relevant competitors,
- market prices and pricing structure,
- and joint exploitation perceptions gathered from the Consortium Partner’s discussions.

This deliverable arises from Task 7.5 “Commercialization initiatives and action plan” of the Work Package 7 “Business Model, Exploitation & Innovation Impact Assurance” of the Trusted Secure Data Sharing Space (TRUSTS) project.

In commercialization, the business model designed in Task 7.1 “Sustainable Business Models”, has assisted the TRUSTS project in defining a strategic plan of action to ensure the sustainability and financial viability of the project. The goal of Task 7.5 has been to explore and define the strategy for bringing TRUSTS to the market. Additionally, it has also developed a pricing model intended for the use of the TRUSTS services and a remuneration model for partners contributing technology to the TRUSTS services.

This task has carried out a technology watch to identify potential competitors to TRUSTS entering the market. Finally, a business plan for the TRUSTS services, the cloud hosting and operations of the TRUSTS Professional Partners Community has been created, to ensure sustainability and financial viability after the end of the project.

In summary, the objective of this deliverable is to describe the strategy of the TRUSTS consortium to transform the platform into a sustainable ecosystem, and it includes the presentation of the TRUSTS evolving business plan (incl. business target, services, pricing, costs, remuneration of partners, etc.).

In essence, the goal of this report is to analyze how TRUSTS platform can successfully enter the European market and achieve profitability, while overcoming potential limitations.

1 Introduction

This deliverable (D7.8 Business plan and Implementation plan II) consists of a final market assessment that represents our final conclusions regarding the demand for the data management solutions and presents deeper information regarding the market's competitors. It also sets the basis for the joint commercial exploitation pathways as well as individual plans.

The main objective of the present deliverable is to provide useful insights from the market and competition, adding to the first version of the deliverable D7.7 “Business plan and Implementation action plan II for the market entry strategy and business plans”.

The global amount of new data created every year will grow up to 530% from 2018 to 2025[1]. A myriad of applications in different sectors require huge amounts of information to feed models and algorithms for key inputs in business processes to facilitate decision-making in data-driven organizations, which are benefiting from acquiring data from third parties. Responding to this demand, new entities and novel business models have appeared with the objective of matching data requirements with the right providers and facilitating the exchange of information. According to Grand View Research, the European Data Centre colocation market was valued at USD 12.81 billion in 2020 and is expected to expand at a compound annual growth rate of 13.1 percent until 2028 to reach USD 33.66 billion by 2028.

The TRUSTS ‘Trusted Secure Data Sharing Space’ project aims to launch a reliable, safe, and secure data exchange platform compliant with the regulations to contribute to the European ambition for positioning and growth in the data-driven economy, as e.g., outlined in the European Data Strategy.

This report of the TRUSTS project is part of WP7 “Business Model, Exploitation & Innovation Impact Assurance” and describes the strategy of the consortium to transform the platform into a sustainable ecosystem, crystalized as TRUSTS business plan (defining business targets, services, pricing models, operational costs, remuneration of partners, etc.).

The commercialization plan is designed to maximize the full impact of the TRUSTS developments and prepare the transition towards market uptake, in order to ensure the exploitation beyond the project itself.

The methodology for creating the business plan comprises of the following building blocks:

- Identification and definition of the TRUSTS exploitable results
- Definition and alignment of the TRUSTS IPR management strategy
- Development of the market analysis
- Definition of the common exploitation approach
- Definition of individual business plans for the partners exploiting their results

[1] David Reinsel – John Gantz – John Rydning. 2018. The Digitization of the World - From Edge to Core. Data Age 2025 (2018). https: //www.idc.com/getdoc.jsp?containerId=IDC_P38353

1.1 Mapping Projects’ Outputs

The purpose of this section is to map TRUSTS Grant Agreement (GA) commitments, both within the formal Deliverable and Task description, against the corresponding project target outputs and the work performed.

Table 1 Adherence to TRUSTS GA Deliverable and Tasks description

TRUSTS Task Description		**Respective Document Chapter(s)**	**Justification**
T7.8 Commercialization initiatives and action plan II	This task will explore the strategy for bringing TRUSTS to market. It will also develop a pricing model for use of the TRUSTS services and a remuneration model for partners contributing technology to the TRUSTS services, but also for organizations that have contributed resources. This task will also carry out a technology watch to identify potential competitors to TRUSTS entering the market. Finally, a business plan for the TRUSTS services, the cloud hosting and operations of the TRUSTS Professional Partners Community will be created, to ensure sustainability and financial viability after the end of the project. The form in which the TRUSTS Professional Partners Community will be instantiated beyond the end of the project will also be decided and implemented in this task.	Sections 1 - 6	Section 1: Introduction Section 2: TRUSTS value proposition Section 3: Market assessment Section 4: TRUSTS exploitation pathway Section 5: SWOT and critical success factors Section 6: Conclusions and next actions
TRUSTS Deliverable			
***D7.8 Business plan and Implementation action plan* II** This document describes the strategy of the TRUSTS consortium to transform the platform into a sustainable ecosystem. It includes the presentation of our business plan (incl. business target, services, pricing, costs, remuneration of partners, etc.). The document has been presented in 2 versions in M18 as D7.7 and M36 as D7.8.			

1.2 Deliverable Overview and Report Structure

The structure of this deliverable is the following:

- ✓ Section 1 is for the Introduction, and it serves for contextualizing the work developed under the task T7.5 “Commercialization initiatives and action plan”, and the methodology used for compiling the information and outcomes of the analysis made for bringing the TRUSTS solutions to the market.
- ✓ The document continues with the definition of the TRUSTS value proposition in Section 2, with the enumeration of the features, services and key developments that go beyond the state-of-the art. The identification of the value proposition is the baseline for comparing TRUSTS in front of existing competitors, given that it explains to the potential customers the reasons why the solution is unique.
- ✓ Section 3 continues with a market assessment, where an analysis of the TRUSTS competitors has been done, enabling the Consortium to understand the need and demand for what TRUSTS is offering in the market, and the market competitiveness. It also helps to detect opportunities, growth drivers, and market trends.
- ✓ TRUSTS exploitation pathways are discussed in Section 4, from two different perspectives, first as a single solution to be offered to the market, and second, as a breakdown of components and pieces of software feasible to be exploitable.
- ✓ Section 5 defines the SWOT (Strengths, Weaknesses, Opportunities and Threats), to identify the situational assessment related to business competition, which can help in decision-making processes because it evaluates the strategic position of the project results.
- ✓ Finally, the conclusions of the Business plan analysis and commercialization strategies are compiled in Section 6, in which the next recommended steps for bringing the TRUST solutions to the market have been detailed.

Within the Work Plan, tasks such as T2.2 “Industry - Specific functional requirements Elicitation and analysis” along with the feedback and lessons learnt received from the Use cases (UCs) which have showcased the sharing, trading, and use of data and services, from WP5 “Demonstration of the TRUSTS Platform in 3 business – oriented Use Cases”, have been a key reference for the definition of the business models and potential commercialization plans.

2 TRUSTS Value Proposition

A wide variety of entities have had to address the exponential increase in demand for data. Traditionally, data providers have long collected and enriched public information scraped from the internet and their users, and by leveraging those valuable and in time information silos, they have built successful business models mainly around marketing (Acxiom, Experian, etc.), or financial or business intelligence (Bloomberg [2], Thomson Reuters [3], Factset [4], Quandl [5], Refinitiv [6], etc.). Other models in trading are rising as well, for example for techno-graphic data (Crunchbase), or geo-located data (Crunchbase [7]). More recently, data marketplaces - two-sided platforms intended to match data sellers and buyers and, in some cases, facilitate and manage data exchanges and transactions - have also arrived on the scene.

Data markets are either public - i.e., open to any data seller or buyer - or semi-private, which means that any seller or buyer depends on the approval of the platform in order to be allowed to trade data. Furthermore, data markets often deal with data curation, categorization, and management of metadata to help potential buyers searching relevant data products.

The first-generation of Data markets with **general-purpose** are being complemented by **niche Data market platforms** that target specific industries (e.g., Caruso[8] for the connected car, Veracity[9] for energy and transportation), and cover data sourcing for specific innovative purposes, such as feeding AI / ML algorithms (Mechanical Turk[10], DefinedCrowd[11]), or trading IoT real-time sensor data (IOTA [12], Terbine [13]).

There are some leading data-management systems (e.g., Snowflake[14], Cognite[15]) and niche digital solutions (e.g, Carto[16], Openprise[17], LiveRamp[18]) integrating secure data exchanges and, in some cases, enabling an internal data market to buy and sell data within the system. Such embedded private marketplaces provide their users with a fit-for-purpose complementary sourcing functionality, to quickly find and seamlessly integrate useful data from third parties.

While increasing concerns about privacy were on the rise, some start-ups have developed innovative solutions to manage and monetize personal data from individuals in recent years. “Such Personal Information Management Systems (PIMS) have been brought on by recent legislative developments, such as the General Data Protection Regulation (GDPR) in the EU or the California Consumer Privacy Act (CCPA)

[2] https://www.bloomberg.com/professional/product/enterprise-access-point/
[3] http://thomsonreuters.com/
[4] https://www.factset.com/marketplace#/
[5] https://www.quandl.com/
[6] https://www.refinitiv.com/
[7] https://www.crunchbase.com/
[8] https://www.caruso-dataplace.com/
[9] https://store.veracity.com/
[10] https://www.mturk.com/
[11] https://www.defined.ai/
[12] https://www.iota.org/
[13] https://terbine.com/
[14] https://www.snowflake.com/guides/data-management
[15] https://www.cognite.com/en/
[16] https://carto.com/
[17] https://www.openprisetech.com/
[18] https://liveramp.com/

in the US. Leveraging such legislation, PIMS empower individuals to take control of their personal information (PI) made available to internet service providers, and to manage their consent so that their data is only given away to certain entities, or for some specific purposes. Moreover, some PIMS have also implemented marketplace functions for users to sell their consent at a price, thereby enabling the monetization of personal information” [19].

Due to the nature of data as an asset (freely replicable, non-perishable, serving a wide range of uses, holding an inherently combinatorial and aprioristically unknown value), which also depends on the buyer and the use case[20], commercial data markets are still immature and do not suffice for realizing the benefits of a widespread information exchange. As a result, most information still remains in silos, and data sharing often requires signing bilateral partnership agreements and ad hoc negotiation in practice.

In this scenario, market players usually fight to integrate themselves horizontally into the value chain [21], and secure a niche where they can act as a de facto monopoly by leveraging and fiercely protecting their core data, as their main competitive advantage. This structural market fragmentation is ultimately deterring the potential benefits of a healthy FAIR [22] data economy.

Within the current deliverable, it will be analyzed:

- how different entities are selling data in the market,
- what kind of relationships are taking place in the value network,
- how data trading is evolving, and
- what challenges must be overcome in order to leverage the power of data in the markets.

TRUSTS aims to develop a secure, trustworthy, and GDPR compliant data sharing space which will benefit data producers and data consumers, acting as intermediary by connecting stakeholders, and as platform federator between data markets. Specifically, TRUSTS aims to fulfil three roles in the EU data economy, and these are:

1. A Data marketplace,
2. A platform federator
3. An ecosystem facilitator of data marketplaces

TRUSTS is a **key model and a set of components** to support the evolution of digitization, and the **deployment of data exploitation technologies in any domain** of the economy and society. The platform is providing a trustworthy concept of data markets as a whole, based on an innovative and extensible architecture.

Despite various local initiatives at setting up data marketplace platforms, **interoperable pan-European industry platforms are still missing**. Existing data marketplaces often offer non-commercial data (e.g.,

[19] S. Azcoitia, N. Laoutaris (2021) A survey of Data Marketplaces and Their Business Models 2201.04561.pdf (arxiv.org)

[20] Anish Agarwal, Munther Dahleh, and Tuhin Sarkar. 2019. A Marketplace for Data: An Algorithmic Solution. In Proceedings of the 2019 ACM Conference on Economics and Computation. 701–726. https: //doi.org/10.1145/3328526.3329589

[21] Carl Shapiro and Hal R. Varian. 2000. Information Rules: A Strategic Guide to the Network Economy. Harvard Business School Press, USA.

[22] M. Wilkinson, M. Dumontier, and I. et al Aalbersberg. 2016. The FAIR Guiding Principles for scientific data management and stewardship. Scientific Data 3 (2016). https://doi.org/0.1038/sdata.2016.18

open government, satellite, and weather data). The key value proposition for TRUSTS is that it can act independently and as a platform federator while examining legal and ethical issues implemented through smart contracts. The based architecture is innovative, as not just data sets can be traded, but also access to services and applications while maintaining security and privacy. As a training example, two connectors for the **EOSC [23] initiatives, OpenAIRE [24] and Europeana [25]** were developed as well as another component to programmatically load metadata of datasets into TRUSTS.

When companies work together, they can create a much larger and more valuable market that they could achieve by working individually. Long-term business success comes not only from competing successfully within the current context, but also from being an active participant in shaping the market’s future, changing the game to our own advantage. Competitors, customers, suppliers and complementors offer opportunities for cooperation, and this is the reason we are also considering **TRUSTS as a platform federator**, a federated ecosystem that enables the connection to multiple systems and platforms with TRUSTS integrated toolsets and services, for boosting data driven business opportunities.

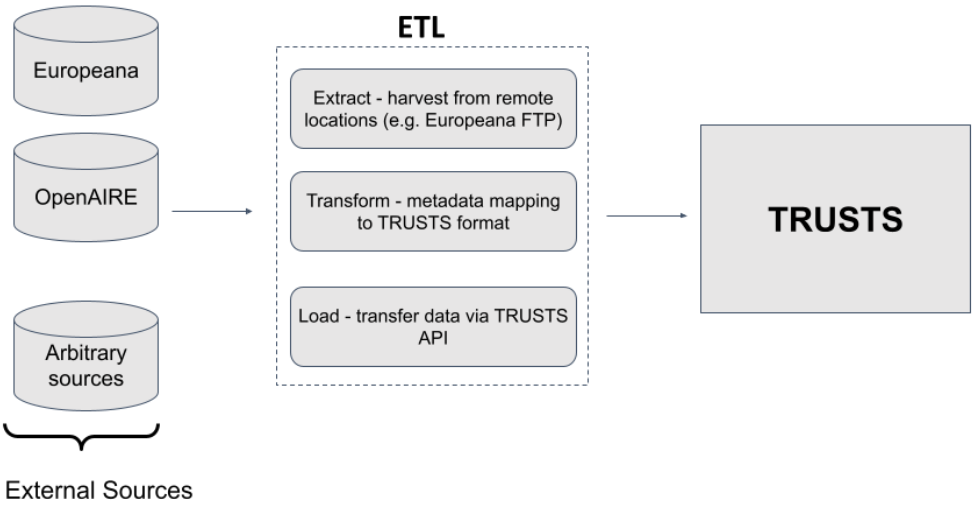

Figure 1 The TRUSTS solution to load data from external sources

As key features, TRUSTS is offering:

- A recommender system.
- Models, ontologies and taxonomies for the classification and semantic representation of the accommodated datasets and services. The technical development of the TRUSTS platform may exploit the taxonomy for purposes of metadata management, population of user interfaces, and normalization of catalogues coming from different external marketplaces and EOSC initiatives.
- Definition of semantic descriptions and data models to support data interoperability.
- Data exchange across various data market platforms and with the EOSC (e.g., OpenAIRE, and Europeana)

[23] Advancing Open Science in Europe | EOSC Association
[24] OpenAIRE
[25] https://www.europeana.eu/

- Smart Contracts to incentivize providers, users, and owners of data.

TRUSTS’ embedded Services:

- Computing infrastructures, tools, and base technologies to develop, test and deploy applications based on the exploitation of data from various data sources accessible from TRUSTS.
- Secure proprietary datasets for the development of applications or services for any type of company or sector.
- Access to datasets available for sharing with varying degrees of protection and with different usage policies. For the inclusion in the development of value-added services, and for the development of customer services, citizen, or public administrations.
- Providing various mechanisms for data preparation: anonymization.
- Access to public datasets, including mechanisms for accessing datasets available through other federated Data Spaces.
- Facilitating the collaboration with providers of applications and services accessible and integrable in TRUSTS platform.
- Marketing channel (Marketplace) for companies willing to exploit their data.

Overall value proposition

The generic value propositions of TRUSTS are as follows:

1. TRUSTS ensures the **security, privacy, and sovereignty** of data trade while also guaranteeing **GDPR compliance and interoperability** amongst all involved parties. TRUSTS provides sovereignty features like anonymization, encryption, and smart contracts.
2. TRUSTS value creation is centered on **value chain coordination**, with a particular emphasis on data sharing, data trading, cooperation, and ecosystem access for ecosystem members. TRUSTS ecosystem is interoperable, providing data quality and a data exchange framework to exploit the value of own and shared data.
3. TRUSTS provides a key **model and a set of components** to support digitization and the deployment of data exploitation technologies in any domain of the economy and society (multisector).
4. The TRUSTS model is aligned with **reference positions and architectures** such as GAIA-X and IDSA.
5. TRUSTS establishes guidelines for **the provision of services** around the complete data cycle (capture, communication, protection, storage, processing, analysis, visualization).
6. TRUSTS provides a data **catalogue** in which users of the TRUSTS Marketplace will be able to monetize and package datasets or files as Data Products and Application Services, as well as infrastructure and integration services.
7. Simplified ease of access (by a web interface) that incorporates (near) real-time access to ensure data quality.

Value proposition as a data marketplace

TRUSTS can potentially offer value-adding services to distinguish itself from the competitor by:

1. Providing **data cleansing services** to guarantee data quality.
2. **Aggregating datasets**, for instance, the option to harvest open (meta)data in order to supplement the existing data catalogue. This option will be beneficial to increase the volume and accessibility of datasets in TRUSTS.
3. **Offering consultation services** for data sale and acquisition. Currently, data marketplaces that offer personal assistance appear commercially viable compared to data marketplaces that merely provide data trading.
4. **Technical sales assistance** may provide a business potential since one of TRUSTS’ target segments is MSMBs. Many of them are still in the early phases of digital transformation, which adds to the difficulty of enrolling them in TRUSTS. While standardized *connectors* will facilitate integration, extra assistance may be required for awareness development and education, internal data management, and setup, to mention a few.
5. A **secure data environment topic-oriented**, offering the possibility to train algorithms that need to be trained on real data while offering guarantees of **Intellectual property rights (IPR) protection** and ensuring that databases in these environments are accurate, also constitutes a crucial aspect for TRUSTS value proposition. Within experiments and testing phases for launching new artificial intelligence (AI)/machine learning (ML) services, such secure environments would exempt the enterprises that need data from the responsibility to prove that they have all the necessary security measures in accordance with the legal precepts. In this respect, TRUSTS should investigate the possibilities of becoming a certified platform through standardization entities or certification bodies related to the field of data traffic.

TRUSTS value proposition as a federator of data marketplaces

A federated data marketplace offers many value proposition possibilities (see D7.1 and Abbas (2021)[26]):

1. By providing a **one-stop-shop** through a standardized portal, data providers and buyers from various data marketplaces can enhance their data discovery (and transaction) processes. The federation can forward the traffic from the one-stop-shop portal to the proper data markets in its simplest form. This may result in a decrease in both search and transaction costs.
2. Offering **commission-based brokerage services** to data buyers to find appropriate data assets.
3. Offering **shared services** for data marketplace operators, specifically in non-core services such as billing, user management. As a result, the operators can concentrate more intently on and improve their Unique Selling Propositions (USPs).

[26] Abbas, A. E. (2021). Designing Data Governance Mechanisms for Data Marketplace Meta-Platforms. Proceedings 34th Bled eConference – Digital Support from Crisis to Progressive Change, online.

4. **Expanding the quantity (and quality)** of available datasets and solutions, as well as integrating meta-data from all onboarded data markets to increase the overall exposure of available datasets and solutions.
5. **Lowering advertisement cost.** Advertising exposure via meta-search engine has the potential to boost data market popularity. Additionally, collaboration may help reduce the expense of formal advertising.
6. **Coordinating and establishing standards** to harmonize the technological stack gradually. Especially for SMEs data markets, maintaining technology-stack and solving technological challenges trigger high expenses.
7. **Assuring compliance** with applicable laws, such as GDPR, in the data trading procedures inside this federated ecosystem.
8. By **establishing a single registry**, data providers and buyers can monitor the data trading code of conduct breaches.

TRUSTS value proposition as an ecosystem facilitator of data marketplaces

1. TRUSTS has the privilege of influencing the ecosystem’s trajectory via **checks and presiding over essential problems** that may impact the ecosystem, such as restraining the powers or undesirable actions of specific partners.
2. Having the **facilitator and brokerage roles**, TRUSTS brings a wider audience to participate in the ecosystem. It will enable cross-fertilization across different industry domains.
3. Set up **guidelines for components** to create data spaces per domain or value chain in which to extract value, favoring the creation of intelligent applications to help decision-making.
4. TRUSTS data market members can **grow their end-user numbers** by interacting and being interoperable with each other.

2.1 Competitive position of TRUSTS Against Similar Sector-Peers

With the objective of elaborating a benchmark and exploring the more extended business models for data trading, data market businesses have been identified, by either searching the internet with specific keywords, or by browsing articles on the web, scientific papers, public videos, product brochures and presentations. As a result, a total of 180 companies offering data products on the internet have been taken into account.

After an initial assessment, the entities were classified depending on parameters like type of data traded, target industry, and business models. We then proceeded to discard the ones not offering paid data products in the market, online advertising platforms, internet service providers not specifically offering data products, concept projects, and open data repositories, which resulted in a total of 97 selected companies revised.

The selection is composed of companies with different sizes belonging to 22 countries. The information observed has been the year of foundation and stage of development, and we found that almost half of the companies have started running within the past five years, and the 90% are scaling their customer base or are in commercial development stages.

From the scraped information about current data products and data providers active in diverse data marketplaces, we found that for what regards the kind of data traded on the internet, the marketing and financial data markets are currently the most popular. However, the most novel initiatives are focused on trading real-time IoT data, delivering AI/ML models (instead of providing data for buyers to train the data), and managing personal information of individuals.

In summary, some interesting trends have been noticed, such as:

- Data markets are progressively making use of a distributed ledger management and transaction accounting technologies
- Most of the current platforms are choosing distributed architectures rather than centralized systems to store and process the data (Lemochain [27], Madana [28], Datum [29]).
- Transactions are being increasingly paid in cryptocurrency, which together with the use of distributed ledger technologies mean an acceleration in transaction processing time, thus avoiding the latency time needed by financial intermediaries.

Although each member of the ecosystem encounters its own specific challenges, setting up, and scaling data-exchange and marketplace platforms represent a common shared challenge. This is the reason why increasing the value of the service provided and ensuring the trust and reliability of every actor involved become major barriers for new data trading platforms.

What can be also observed is that the latest data markets are focusing their activity on specific industries, or in concrete types of data, because more expertise enables the increased value, they are able to provide, and as a result, the market is evolving from more general-purpose, towards niche data trading platforms, which are more chances to scale and become a reference within a domain.

Also, some market players integrate data from third parties and commoditizes, as a functionality of their data-driven products or services, hence complementing its already well-established services.

Data trafficking brings with it other major challenges such as dealing with data ownership and preventing data theft, dealing with market fragmentation, and developing open standards to manage the secure exchange of data on the Internet.

In the context of a data market, sector-peers in the value chain are legal entities playing an effective role in producing data-driven services or data products, being intermediaries, offering or acquiring data or data-driven solutions in the market.

In order to identify relevant business models, a key step is understanding the data value chain, its layers and its principal functions. The following figure shows the diagram of four functional layers that allow buyers and sellers to exchange.

On top of the infrastructure, the management layer enables the application interfaces (APIs), such as cataloguing, pricing, contract and reward management, buyers onboarding, governing transaction management, charging, billing, and accounting, tracking the activity, and audit.

At the bottom the infrastructure layer facilitates the processing, storage, communications, and security to the upper layers in the system.

[27] https://www.lemochain.com/
[28] https://www.madana.io/
[29] https://datum.org/

The enabler layer in the middle provides standard operational and management processes such as anonymization, secure data exchange, and data sandboxes.

The data layer operates the data processing and is responsible for the effective provision of data or data-driven services to customers.

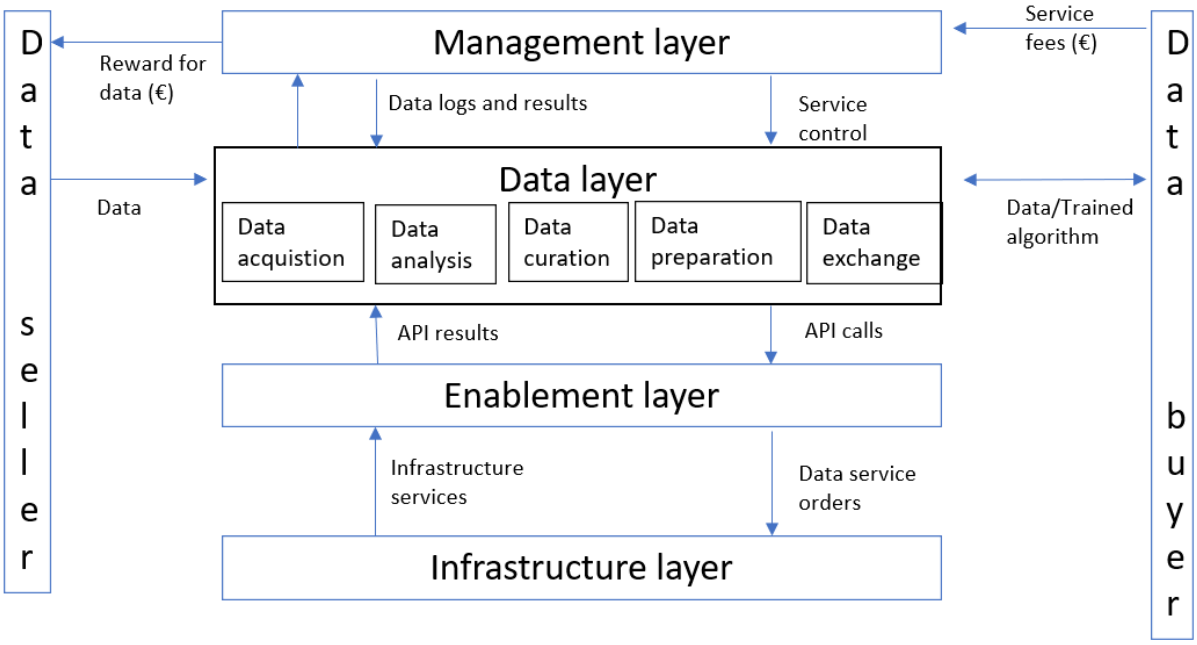

Figure 2 Layers in data trading

Data platforms do not necessarily implement all the layers or processes in the previous figure, some of them only implement a secure data trade without bidding or pricing features, which are left out and then interested parties agree upon them (e.g., Cybernetica [30]).

Some data markets provide a set of open solutions including anonymization of personal information (AirCloak [31]), anonymization of buyers’ identity (Datavant), and/or facilitates secure exchanges (Cybernetica). For what refers to billing, usually the charges are for transactions, as number of calls to the API, or volume of data processed.

[30] https://cyber.ee/
[31] https://aircloak.com/

Even if some peers are focused on specific fields of data, niche, or industry, (health, IoT related, energy, automotive, etc.) some target a broad purpose trading any type of data (AWS [32], Advaneo [33] or Data-Rade [34]), providing secure data exchange between different organizations.

Some marketing-related platforms (Liveramp [35], Lotame [36], Openprise[37]) are embedding private marketplaces into their data management platform to allow secure exchanges, trading, and data monetization from trusted partners (data brokers) within their system. The private marketplaces are frequently an add-on to the data management platform subscription, and therefore can only be accessed by their users.

Apart from commercializing the services through their website, service and data providers also make use of data markets to advertise their services, to provide access to free samples of data, or to offer specific data products as perks. Almost half of the data brokers scanned like Acxiom, Gravy Analytics or Experian offer their products related to marketing (Lotame, TheTradeDesk [38], Liveramp) and commercialize their services in other data markets such as AWS or DataRade too. The same happens with some providers making use of financial related specialized data platforms such as RepRisk [39], Arabesque S-Ray [40] or Equifax[41].

If we look at the start date of activity, we can deduce that there is a certain trend towards an evolution to real-time data streaming marketplaces, to take advantage of the potential of IoT (Terbine [42], IOTA [43]), and those specialized in training ML and AI models (Ocean Protocol[44], Skychain [45]).

Very often data sellers and buyers are invited to subscribe for free to the platform. However, some platforms charge for freemium subscriptions, or charge like Infrastructure as a service (IaaS) fee for the delivery of data. Some others opt for charging sellers according to the money they make through the platform, either through commissions or revenue sharing.

In addition, buyers often pay the Data market for data. Both the data seller and the Data Market are responsible for setting the prices for data products, in most cases one-off charges for downloading or gaining access to datasets, or periodic subscriptions to data feeds in general-purpose data markets. On the other hand, niche data markets more frequently apply prices related to volume or usage-based charge for APIs, and price customization depending on who the data buyer is.

[32] https://aws.amazon.com/marketplace/
[33] https://www.advaneo-datamarketplace.de/en/
[34] https://datarade.ai/
[35] https://liveramp.com/our-platform/data-marketplace/
[36] https://www.lotame.com/
[37] https://www.openprisetech.com/
[38] https://www.thetradedesk.com/us
[39] https://www.reprisk.com/
[40] https://www.arabesque.com/
[41] https://www.equifax.com
[42] https://terbine.com/
[43] https://www.iota.org/
[44] https://oceanprotocol.com/
[45] https://skychain.global/

	Data Providers (DP)		Data Marketplaces (DM)		Data Management Systems (DMS)	
Concept	**DP/SP**	**PMP**	**General-purpose DM**	**Niche DM**	**Embedded DM**	**PIMS**
Data exchange	Public, semi-private, private	Private	Public / Semi-private		Private	Public / Semi-private
Scope	Focused		Diversified	Focused		
Type of data	Any	Specific data to be used within their service / platform	Any	Industry or type-specific	Data exchanged within the system	Personal data
Roles / Players interacting	Partners, Customers		Sellers, buyers		Owner, requester	Users, data Providers, buyers
Gets data from	internet, self-generated, partners, users	Partners, Data providers	Data providers	Data providers, self-enriched	Data providers	Users, Data providers
Provides buyers with	API, datasets	API, access to data through the system	API, datasets		API, Access to data through the system	API, Key to decrypt data
Owners get access through	Partnership	Partnership, the service platform	Web-services		Data Management platform	Mobile App Web services
Buyers get data through	Web-services, APIs	Web-service, the service platform	Web-services	Web-services, APIs	Data Management platform	Web-services, APIs, compatible systems
Type of platform	Centralized		Centralized or decentralized		Centralized	Decentralized
Access pricing for buyers	Subscription, pay for data	Included in the main platform	Predominantly free. Some freemium, subscription and data delivery charges		Add-on to the data management Platform	Pay for data
Access pricing for sellers	Partnership (when applicable)	Partnership, time subscription	Predominantly free. Some freemium subscription, and revenue-share charges		Subscription to the platform	Free
Data pricing schemes	Fixed one-off, subscription, customized, volume-based	Subscription, specific (e.g., CPC, CPM, …)	Fixed one-off, subscription and customized	Customized, volume/usage-based, fixed one-off	Open	Open, bid by buyer
Control of data pricing	Platform	Platform, buyers	Platform, providers		Open	Users, Platform
Payment method	Fiat currency			Fiat, token	Open	Token, fiat currency

Table 2 Trading data: Business models characterization[46]

Additionally, there are platforms that could be considered as data marketplace enablers, providing functionalities on top which can be built into full-fledged end to end data markets, as for example Ocean Protocol (providing a marketplace with enabled AI/ML data trading). Its customers can use the services to

[46] S. Azcoitia, N. Laoutaris (2021) A survey of Data Marketplaces and Their Business Models 2201.04561.pdf (arxiv.org)

develop end to end services and processes. As an example of data markets using Ocean Protocol, we can mention GeoDB [47] and Decentr[48].

Data Management Systems (DMSs) objective is to collect, store, organize, combine, and enrich information within an organization or also, personal data from individuals. They are offered as an add-on that enables secure data exchanges inside an organization and enriching corporate information by acquiring data from third-party providers. These data management systems do not include full marketplace functionality, and what provides is the control of the delivery and access to data assets within the walled under control of each customer. Some of them charge Infrastructure like fees for delivering data, and a recurring subscription fee to authorized sellers.

On the other side, **PIMS** aim to empower individuals to take control of their data, and according to the data protection laws (GDPR, CCPA) let customers collect personal information controlled by service providers on the internet, and exercise their right to erasure, modify the rights granted, manage permissions, manage cookie settings, etc. In addition, some PIMs ask their users’ consent to share their personal information with third parties through the platform and as a compensation they receive a reward. Lots of the PIMs include marketplace functionalities and are focused on trading personal data for marketing purposes, as for example, ad targeting and user profiling. In this case, the data owners are the data subjects, and the platform negotiates fees for consenting the access to their data, becoming a data broker, letting users monetize their data, and controlling who has access to it and for what purposes. Examples of health related PIMS are MedicalChain[49], Longenesis[50], or HealthWizz[51], specialized in healthcare management. These health related PIMS often use blockchain to comply with the strong health regulation and to provide additional security to sensitive data.

For what regards the **type of data** traded in the market, there are very different kinds of data, and as can be seen in the graph below, the most data markets in our sample are related to marketing data (31%), financial data (11%), and healthcare (8%). The tag general purpose (including companies such as AWS marketplace, DIH, Advaneo, DataRade, Knoema, Snowflake, DAWEX, Carto, Veracity, Crunchbase and Refinitiv), accounting for the 34%, trading any kind of data, whereas healthcare, automotive, IoT related have less representation.

[47] https://geodb.com/en/
[48] https://decentr.net/
[49] https://medicalchain.com/en/
[50] https://longenesis.com/
[51] https://www.healthwizz.com/

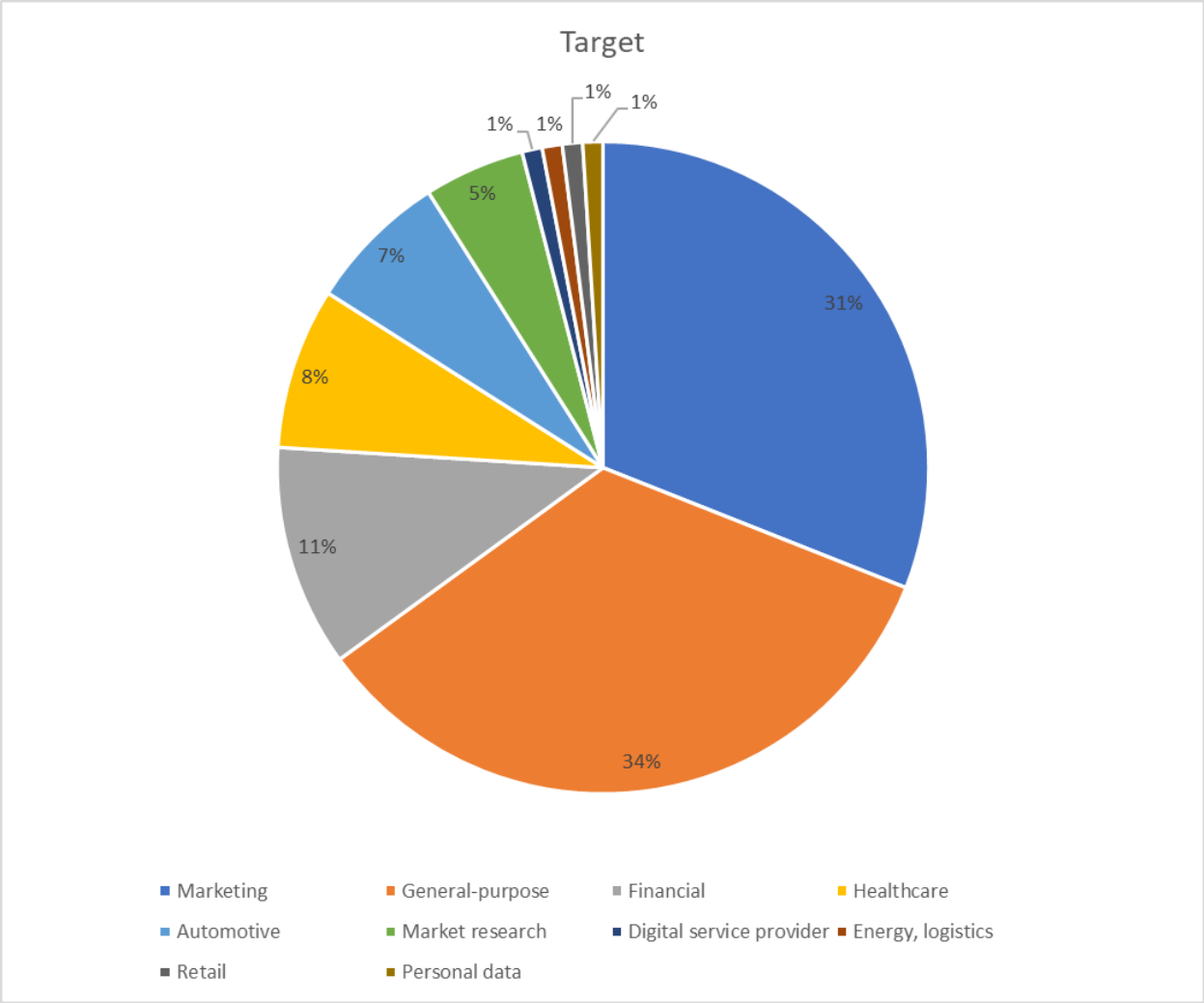

Figure 3 Types of data traded in the sample

An interesting outcome from this analysis is that most data products in general-purpose data markets are made available for free, and some data markets such as DIH, Advaneo, and Google Cloud Marketplace lack any significant offer of paid products. We have seen that free data products in commercial data markets are either open data collected from open data repositories, or data samples uploaded by data providers.

Special attention should be put in the case of entities whose aim is to make profit, like DIH or Advaneo, which collect, and link open data made available by authorities or public institutions. Metadata for these open datasets is often scarce, and the business explanation behind this offer can be that such a vast amount of data may serve as a ‘hook’ for sellers and buyers, and a complement to third party paid data products.

Another interesting takeaway is that data providers are using public data sources to upload outdated samples of their products so that potential customers can test them and get to know the utility of the entire data product for their purposes, before acquiring it. This strategy would be interesting for TRUSTS platform, providing a trial sample for testing.

If what we analyze is how the data is being priced, and how the platforms price the data in a transaction, it was found that the 25% of the data markets do not disclose clear explicit public information about how the data pricing is set up on their platform. The rest of data markets are somehow flexible in their pricing scheme and allow their customers to choose between different options. The most adopted pricing mechanisms are:

- **Fixed price**, in which buyers pay a lump-sum as a one-off for a data product, or fixed subscription charge for accessing a stream service for a period. Most of the companies providing pricing information support transactions with fixed prices and is the most frequently used mechanism for data products.
- **Volume-based pricing** is established depending on the volume of information that is accessed or downloaded. Some data providers offer unit prices for data, usually with discounts per volume. This schema is common among data providers that charge per contact, like Otonomo, which sells data points to automotive service providers, according to the volume of data to be downloaded. It can be concluded that the data product price depends a lot on their size [52].
- **Usage-based pricing**: in this case the access to data is provided through APIs calls, as well often with volume-discounts. In addition, the products are segmented into different groups, and each of them allows a maximum number of calls in a certain period for a fixed price.
- **Bid by buyer:** For the transaction to take place, the bids are placed by the buyers, which have to be accepted by the sellers. This mechanism is frequently used by the PIMS.
- When the price is established by the seller case by case, depending on the type of buyer, and what the data is to be used for, is the **Customized method**. Usually, the transaction starts when the seller receives this information from the potential customer, allowing a personalization of the data product and the price.
- We can also find **free models**, in which as e.g., Carto, the customers can get the data for free without transaction price. Many times, because the access to data is included as part of the subscription to the platform.
- **Open** is an option which means that to set the prices, there is no mechanism and depends on the buyers and sellers to agree on them. This allows various of the pricing schemes mentioned before (e.g., Ocean Protocol), or don´t manage the terms of the transaction (e.g., Meeco).

Moreover, some other mechanisms can be found in specific cases, for example, MyDex has set transaction charges using **revenue sharing**, it means that when a buyer purchases the rights to access the personal information of a user, the platform claims its rights to 4% of the revenues that such a buyer makes on the platform from that user. **Revenue sharing** requires downstream control of the use of data, which discourages its indiscriminate implementation in charging for data transactions. Digi.me, mentions this pricing scheme.

[52] Santiago Andrés Azcoitia, Costas Iordanou, and Nikolaos Laoutaris.2021. What Is the Price of Data? A Measurement Study of Commercial Data Marketplaces. (Oct. 2021), 13 pages. https://arxiv.org/abs/2111.
04427

In a different setting, **data partnership agreements** often resort to revenue sharing when charging sellers for data transactions; it is being used by e.g., DataRade or TheTradeDesk..

Cost per mile impressions (CPM), **cost per click** (CPC) and **percent of gross media expenses** are specific to online advertising platforms (e.g., LiveRamp, Oracle or Kochava), thanks to their end-to-end control of online ad campaigns.

To finalize the list, **auctions** are very popular for setting mechanisms of pricing in other fields, and they are widely used in online advertising where advertisers bid in real time to show their ads to a user browsing a certain webpage[53]. Nonetheless, they are not so common when selling data, due to its non-rivalrous nature. Even though some works of research have already defined a whole family of auctions that artificially creates competition among interested buyers [27, 28], we found only one enabler (Ocean Protocol) that mentions auctions as a potential mechanism to set the prices of data products.

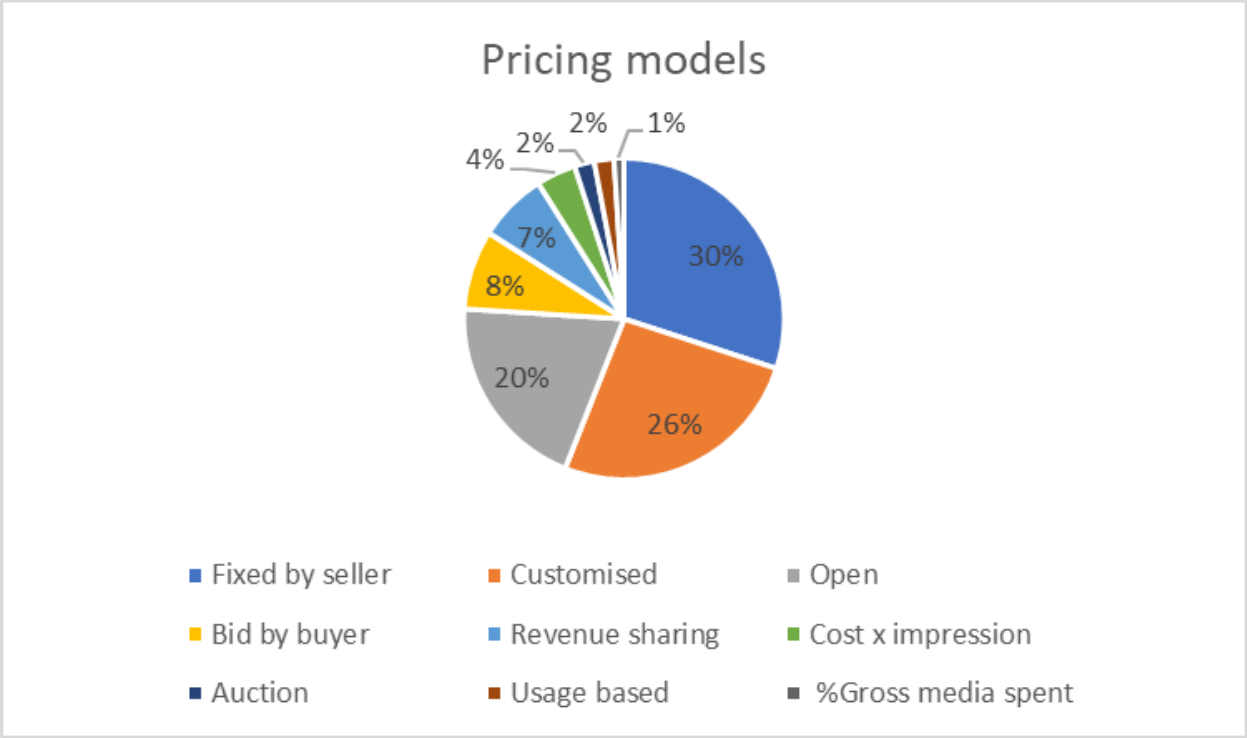

Figure 4 Data transaction pricing in the sample

[53] Panagiotis Papadopoulos, Nicolas Kourtellis, Pablo Rodriguez Rodriguez, and Nikolaos Laoutaris. 2017. If You Are Not Paying for It, You Are the Product: How Much Do Advertisers Pay to Reach You?.In Proceedings of the 2017 Internet Measurement Conference (London, United Kingdom) (IMC ’17). Association for Computing Machinery, NewYork, NY, USA, 142–156. https://doi.org/10.1145/3131365.3131397

Another option found in a niche data market such as Otonomo is to offer partnership models to big data sellers, and tailored agreement to share data frequently, another one, Caruso, requires a partnership agreement with buyers which requires their participation as stakeholders for using the platform.

How the trading is made between the entities:

Here we are referring to what the platforms provide buyers with, and how users - from both sides the buyer and seller, have access to data. It appeared that the 67% of entities’ websites claim to be using one or more of the following mechanisms:

• Publishing or sending in advance free samples of data to potential buyers or allowing free access to part of the data (e.g., some fields of a structured database).

• Offering a trial period in which to have access to a data feed or subscription-based service.

• Providing buyers with a sandbox (Battlefin, Otonomo), a controlled environment that lets them play with real data before bidding for it or making a purchase decision, while ensuring that data is not downloaded or copied.

• Offering a live demo of their services and the data they offer.

• Hosting a reputation mechanism by which buyers are able to rank both information and/or data providers.

Free samples are the most widely used method to let buyers know a data product in advance. Not only offering them on their websites but also some have such samples in public data markets in which buyers can download for free.

Being able to know the value of data beforehand is not equally critical in all the cases, for example, data providers offering real-time data feeds or stream often allow buyers to cancel subscriptions at any time, like this the risk of finding data obsolete or useless after subscription diminish, in other cases for general-purpose data markets given the heterogeneity of data, it is difficult to anticipate the usefulness of pieces of data before testing them.[54] In other cases, platforms such as Liveramp, Lotame, Wigson[55], Vetri, HealthWizz sell data customization services that allow customization of the data characteristics and thereby reduces the possibility of acquiring useless data.

[54] Santiago Andrés Azcoitia and Nikolaos Laoutaris. 2020. Try Before You Buy: A practical data purchasing algorithm for real-world data marketplaces. arXiv:2012.08874 [cs.DS]

[55] https://wibson.org/

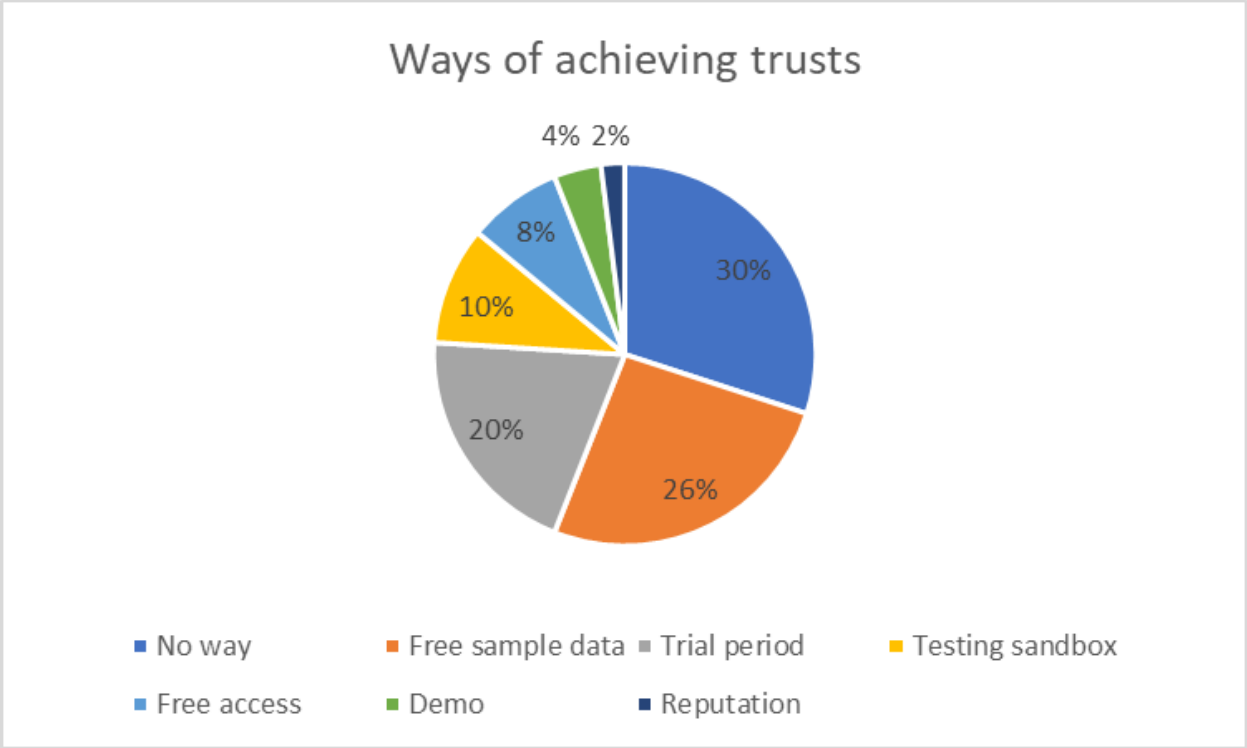

Figure 5 Methods usually used for achieving trust from customers

Another important factor to consider is the **security measures in their policies:**

User authentication and **SSL encryption are** extensively used. The first is useful to control who is accessing the platform, in which role, and with which permissions, while the second one ensures the security of information while “on-the-move”.

Anonymization or de-identification of personal information is used to make identity matching more difficult. For instance, Airbloc avoids exposing personal information, and by default shares only non-personal information from users.

Revocable DLT decryption keys, (DAWEX) or **cryptography** (Streamr, Datum, Mydex), are implemented by some marketplaces and allow buyers to decrypt an encrypted data stream or dataset while their contract with the seller is still valid. They often include additional security measures for storing such keys (Digi.me). Others rely on a temporary URL to provide access to data (Datapace).

Secure data connectors (Advaneo, DIH, Databroker), are used by data exchange platforms to make sure that both parties trade data within the scope of a valid contract.

To protect buyers, some provide **tamper-proof data through data signatures and message chaining**, which sometimes make use of a blockchain to ensure immutability (Datapace).

Some IoT marketplaces offer sellers a specific service and **software that certifies the origin of data**, which is sometimes bundled with the secure connector and allows some data management functionality (Veracity).

By conducting this market screening, we have a better understanding of the current state of the data market business, as well as the main trends, challenges, and indicative customer segmentation, which is critical to help to build a more targeted TRUSTS market entry strategy.

It is of the utmost importance that TRUST is capable of capturing the existing market opportunity by clearly demonstrating its value added to potential customers via a market plan, user-friendliness platform, in a competitive environment but with no clear winner at the moment.

3 Market assessment

3.1 Total Available Market Demand

Total Addressable Market (TAM) size provides an overview of potential opportunities that a business can capture. The opportunities are expressed in monetary value or economic return that can be generated from the opportunity. For example, suppose the technology and financial sectors are our focus targets. In that case, we assume that each technology and financial service industry will rely on data for its operations. The total addressable market for the data market will be a cumulative demand of the data needs of the industries with the assumption that data marketplaces can address all those needs. TAM can be estimated using two main approaches: top-down approach and bottom-up approach.

A top-down approach seeks to estimate the total addressable market relying on secondary data sources (e.g., consultant reports or white papers) to gain insights into market estimates.

Top-Down TAM = Total Spend in Market x Estimated Market Share

On the other hand, a bottom-up approach relies on a primary survey conducted by a study to estimate TAM.

Bottom-Up TAM = Potential Customers x Price of Product

A downside of a top-down approach is that the collected sources or data might not accurately capture the specific phenomenon of interest, which is the total addressable size of the data market. The bottom-up approach relies on primary data, e.g., surveys specific to the phenomenon of interest. Extracting large volumes of data from specific customer contexts requires gaining access to firms and price ranges for different data. This can be challenging since the pricing of data as an intangible product is often difficult to predict without knowing data’s characteristics, for example, whether the data is structured, unstructured, personal, business, or strategic data. Thus, in estimating TAM certain assumptions are made throughout the estimates.

3.2Segment of the total market demand targeted

The global data market size revenue forecast worldwide from 2011 to 2027 (in billion U.S. dollars) is expected to grow (see Figure 6). A forecast by static shows an upward trend in the revenue of the data market ranging from a steady increase from 2.7 billion in 2011 to a projected amount of 103 billion dollars in 2027 in revenue [56]. Although a large part of data is stored and handled by a few Big Tech [57] which might suggest a limited opportunity for data marketplace entrants, there are grounds to be optimistic about opportunities for data marketplaces. First, there continues to be a general increase in the production of data. For example, it was estimated that data will grow from 33 zettabytes in 2018 to 175 Zettabytes by 2025 [58]. June edition of Forbes Magazine [59] places datafication as the third tech trend that will continue to transform industries. There are several opportunities for both public and private entities due to the enormous availability of data [60]. For instance, data opens new opportunities to produce and capture value, even for companies that hold substantial amounts of data. It is estimated that around 30% of organizations(public/private) are actively searching for and developing new products and services reliant on shared data and services [61] . In addition, it is predicted that organizations that share data with their industry ecosystem will realize a revenue increase of 3% percentage points higher than nonparticipants [62] . Such trends are positive indicators for the growth of the data economy and data market size. Other positive indicators for the data market size can also be seen in the investment of the European Union, which is investing around 6 billion euros in the upcoming years to boost data architecture and data marketplaces. Such indicators in the growth and investment in the data economy are positive signs for data marketplace entrants and potential buyers of data. 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 [63]. The availability of data would power the operations of companies operating in business ecosystems and networks [64] .

[56] Global big data industry market size 2011-2027 | Statista
[57] European Commission 2020
[58] European Commission, 2020
[59] *The 10 Tech Trends That Will Transform Our World (forbes.com)*
[60] Beverungen et al., 2022
[61] *IDC FutureScape: Worldwide Future of Industry Ecosystems 2022*
[62] *FutureScape: Worldwide Future of Industry Ecosystems 2021*
[63] *FutureScape: Worldwide Future of Industry Ecosystems 2021*
[64] *FutureScape: Worldwide Future of Industry Ecosystems 2021*

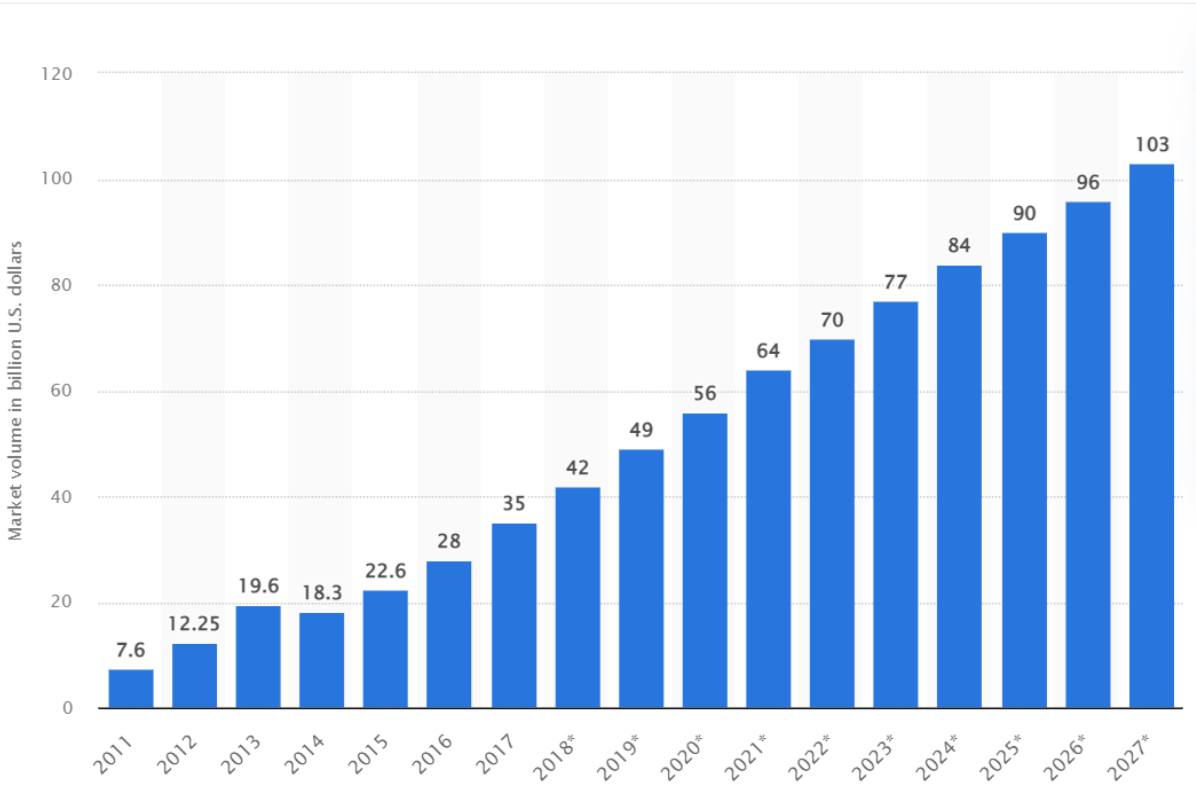

Figure 6 Big data market size revenue forecast worldwide from 2011 to 2027 (in billion $)

Segment of the total market that TRUSTS can capture

The previous section described the total addressable Market for data economy. This section focuses on the market size that can be addressed by data marketplaces. Assuming, TRUSTS customer base (data suppliers and users) are companies within the EU. Building on this assumption, this report findings rely on the latest statistics from European Data Market Monitoring Tool, IDC 2021 (see Table below). As of 2019, the EU monitoring tool on Data market [65] trends show a consistent increase in the size of the value of data market from 58.427 (2019), 60.635 (2020), to 63.627 (2021). The statistics also show a growth rate of 4.9% for the year 2021/2020. Looking at the statistics there is an equal increase in the number of data suppliers from 166.063 (2019), 175.605 (2020) and 185.866 (2021).

Based on these estimates it is confident to project that there is a substantial market both in terms of data suppliers and data professionals that TRUSTS can target. Zooming into current market trends in the data

[65] *European Data Market Monitoring Tool, IDC 2021*

economy and projected value of the data market size, from a commercial perspective there is a high potential market for TRUSTS.

Resources are also required to make TRUSTS viable and feasible as it requires a large investment to be able to benefit from the projected growth of the data economy. From the financial perspective it is clear to say that there is a high potential for a company thriving out of the TRUSTS project to be financially successful. There is a high market value which yet not have been exploited and the fact that TRUSTS with focusing on GDPR alignment actually have a big competitive advantage over other market operators. However, it needs to be considered that the analyses we applied are fully based on assumptions which is also why a precise break-even analysis could not be conducted. Therefore, we advise the project team and the company initiators to look at this part again once the end of the project is approaching and more accurate information is present about pricing and revenue models.

Table 3: Summary of data economy with Europe [66]

EU27 – Indicators Overview					
Name	**Metrics**	**2019**	**2020**	**2021**	**Growth rate 2021/2020**
Number of Data Professionals	Total Number of Data Professionals (Thousands)	6.026	6.502	6.853	5,4%
Number of Data Suppliers	Total number of data supplier companies (000s)	166.063	175.605	185.866	5,8%
Value of the Data Market	Estimate of the overall value of the data market (Million Euro)	58.427	60.635	63.627	4,9%
Value of the Data Economy (Direct Impacts)	Direct Impacts (Million Euro)	64.262	71.050	73.116	2,9%
Value of the Data Economy (Backward Impacts)	Backward Impacts (Million Euro)	98.668	108.546	112.221	3,4%

[66] *European Data Market Monitoring Tool, IDC 2021*

Incidence of the Data Economy on GDP (Only direct impacts)	Ratio between value of the data economy and GDP (%)	0,51%	0,60%	0,59%	-2,0%

4 TRUSTS exploitation pathway

The commercial exploitation of the project’s results are important targets of the TRUSTS consortium for ensuring the scientific progress beyond the state-of-the art, and for the economic sustainability of the results after finishing the project.

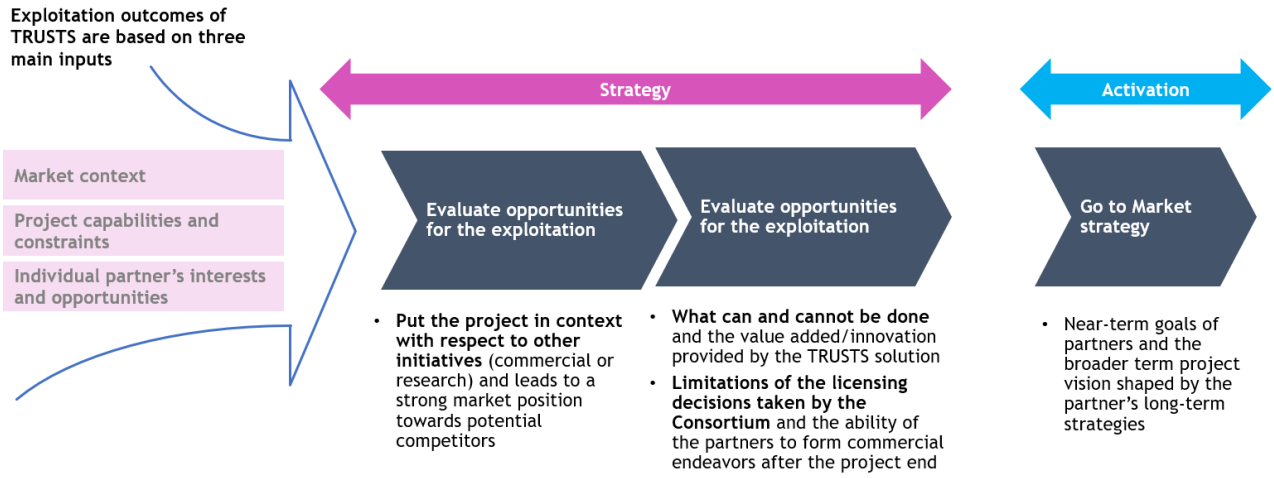

Figure 7 Exploitation pathway

The exploitation outcomes of the TRUSTS project are based on three main inputs:

1. **Market context:** it helps identify and evaluate opportunities for the exploitation, puts the project in context with respect to other initiatives (commercial or research) and leads to a strong market position towards potential competitors.

2. **Project capabilities and constraints:** they determine what can and cannot be done and the value added/innovation of the TRUSTS solution provides the uniqueness which will give project potential results in a commercial environment. Also included in this input are the limitations of the licensing decisions taken by the Consortium and the ability of the partners to form commercial endeavors after the project ends.

3. **Individual partner’s interests and opportunities:** the strategy for individual partners is driven by the near-term goals of those partners and the broader term project vision shaped by the partner’s long-term strategies. This long-term vision is as important as the near-term vision for leading TRUSTS towards maximum value and impact creation. Of course, the individual interests and opportunities are very much related to (i) the nature of the entity (for example, private for-profit entities vs. R&D non-profit entities) and (ii) the market opportunity that tangibly exists for the effective results of the project.

Key takeaways:

Data market growth: The forecast for the global data market size is expected to grow ranging from 2.7 billion in 2011 to a projected amount of 103 billion dollars in 2027 in revenue[67] . IDC estimates that around 30% of organizations (public/private) are actively searching for and developing new products and services reliant on shared data and services[68]. In addition, it is predicted that organizations that share data with their industry ecosystem will realize a revenue increase of 3% percentage points higher than nonparticipants[69].

Market competitors: Some data markets that have collapsed in recent years, and it shows the limitations of data trade and cross-company data interchange. Examples include Microsoft's Azure Data Marketplace, which shut down in 2017 due to a lack of demand after several years of operation, other examples are xDayta and Kasabi. Thus, lack of demand from data users might hinder data holders from using the TRUSTS platform.

Legal constraints: The legal framework imposes requirements on transferring data to third parties and other countries to guarantee that the degree of data protection is not jeopardized. The EU's stringent data protection law has been presented as a digital trade barrier at times. Different components of the digital single market are governed by the principles of competition law, intellectual property law, data protection and privacy legislation, (e.g., platform regulation, standardization, and interoperability under proprietary models of ownership, etc.).

Other TRUSTS value added services to consider:

- Consulting services
- Setup of local infrastructure e.g., corporate node
- Transaction insurance
- Storage, computing power
- Data services e.g., cleansing, visualization, de-anonymization risk analysis, quality check & valuation, etc.
- Bundled subscriptions to GAIA-X, IDSA, DIO, Dairo, etc.
- AI models training services
- Taxonomy and ontology modelling
- Training courses

[67] Global big data industry market size 2011-2027 | Statista

[68] *IDC FutureScape: Worldwide Future of Industry Ecosystems 2022*

[69] *FutureScape: Worldwide Future of Industry Ecosystems 2021*

4.1 TRUSTS Joint exploitation

Profit estimation:

For a company to be profitable, the revenues must exceed its costs. At the beginning of the activity, eventually the costs are higher than the revenues, but from a certain point on, revenues and costs start to balance out, so that in the end, the margin of revenues over expenses gives a positive balance originating profit.

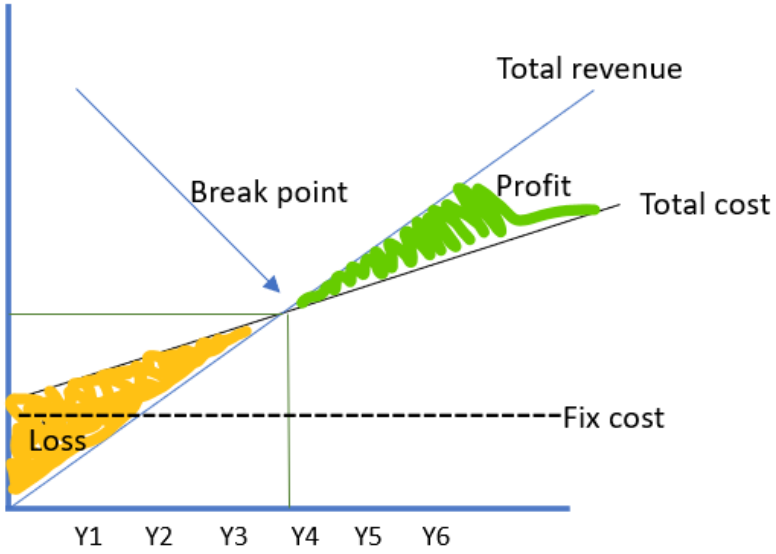

Figure 8 Break point

In a break-even analysis the total costs of a product consisting of fixed and variable costs are included and confronted by the potential revenues.

Specifying the costs up-front is needed and is hard to estimate. According to the basic economic principles, to start a business TRUSTS should book the minimum resources needed that will be surely used and adapt the resources to address the scalability needs.

Some of the costs can be also identified in different stages of the commercialization, but an initial breakdown of operational costs has to be estimated.

In terms of organizational structure cost, TRUSTS needs to invest in establishing the infrastructure, technical support, finance, administration, human resources, and management.

Support of the TRUSTS software modules: For operating the TRUSTS platform an agreement of the TRUSTS consortium on the issue of support, maintenance, and further development of the software components is needed. The TRUSTS platform "must-have", "good-to-have”, and “nice-to-have" have to be decided, and accordingly which software components should be maintained. The aim is to distinguish which components must be further maintained or developed for the basic operation of the platform ("must have"), which could be useful additions ("good to have") and which developments are rather optional ("nice to have").

Infrastructure: Based on the usage of the development/testing environment of the TRUSTS implementation, especially during the use case trials and taking into account the performance issues identified, but also factoring in the resources needed for the maintenance of the system, (backup, rollback and failover mechanisms, etc.) and the fact that at least a two-stage deployment environment will be needed in a fully operational, always on real-world production system, a rough estimation of the cost of the infrastructure would be at the order of 2000 euros per registered organization per month, for 1-2 small size datasets, not exceeding 500MB in total.

This is a rough estimation and should be considered rather as a minimum, based on the limited number of datasets and their small size, used in the use case trials in the google cloud platform used during the project, without any optimization.

A full and precise cost analysis is not possible in the limited implementation of the project since the usage is very reduced and controlled, and also the data transfer over the network and its implications cannot be calculated in this closed environment. Concurrent user access is also not factored in.

Technical support service: The average cost of an engineer in Europe is around 50.000 € a year, although there are some differences depending on the country. It is estimated that at least 1 full time engineer should be allocated for the quality assurance process, to identify and prevent errors and problems related to the services. This support is key for users to have a positive impression, and adds value to the platform, having a positive impact on the brand reputation.

Customer service: apart from the previous specialized support for technical issues, it would be convenient to use Chatbots for helping the customers needing quick solutions. AI technology enables pre- defined answers to troubleshooting problems or generally asked questions to reduce overall effort, cost, and time. This technology will incur initial cost for development but will need low monthly as well as maintenance cost later. Chatbots Cost estimation goes from 40€ to 400€/month.

Marketing costs: It is an essential cost for the TRUSTS solution to enter the market. Advertising can be done on different channels to attract different customers. For B2B customers, direct mail campaigns can be considered as a decent option whereas for B2C customers, business channels, magazines can be a word of mouth. Direct mail campaign is a prepaid expense and will not incur any additional costs whereas ads in magazines, business-networking sites and other business channels can vary depending on local or national ads and frequency of ads.

Costs of ad in magazines - 800€- 2400€/ad approx.

Costs of ads in business networking sites such as LinkedIn, depend on several factors, including target audience, campaign objective, and bid. On average the cost of ads is $5.26 per click, $6.59 per 1000 impressions, and $0.80 per send.

Within this chapter we should include the implementation of a professional webpage, that could serve as an entry point for commercialization, this implies the creation of all the corporate visuals logo, design of e-commerce website, and its maintenance.

Regarding the **revenues**, it is hard to make assumptions. The different revenue streams can be estimated by deciding how much for example one subscription might cost for a customer. Regarding these subscriptions they could for example offer three different levels - a base subscription, a business subscription, and an advanced subscription. They could also even offer additional consultancy subscriptions, where customers pay yearly in advance to then use the consultancy services whenever needed without paying extra. On top of that customers could be able to extend their subscription with the purchase of certain packages.

A basic subscription for the allowance to use the TRUSTS platform might cost the participant 89€ per month, or 1000€ yearly, which would mean a 68€ discount. The different levels of subscription then could add up to 200€ monthly for having access to a certain number of additional features and 350€ monthly for the advanced level, having more services available. Depending on how many analysis tools or support services are needed, the subscription packages could include more services but therefore simultaneously increase in price.

For what respects data suppliers, they have the power to decide the price of data, they can have fixed or dynamic pricing strategies, based on demand and supply of data, market dominance or the economic market conditions.

The pricing method can be divers, such as for instance:

- Flat Rates - Data suppliers can have fixed prices for regular data being generated
- Per Transactions Rates - Data-customers are basically charged upon the data shared/consumed. X GB of data sold for Y price. More units of data mean more price.
- Auctions - Large and valuable volumes of data can be sold off by bidding criteria to make more profits.

Also, differential licensing strategy could be used, based on creating a package price for customers in accordance with applications they use. Data analytical tools can be helpful for end users to compute and analyze data for their own benefit. And users can be charged for the tools they utilize.

In order to understand the costs for maintaining TRUSTS architecture and components (software modules), a survey has been conducted among the partners contributing to the development of the solution. As can be seen in the table below, they were asked to fill a questionnaire in which the estimated costs for maintaining and exploiting the different components had to be detailed and quantified.

As costs for running the platform, the IP acquisition, Equipment needed, and other CAPEX were envisaged. For what regards the operational structure costs linked to the exploitation of the platform, the cost of buying external data, potential external services, technical support, personnel cost, overheads, maintenance costs, etc. were listed.

	Topic	Initial CAPEX (EUR)	Value per new client setup	Annual value for YEAR 1 operation (EUR)	Estimated annual value for operation (EUR) - YEAR N
Initial investment					
TRUSTS platform					
1	IP acquisition				
2	Equipment				
3	Other CAPEX				
TRUSTS component exploitation -					
1	IP acquisition				
2	Equipment				
3	Other CAPEX				
Operational costs structure					
Costs linked to run and commercialise the TRUSTS platform					
1	External data				
2	Other external services				
3	Equipment				
4	IP licensing				
5	Platform technical support				
6	Sales & marketing cost (exc. Personnel)				
7	Personnel cost				
8	Overheads				
9	Maintenance/ R&D costs				
10	Other costs				
Costs linked to the Service/Component exploitation -					
1	Personnel cost				
2	External data				
3	IP licensing				
4	Other external services				

Table 4 Costs break-down table

TRUSTS common exploitation strategy at this point of the project has not succeeded, due to the heterogeneity of the partners, as it was predictable, not the whole Consortium members are commercially minded, since as already known, Universities, and research centers, do not have as their basic objective commercializing the outcomes coming from the projects, but rather to continue advancing their research in future collaborations and new funding opportunities.

On the other hand, during different meetings held during the project, a Consortium partner NOVA has expressed its interest in exploring the potential exploitation of the TRUSTS platform as a whole and providing a complete marketplace, and of such IP transfers/subcontracts with the rest of the Consortium partners for the different components. NOVA is one of the largest alternative fixed operators that provides broadband and pay TV services in Greece with more than 1 million subscriptions. NOVA invests in state-of-the art technologies and is fully exploiting its knowhow, offering a set of individual or bundled fixed telephony, broadband internet, and TV-content services (primarily DTH and also OTT), to customers, enterprises and Public Bodies throughout Greece. Currently, the company that brought internet, satellite TV and OTT services in Greece, has a chain of 132 shops in more than 60 cities all over the country.

NOVA commercialization and exploitation of the TRUSTS solution is foreseen under two different circumstances:

1. TRUSTS solution reaches the appropriate Technology Readiness Level (TRL 8-9), and all the functional requirements that were set during the project lifecycle have been successfully addressed.
2. The creation of a spin-off company that will act as a TRUSTS solution, where NOVA is keen on taking a leading role.

In parallel, also other options can be evaluated once the TRLs are more mature, e.g., operators with interest in exploring the TRUSTS solution or partnerships.

4.2 TRUSTS individual exploitation pathways

The exploitation plan is based on a detailed identification of the project’s results. For each of the results identified, the project partners have reviewed their ownership claims, both in background and foreground. The initial claims brought to the project and subject to intellectual protection (IP) can be found in the Consortium Agreement (CA). Together with the background knowledge from the research and development activities are to be monitored during the project implementation and will be the basis for the exploitation agreements.

Considering the above, the TRUSTS Partners have already cleared how they view their role in the commercial exploitation of results, presented in the following table:

Table 5 TRUSTS Consortium Individual exploitation pathways

Entity	Platform provider	Intelligence services provider	Subcontracting agreement for support / development	IP licensing	No involvement
	Operates a shared infrastructure enabling intelligence services providers to	Ability to deploy and/or manage an intelligence service to be provided through TRUSTS platform or stand-alone service	Deep knowledge or expertise regarding a service or its inputs	IP licensing of IP developed during TRUSTS project	Will not be involved in the commercialization (except for informal

	leverage it for their own business model				facilitation of contacts/ dissemination)
LUH					✓
SWC		✓ (Semantic layer T3.4)		✓ (GNU Affero)	
KNOW		✓ (Brokerage T3.6)	✓	✓ (Proprietary)	
TUD					
KUL					
FHF		✓ (Smart contracts (T3.2)		✓ (Apache License 2.0)	
RSA		✓ (De-anonymization/anonymization toolkit (4.3))		✓ (MIT License)	
G1					
IDSA					
DIO					✓
NOVA	✓				✓
PB					
EBOS					
LST		✓			
REL					
FORTH					
EMC Israel		✓			

(Compute intense neural networks over several nodes)

Moreover, consultancy services and data analysis tools could form the secondary revenue stream. They could be included within the subscription up to a certain extent or could be purchased in addition - when needed - by the customer.

The following are the individual exploitation plans for each of the partners that have identified results developed within the TRUSTS project:

FRAUNHOFER GESELLSCHAFT ZUR FÖDERUNG DER ANGEWANDTEN FORSCHUNG E.V. (FhG):

Being a university, FhG has by nature non-commercial interest, and its primary focus is to transfer research results into products that bring value to industrial customers. FhG is especially interested in pushing semantic and trust-preserving technologies with application to data markets forward and to the industry. Being an active contributor of technology components to the IDSA and its members, FhG will furthermore exploit TRUSTS results in enabling existing or new industrial customers to optimize their processes and products by making use of the semantic data integration and data market technologies, by providing them a competitive advantage by strengthening EU economy.

In the IPR table FhG have identified one result, the Smart contract executor, developed within Task 3.2. The software used for developing it has been the Hyperledger Fabric, and it is allocated in the Corporate Node.

FhG plans for exploiting it is through an Apache License 2.0, which is the more popular free-open-source software permissive license that has minimal requirements about how the software can be modified or redistributed.

RESEARCH STUDIOS AUSTRIA MBH (RSA)

As an applied research organization, spanning the gap between universities and markets, it is a non-profit research institution that manages innovations from universities to market in the domain of eTechnologies and Smart Media.

RSA aims to utilize the two connectors created within TRUSTS, to access data from the two initiatives Open AIRE and Europeana in the context of future work and research in the area of data spaces, especially in the domains of green technologies and cultural heritage. The connectors help to make the data from those two initiatives available in respective data spaces, which allows for the future creation of innovative data-driven applications. Furthermore, this path is in line with the goals of GAIA-X, which aims at the creation of a data-driven economy within Europe.

As a research institution the main path for exploitation of TRUSTS would potentially be in acquiring further public funding to research on aspects of TRUSTS.

In the IPR table have identified:

1. De-anonymization / anonymization toolkit: This tool combines risk analysis and anonymization to provide an integrated solution for the secure processing of personal information. This

component is not part of the core functions in the TRUST platform. In this case, RSA potential type of license for exploitation is the MIT License.
2. Metadata schema for data
3. Protocol for metadata exchange
4. Interoperability component: This is a core part of the TRUSTS platform, and the License envisaged for this component is the MIT License.

MIT license is a permissive license that has minimal requirements about how the software can be modified or redistributed, which cannot be used for commercial purposes and their modifications should follow the same license.

KNOW-CENTER GMBH RESEARCH CENTER (KC):

The protocols and algorithms developed by KC within the TRUSTS project will pose a steppingstone for future R&D activities in the fields of Data Security, Knowledge Discovery and Social Computing to include new fields of application. The integration of such technologies will allow increased visibility for KNOW as an expert in this field of research.

In the IPR table identified the following results:

1. Brokerage, developed within the task T3.6: It is a recommender system providing services proposing connections between datasets. The software used as baseline is the Know-Center ScaR recommender framework. It is allocated in the corporate node, and the plan for exploitation is in the form of Proprietary License.
2. PSI library PSIttacus, Protocol for private set intersection, is one of the outcomes of the WP4: This is a Java library that enables two parties to find identical data in their datasets without sharing the full sets with each other. The PSI protocol is based on the KC solution for Mobile Private Contact Discovery. It is running in the corporate node, and when exploiting the asset, the proprietary License will be used.

Of all types of licenses, the most restrictive is the **proprietary**, in which all the rights are reserved, and it is mostly used when the work may not be modified or redistributed.

An initial estimation of cost has been done, and it is displayed in the table below:

Table 6 KC estimation of costs for exploitation

		Cost	Initial CAPEX (EUR)	Description/comment
Initial investment				
Costs linked to the Service/Component exploitation -				
	1	Personnel cost		
	2	External data		
	3	IP licensing	5000	5000 per year for IP of ScaR recommender system
	4	Other external		
	5	Equipment	10000	Server or virtual hosting for recommender system to be
	6	Equipment		
	7	Overheads		
	8	Sales & marketing	3000	Min. 20h per year for technical support, with 150 euro
	9	Technical support		
	10	Maintenance/ R&D		
	11	Other costs		

SEMANTIC WEB COMPANY GMBH (SWC):

SWC is a software vendor and consulting company in the fields of semantic data and information management, data governance and lineage as well as metadata management.

The technologies resulted from TRUSTS can be directly applied in SWCs market penetration, by (i) improve existing products (as mainly SWCs core product PoolParty Semantic Suite, www.poolparty.biz) and (ii) expand the companies consultancy portfolio in the field of data & information management, data governance and metadata management. This will be done by (a) upselling activities for existing customers (~200 worldwide, mainly big corporations), (b) reach out to new customers.

The TRUSTS target market of (i) operators and (ii) financial services is partly covered by SWC (mainly the financial services market), nevertheless it is a huge market SWC wants to enter and establish.

The IPR table has identified one key exploitable result, the Semantic layer developed within the task T3.4, it is used in different components of the platform:

- In the Vocabulary Management System: a user interface where users can image vocabularies that are to be used throughout the platform. It is allocated in the central node. The software used for its development is PoolParty. SWC commercialization plan is in the form of proprietary license.
- In the Metadata Broker: Central metadata repository of the platform, compliant with the IDS communication protocol. It is allocated in the Central node, and Apache V2 is the type of license chosen for this application.
- In the metadata storage system: The triple store (database) where the metadata is stored in RDF format. The software used in this case is Apache Jena Fuseki, it is running in the central node and SWC is planning Apache V2 for licensing it.
- In the platform interface: The base component of the user interface that each node in the platform has, allows for onboarding, searching and consuming assets. CKAN is the software used, this component is running in the corporate node, and the form of license chosen is GNU Affero General Public License.
- In the IDS extension for CKAN: This extension is required to make the CKAN platform interact with the IDS components. This development is allocated in the corporate node, and also in this case the License planned is GNU Affero General Public Licence.

- In the Vocabulary extension for CKAN: This is required to have CKAN platform software to use the vocabularies in asset. It is also running in the corporate node, and the GNU Affero General Public License will be also used.

The GNU Lesser General Public License, LGPL allows linking open-source libraries, and facilitates the release of the new application under any new license (even a proprietary), when a code is compiled or linked with an LGPL library.

It is also worth noting that apart from the key exploitable results listed, there are additional outcomes derived from the TRUSTS project:

EBOS Technologies Limited:

EBOS has filed a patent for an outcome coming from the use case 1:

Adaptive Anti-Money Laundering (AML) Transaction Processing:

Official title of the application: 6200-023FR Compliance Resource Constrained Intelligent Scaling of Transaction Review. The patent has been filed in France, Germany, Belgium, and the USA.

Concept: Money laundering is the process of rendering illegally gained money - legal - hence "laundered”. Embodiments of the present invention address deficiencies of the art in respect to AML transaction processing and provide a novel and non-obvious method, system, and computer program product for adaptable AML transaction analysis. A data processing system adapted for adaptable AML transaction analysis, comprising a host computing platform comprising one or more computers, each comprising memory and at least one processor; and an adaptable AML detection module comprising computer program instructions enabled while executing in the host computing platform. It is utilized by the TRUSTS project and more specific throughout the trials of Use Case (Smart big-data sharing and analytics for AML compliance, led by EBOS) and the testing and evaluation of the TRUSTS Platform, as the baseline for the realization of the defined UC KPIs.

Building on the AML solution capabilities, EBOS designed, developed, and integrated new adaptive analytics algorithms and cognitive self-learning models into an upgraded AML module with new functionalities, to benchmark the performance improvements. The TRUSTS Platform sits at the center of data exchange between actors and facilitates the trading of the resulting data and data analytics services for a wide range of actors interested in progressing to the next step of AML compliance.

Another result for EBOS is: **Allied Federated Learning and Ensemble modelling approach to ensure data privacy and security**.

Concept: The use of the TRUSTS platform allowed the successful combination of the two techniques; Federated Learning (FL) and Ensemble modelling. *Ensemble learning* is a technique that aggregates different models that are trained on the same dataset, as a way to utilize the datasets from different users to increase the accuracy of the predictions and ensure data privacy. FL decentralizes ML by removing the need to pool data into a single location but as an alternative, the model is trained in multiple iterations at different locations without exposing any meaningful information about the end user’s datasets.

Hence, UCs used ensemble learning but with models that are trained on different datasets, which is part of the FL, and then aggregated these models using the dataset of the end-user as part of the ensemble learning. The combination of the ensemble techniques using FL procedure had a positive outcome on the results, considering the initial aim of this task as previously mentioned.

Using the two approaches, the opportunity of collaboration between different parties without exposing their private data to each other is achieved. Therefore, by preserving the data privacy, only the final results of local evaluations are aggregated with highly accuracy in the predicted results.

In this case **EMC Israel** has also participated in this result.

EMC Israel

EMC intends to utilize the smart contract demonstrator work as a basis for further investigation of blockchain and smart contract security issues post-project. The payment compatibility demonstrator showcases how it is possible to use more conventional payment systems in conjunction with smart contracts, while still leveraging the blockchain’s integrity guarantees, as opposed to using tokens or cryptocurrencies in tandem with the blockchain. Dell EMC is interested in further exploration of this approach, and both the security research and payment system research will continue after the project ends.

LSTECH ESPANA, S.L. (LST)

LST is a SME providing software services, building innovative Big Data analytics, specializing also in technologies and tools for auditing and regulation compliance with emphasis on privacy and discrimination issues. LST will use the knowledge and technologies acquired in the TRUSTS project to expand its activities in the emerging and competitive Data Markets domain. LST aims at offering through its portfolio innovative B2B applications in the area of privacy-preserving data management and secure data-sharing services adopting TRUSTS technologies.

Under the scope of task T5.2, LST developed the admin-dashboard of the TRUSTS platform, which is a basic but essential tool for monitoring the usage of the platform. Through an intuitive dashboard information related to registered organizations, users and data sets is available.

LST plans to exploit this component in two ways. First, by providing it directly as an add-on tool to the owner of the platform and second, using the acquired knowhow, as an add-on tool to any CKAN implementation.

In the first case, and since NOVA is interested in exploiting the TRUSTS platform as a whole and providing a complete marketplace based on that, a close collaboration is being discussed. In such a case, the implementation will be enhanced and customized accordingly to fit the requirements of the offering.

In the second case, LST will seek collaboration with CKAN in order to offer this component to the organizations that use it. An exploitation model will be discussed, either through an open-source offering or through a more extensive and customized implementation under a payment scheme.

4.3 Business model canvas

The business model canvas reflects various components identified across extant literature. The components of the business model can be grouped into three overarching categories [70] : (1) value creation, (2) value delivery, and (3) value capture.

Value creation describes how the company utilizes its resources to create value for its different customer segments. Customer segments are diverse groups of entities to which the business delivers value. The customer segment could be categorized based on sectors, income, and geographical location. To reach their distinct customer segments, Osterwalder & Pigneur [71] companies influence the overall customer experience by creating customer relationships. 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 it solves a problem or a customer's pain.

Value delivery is about the asset arriving at the customer. Chesbrough & Rosenbloom [72] conceptualize 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 and [73] 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 [74]. These are the channels, key resources, key activities, and key partners which broadly captures 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 specialization of partners. For example, a firm can

[70] Teece, D. J. (2010). Business models, business strategy and innovation. Long Range Planning, 43(2–3), 172–194. https://doi.org/10.1016/j.lrp.2009.07.003

[71] Osterwalder, A., & Pigneur, Y. (2010). Business model generation: A handbook for visionaries, game changers, and challengers

[72] Chesbrough, H., & Rosenbloom, R. S. (2002). The role of the business model in capturing value from innovation: evidence from Xerox Corporation’s technology spin-off companies. Industrial and Corporate Change, 11(3), 529–555. https://doi.org/10.1093/icc/11.3.529

[73] Chesbrough, H., & Rosenbloom, R. S. (2002). The role of the business model in capturing value from innovation: evidence from Xerox Corporation’s technology spin-off companies. Industrial and Corporate Change, 11(3), 529–555. https://doi.org/10.1093/icc/11.3.529

[74] Osterwalder, A., & Pigneur, Y. (2010). Business model generation: A handbook for visionaries, game changers, and challengers.

outsource human resource management to a company specializing 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 monetization of created and delivered value. Many businesses assume that when they create a product or service, the customer will pay for it [75] . According to Teece [76] 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 [77] . The trade of such goods requires a revenue model that captures value from the sale of a solution, not an item. The revenue model includes the revenue streams and the pricing model. Osterwalder & Pigneur [78] 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.

5 SWOT and critical success factors

5.1 SWOT analysis

The analysis of Strengths, Weaknesses, Opportunities and Threats for TRUSTS position shows that if we consider the internal environment, for what regards the strengths and weaknesses, it can be said that the fact that TRUSTS is a Proof of concept derived from a EC-funded project could ensure reliability for their potential clients or investors. Moreover, data integrity and data quality are highly valued which is important for a meta-platform to be trustable.

However, weaknesses are that the meta-platform requires a large installed base such that there can be benefited from network effects, which is a strong requirement to make TRUSTS a commercial success.

[75] Teece, D. J. (2010). Business models, business strategy and innovation. Long Range Planning, 43(2–3), 172–194. https://doi.org/10.1016/j.lrp.2009.07.003

[76] Teece, D. J. (2010). Business models, business strategy and innovation. Long Range Planning, 43(2–3), 172–194. https://doi.org/10.1016/j.lrp.2009.07.003

[77] Teece, D. J. (2010). Business models, business strategy and innovation. Long Range Planning, 43(2–3), 172–194. https://doi.org/10.1016/j.lrp.2009.07.003

[78] Osterwalder, A., & Pigneur, Y. (2010). Business model generation: A handbook for visionaries, game changers, and challengers

Furthermore, at this point there is not a reputation or brand name build yet, which can lead potential customers to be reluctant to join the platform. A brand name can be built by choosing the right marketing strategy that suits the core values of TRUSTS.

Considering the external environment, for what respects opportunities and threats, the opportunity is that it is a relatively new, and an unsaturated market. There is room and flexibility to adapt TRUSTS to the customer’s needs. However, as it is a relatively new market, there is not much known about the customer market. Threats can then be that the perception of the customers are negative to TRUSTS concept. User acceptance towards the platform can be influenced by various factors such as ease of use, the value created by the platform, ease of access, transaction and maintenance costs, security, and the available resources on the platform.

Also, impacting TRUSTS sustainability and specially when we are talking about federation, are the standardization aspects, because standards applicable to data markets are still not clearly defined, and the future of the data markets growth depends on technological standards allowing data interchange.

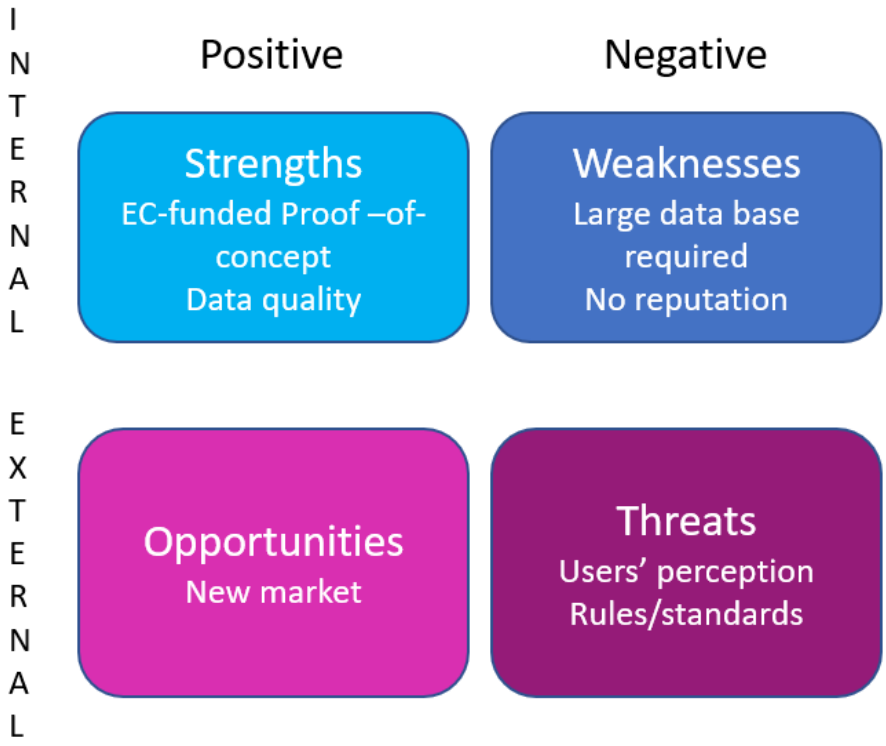

Figure 9 TRUSTS SWOT analysis

In conclusion, the internal strengths that are most important are the reliability and safety, on which should be built. Furthermore, there are internal weaknesses as well, which can be encountered by a right marketing strategy such that the installed base can grow, and thus can be benefited from network effects. For the external environment, it can be concluded that there is a lot of flexibility to apply TRUSTS solutions to the customers.

5.2 Critical success factors

TRUSTS platform should pay attention to some challenges that any data market needs to overcome:

Data cataloguing and discoverability: As the platform grows, the volume and variety of data collected makes indispensable having a good data catalogue, becoming very needed to find the data in question by searching for it, making it simple to explore data and prepare for analysis. Data cataloguing is the foundation for an efficient platform.

Data valuation and pricing: For a healthy data market, it would be convenient to have neutral references known by the players, to avoid the price fluctuation of the data product, these market references should have to consider the particularities of the data to be traded, and its dependencies to the consumers unequal value.

Uncertainty for customers for what regards the outcome of the purchasing, potential buyers need to test the data and know its value before executing a transaction and certify that the information is coming from a trusted data seller.

Data ownership: It is of the utmost importance an effective data provenance to establish ownership and tracking the data traded spread in the market. This concept includes combatting data hacking, to make the marketplace trustable. This is critical when data is easy to copy and transmit without cost, and there is a lack of authorship notion. It won’t be feasible for a marketplace to succeed if anybody can obtain a dataset, process it and resell it possibly at a lower price offering again the dataset to the same or other marketplace.

Revenue sharing: The fair compensations to data providers should be in accordance with the value they can bring to the market, and the platforms have to put accountancy measures for them, providing transparency during the whole trading process.

It is difficult for a data provider to be present in all of the existing data markets, and also for data demanders it is hard to find and compare data and prices across the data platforms, and this is due to the current fragmentation of the data markets.

In this sense, TRUSTS platform introduces the concept of an overlaid standardized infrastructure to securely handle data across the digital domain, to consolidate an ecosystem of data trading options, clustering data and services in a trustable and open manner.

6 Conclusions and Next Actions

Computing, electronics, and digital communications have resulted in an increasingly automated data collection, and in the current context of the major digitalization of the economy, a myriad of applications and data-hungry machine learning models are helping companies and public institutions to improve their efficiency. As a result, Marketplaces are enablers for the exchange of data, platforms on which data assets can be listed, offered, accessed, and traded. Marketplaces enable trade by offering services for buying and selling data, finding datasets, and obtaining access to vendors.

The pricing of data is a challenge and different entities are applying different mechanisms to set revenue, and maximizing prices to data products, often in specific contexts. These mechanisms include auction design, differential privacy, pricing of different queries to a single database and quality-based pricing. In the case of TRUSTS, the subscription model should not be the preferred option, as it will make the platform less accessible, since users who do not plan on using the platform frequently, will not invest that subscription fee, especially smaller start-ups. Viable options could be the freemium and the transaction fee-based revenue models.

A key factor for the commercialization of the TRUSTS platform are the user acceptance and the willingness to pay for the data itself. It is known that some data markets have not succeeded in recent years, showing the limitations of data trade and data interchange. Data holders still have few incentives to sell their data, they are not considering the potential monetization of these datasets, the demand from data users is uncertain ahead of time, and the low willingness to pay for data is a challenge to overcome.

Most of the challenges for TRUSTS to overcome is trust, on the one side, sellers need to feel the absolute control of their data, and the platform has to commit that data is not replicated and resold or used without their authorization. On the other hand, data demanders need to test the datasets and know its utility beforehand, together with some kind of certification that the data comes from a trusted source.

At the present, the more successful data markets are difficult to replicate, they are service providers horizontally integrated, not really sharing but protecting their data assets, and exploiting data gathered from the internet, their user base, or the data acquired from partners. This information is after processed and combined to nourish more refined and elaborated services to the end user.

For TRUSTS to become a one-fits-all solution we should demonstrate that TRUSTS business model is feasible in the long term and how it will be monetized, which is the inventory of data products offered, and avoiding that the data providers sell their data on their own.

There are still additional strategies for TRUSTS to reinforce its value proposition with respect to the competitors, which are:

- Offering **tailor-made services to specific sectors**, specialization can generate a lot of satisfaction and create barriers to entry for new competitors.
- **Bundling services**: This model brings together a combination of several services into a single offer so that the services become more cost-effective, drive competitors out of the market and offer cross-selling opportunities.
- **Standard service**, offering the same service to all buyers, i.e., banks selling reports based on aggregated, anonymous data on the spending patterns of its customers. This service would allow affordable discounts and scale-sensitive margins.

Taking into consideration the heterogeneity of the data and potential use cases, TRUSTS could start focusing on certain industries or types of data. Niche data markets may have advantages over general purposes because focusing on specific expertise facilitates value-added services both to buyers and sellers along with data sharing. Also, as the platform’s resources can be then adapted to the type of data traded, allowing specific concentrated commercial efforts on attracting specific segments of end-users. On the other hand, specializing in a niche market means targeting a much smaller size, and the concept of one-stop-shop for any kind of data is more feasible. On the other hand, selling data to be used within a specific environment significantly reduces the risk of replication, and provides more accurate, specialized and therefore valuable data.

For TRUSTS to consolidate should intensify the task of acquiring users, expanding the number of customers through marketing campaigns, to build a minimum viable base, and then TRUSTS strategic plan should be going towards a distributed specialized exchange platform.

Other key aspects for TRUSTS to use as sales pitch:

- Secure data sharing space
- Provide user-friendly service
- Legal and ethical environment embedded
- Platform federator: Meta platform with other data markets, data interoperability and quality following the standards’ framework.

According to what has been detailed in this section, the time estimated for TRUSTS to be suitable for commercialization is 2-3 years. Needed to implement:

Technical Support services

Security and Risk assessment: TRUSTS must ensure the security and safety of the environment by design, TRUSTS infrastructure, components, key messages to be launched to the market, branding and visual identity should reinforce the safety and security aspects of the platform and build a reputation.

The manual process of locating relevant system vulnerabilities is not sufficient to keep a system up-to-date and safeguard against cyber-attacks. An automated vulnerability scanner which generates reports should be utilized.

Data quality controls and cleanliness: Clean, consistent, and correct data significantly increases the quality of a marketplace. Accountability and quality of data need to be handled in scalable and automated ways.

Data classification: it is of the utmost importance to maintain the data classification within the catalogues offered, as explained in the previous section.

Certification: The TRUSTS platform should ensure full compliance with the principle of proactive responsibility, allowing the traceability of the legal controls, and complying and demonstrating the compliance to third parties.

Billing functionality: What is available in the current platform contains only the base function which enables the customers to pay for their services and datasets. When the platform is to be operated in real life, the payment systems have to be further elaborated.

Partnership program: This is a common mechanism for enriching the ecosystem by encouraging companies to join the program. This could be done by levels, Gold, Silver, and Bronze for example, in

which each type of stakeholder is required to meet certain criteria to reach a level. On the other hand, Partnerships with GAIA-X and IDS would give TRUSTS an advantage when entering the market

Market segmentation: If finally TRUSTS decides to specialize in a niche segment, it would be advisable to choose the one already tested within the TRUSTS implementation, and in fact, the sector on which the three use cases implemented during the project have pivoted (UC1 Anti-money laundering, UC” The agile marketing through data correlation, UC3 Data acquisition to improve customer support services), which is the **financial-banking sector, being Piraeus Bank (TRUSTS Consortium member), a potential early adopter**.

European banks are strongly connected with the European Central Bank and thus have a lot of regulations. As a result, they face a lot of difficulties due to the acceleration of digitization by threats of high tech, digitized payment companies such as PayPal, Adyen and Square as they are not strongly connected with the central banks. If they want to stay competitive in the market, they need large databases to rapidly digitize their working processes. Furthermore, banks need data to form a risk profile, which must be done as good as possible and preferably via a consistent, digital way. Moreover, European banks must be careful in handling customer information, making TRUSTS meta-platform a good ally.

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7 Annex

Entities revised, listed by alphabetical order:

Entity	URL	Business model
1DMC	https://1dmc.io/	DM
Advaneo	https://www.advaneo-datamarketplace.de/en/	DM
Airbloc	https://airbloc.org/	PIMS+DME
Aircloak	https://aircloak.com/	DME
AMO	https://www.amo.foundation/	DM
Atoka	https://atoka.io/	DP
AWS Marketplace - Data Exchange	https://aws.amazon.com/marketplace/	DM
Azure	https://azure.microsoft.com/en-us/services/open-datasets/	DM
BattleFin	https://www.battlefin.com/	DM
Benzinga	https://www.benzinga.com/apis/	DP
Bloomberg EAP	https://www.bloomberg.com/professional/product/enterprise-access-point/	DP
BookYourData	https://www.bookyourdata.com/	DP

BronId	https://www.bronid.com/	SP
BurstIQ	https://www.burstiq.com/	DM
Carto	https://carto.com/	PMP
Caruso Dataplace	https://www.caruso-dataplace.com/	DM
citizenme	https://www.citizenme.com/	Survey PIMS
Cognite	https://www.cognite.com/	Embedded DM
Convex	https://convexglobal.io/	DM
Crunchbase	https://www.crunchbase.com/	PMP
Cybernetica	https://cyber.ee/	DME
datablockchain.io	https://www.datablockchain.io/	DME
Databroker	https://databroker.global/	DM
Dataeum	https://www.dataeum.io/	PIMS+DM
Data Intelligence Hub	https://dih.telekom.net/en/	DM
Data Republic	https://www.datarepublic.com/	Embedded DM
DataPace	https://www.datapace.io/	DM
Datarade	https://datarade.ai/	DM
DataScouts	https://datascouts.eu/	DP
Datasift	https://datasift.com/	SP

Datavant	https://datavant.com/	DME
DataWallet	https://datawallet.com/	PIMS+DM
Datum	https://datum.org/	PIMS+DM
Dawex	https://www.dawex.com/en/	DM
Decentr	https://decentr.net/	PIMS+DM
DefinedCrowd	https://www.definedcrowd.com/	DP
dHealth Network	https://dhealth.network/	DME
Digi.me	https://digi.me/	PIMS+DME
Enigma	https://www.enigma.co/marketplace/	DP
ErnieApp	https://ernieapp.com/	Survey PIMS
Factset	https://www.factset.com/marketplace#/	PMP
Factual	https://www.factual.com/	SP
Fysical	https://fysical.com/	DP
GeoDB	https://geodb.com/en/	PIMS+DM
Google Cloud Marketplace	https://cloud.google.com/marketplace	DM
GXChain	https://en.gxchain.org/	DME
Handshakes	https://www.handshakes.com.sg/data.html	DP
HAT	https://www.hubofallthings.com/	PIMS+DME

Health Verity	https://healthverity.com/	DM
HealthWizz	https://www.healthwizz.com/	PIMS
HERE	https://developer.here.com/products/platform	PMP
HxGn Content	https://hxgncontent.com/	DP
Intrinio	https://intrinio.com/	DP
IOTA	https://www.iota.org/	DM+DME
Knoema	https://knoema.com/	DM
Kochava	https://www.kochava.com/	PMP
LemoChain	https://www.lemochain.com/	DME
LiveRamp	https://liveramp.com/our-platform/data-marketplace/	PMP
LonGenesis	https://longenesis.com/	DM
Lotame	https://www.lotame.com/	PMP
Madana	https://www.madana.io/	DM
Meeco	https://www.meeco.me/	PIMS+DME
MedicalChain	https://medicalchain.com/en/	PIMS+DME
Mobility Data Marketplace	https://www.mdm-portal.de/	DM
Multimedia Lists	https://multimedialists.com/	DP
mydex	https://mydex.org/	PIMS+DM

Ocean Protocol	https://oceanprotocol.com/	DME
OpenCorporates	https://opencorporates.com/	DP
Openprise	https://www.openprisetech.com/	PMP
Oracle DMP	https://www.oracle.com/data-cloud/products/data-management-platform/	Embedded DM
OSA Decentralized	https://osadc.io/en/	SP
Otonomo	https://otonomo.io/platform/	DM
People.io	http://people.io/	Survey PIMS
Quandl	https://www.quandl.com/	DM
Qiy Foundation - DigitalMe	https://www.qiyfoundation.org/	DME
Quexopa	https://quexopa.io/	DP
Refinitiv	https://www.refinitiv.com/	PMP
Salesforce	https://www.salesforce.com/products/marketing-cloud/data-sharing/	DM
SAP data marketplace	https://discover.sap.com/data-marketplace/en-us/data-marketplace.html	Embedded DM
SayMine	https://saymine.com/	PIMS
Skychain	https://skychain.global/	DM
Snowflake	https://www.snowflake.com/	Embedded DM
Streamr	https://streamr.network/	DM

TelephoneLits.Biz	https://www.telephonelists.biz/	DP
Terbine	https://terbine.com/	DM
The Adex	https://theadex.com/#	PMP
TheTradeDesk	https://www.thetradedesk.com/us	PMP
Sales Leads	https://www.salesleadsinc.com/	DP
v10 data	http://www.v10data.com/	DP
Veracity	https://www.veracity.com/	DM
Vetri	https://vetri.global/	PIMS+DM
Vinchain	https://vinchain.io/es	SP
Webhose.io	https://webhose.io/	DP
Weople	https://weople.space/en/	PIMS+DM
Wibson	https://wibson.org/	PIMS+DM
Xignite	https://www.xignite.com/	DP
Zenome	https://zenome.io/	DM