Feasibility Study Consolidated Report

SimpI-Live

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List of Abbreviations

Abbreviation	Definition
AI	Artificial Intelligence
API	Application Programming Interface
DestinE	Destination Earth
DG	Directorate-General
DGA	Data Governance Act
DS4SSCC	Data Space for Smart Cities and Communities
DSSC	Data Space Support Centre
DVA	Data Veracity Assurance
DVCT	Data Value Chain Tracker
EU	European Union
EC	European Commission
EHDS2	European Health Data Space for Secondary Use of Data
eIDAS	Electronic IDentification, Authentication and trust Services
EiO	Entry into Operation
EOSC	European Open Science Cloud
ePO	eProcurement Ontology Documentation
GDPR	General Data Protection Regulation
IDSA	International Data Space Association
LDS	Language Data Space
MVP	Minimum Viable Product
PDH	Personal Data Handling
PDHA	Personal Data Handling Assessment
PDI	Personal Data Intermediary
PoC	Proof of Concept
PPDS	Public Procurement Data Space
PRE-PROD	Pre-Production
PROD	Production
SC1	Specific Contract 1

Abbreviation	Definition
SCDS	Smart Communities Data Space
UI	User Interface
UX	User Experience
VLA	Veracity Level Agreement

Table 1. List of Abbreviations

Glossary

Term	Definition[1]
Application Catalogue	Application providers publish their service descriptions to the application catalogue which can be queried and discovered by consumers.
Authentication provider federation	An Authentication Provider Federation is a collaborative arrangement between multiple authentication providers that enables users to authenticate seamlessly across different systems, organisations, or services using a unified and interoperable framework. This federation facilitates the sharing of authentication credentials and ensures a consistent and secure authentication experience across various platforms.
Capability	Capability refers to the inherent power, capacity, or potential of the Data Space to perform specific tasks or achieve certain outcomes. This could involve the ability to integrate, analyse, and share data across different systems, the capacity to handle large volumes of data, or the potential to support complex data-driven processes.
Consent	Consent of the data subject describes any freely given, specific, informed and unambiguous indication of the data subject's wishes by which he or she, by a statement or by a clear affirmative action, signifies agreement to the processing of personal data relating to him or her; (GDP R Art. 4(11)).
Data Space	The term Data Space describes distributed system defined by a governance framework that enables secure and trustworthy data, application, and infrastructure transactions between participants while supporting trust and sovereignty. A Data Space is implemented by one or more infrastructures and enables one or more use cases.
Data Space participant	A Data Space participant is a party that has committed to the governance framework of a particular Data Space and may have one or more roles in it.
Data Space Support Centre (DSSC)	The Data Spaces Support Centre establishes and operates a support platform for Data Spaces in order to implement the goals of the "European Strategy of Data".
Data usage contract	An agreement between a data rights holder or data provider, and a data recipient specifying the terms and conditions of a data exchange, which may refer to specific data policies.
Destination Earth (DestinE)	The DestinE aims to develop a highly detailed and interactive digital twin of the Earth to aid EU policymakers and other users in responding and adapting to environmental changes.
DS4Skills	The Data Space for Skills (DS4Skills) is a 1-year project aiming to prepare the ground for the development of an open and trusted

[1] Note: The definitions were retrieved from the following sources on July 2024: Simpl Programme Glossary and Simpl Programme Actor Definitions.

Term	Definition[1]
	European Data Space for Skills that supports sharing and accessing skills data.
DS4SSCC blueprints	The DS4SSCC Blueprints provide a framework for secure Data Spaces in smart communities. Key components include a governance scheme for roles and legal frameworks, a technical blueprint for infrastructure standards, and a roadmap for developing a pan-European Data Space, refined through local pilots.
End user	An end user describes either a real person (human actor) that interacts with the Simpl-Open agent mostly through the UI or IT system (machine actor) that interacts with the Simpl-Open agent through APIs.
European Health Data Space for Secondary Use of Data (EHDS2)	The EHDS2 is an EU ecosystem comprised of standards, IT infrastructures and governance rules enabling cross-border utilisation of health data for research, innovation, policy, and regulation.
European Open Science Cloud (EOSC)	The EOSC aims to create a human-centric, trusted and secure digital environment, enabling researchers to seamlessly transition to a new way of working to interconnect and share data and expand the borders of science.
Feature	A feature is a distinctive attribute or characteristic of the Data Space platform that contributes to its overall functionality. Features are specific aspects or components designed to provide particular services or tools to users, enhancing the user experience or enabling specific operations.
Functionality	Functionality refers to the range of operations and tasks that the Data Space is designed or expected to perform. It encompasses the practical uses and applications of the Data Space, ensuring that it serves its intended purpose effectively. Functionality includes both the basic operations (e.g., data storage, data querying) and more complex operations (e.g., automated data processing, real-time data analytics) that the Data Space may support.
Gaia-X	Gaia-X is an initiative that develops, based on European values, digital governance that can be applied to any existing cloud/ edge technology stack to obtain transparency, controllability, portability and interoperability across data and services.
Identity provider federation	An Identity Provider Federation is a collaborative arrangement between multiple identity providers that allows for the sharing and mutual recognition of user identities across different organisations, domains, or services. This federation enables users to use a single set of credentials to access multiple systems or services, thereby simplifying the authentication process and enhancing user convenience while maintaining security and trust.
International Data Space Association (IDSA)	The International Data Spaces Association (IDSA) is a non-profit organisation focusing on establishing and promoting standards for Data Spaces – trusted environments where organisations can share

Term	Definition[1]
	data while retaining full control over its use.
Language Data Space (LDS)	The LDS aims to implement a European platform and marketplace for the collection, creation, sharing, monetising and re-use of multilingual and multimodal language data to power the development of language technologies.
Ontology	An ontology is formalised and structured knowledge within a specific domain. It includes the concepts (also called the vocabulary) as well as the relationships between the concepts. For the use of the automatic validation, the ontology should be provided in a Resource Description Framework Schema (RDFS) or Web Ontology Language (OWL) specifications.
Participant	A participant is an entity that has successfully passed the approval or acceptance in the application process and is now actively involved or engaged in the services offered by the applied Data Space. Participants are either governance authority, data providers, application providers, infrastructure providers or consumers.
Personal Data Intermediary	A Data Governance Act (DGA) data intermediation service that allows data subjects to independently and from a single point.
Policy	Policies define rules that Providers want to enforce in order to control the access and usage of their resources.
Public Procurement Data Space (PPDS)	The PPDS aims to create a comprehensive Data Space consolidating public procurement data across Europe and providing interoperability through common data semantics
Quality Rules	Quality rules can be defined as a set of guidelines, standards, or criteria used to assess and ensure the quality of a self-description.
Self-description (Technical term for 'resource description')	A metadata record that providers use to describe themselves, their data product offerings, and the resources and services their data products are composed of.
Simpl-Live	Simpl-Live focuses on the practical deployment of Simpl-Open within specific Data Spaces, conducting feasibility studies and providing tailored solutions for integration.
Simpl-Open	Open-Source Smart Middleware for Cloud-to-Edge Federations and Data Spaces.
Smart Communities Data Space (SCDS)	The SCDS aims to empower European cities and communities to contribute to and benefit from shared cross-sectoral data resources to facilitate the development of interoperable national, regional, or local Data Spaces.
Usage Contract	A usage contract is the signed agreement between a provider and a consumer, that stipulates the type of services a provider offers to the consumer and includes the conditions and policies the service, provider, and consumer needs to adhere to. The usage contract is formed and signed by both the Provider and Consumer during the

Term	Definition[1]
	contract negotiation process. The usage contract is afterward used as an immutable credential by the Provider and the Consumer.
Usage Policy	Usage Policies are policies defined by the provider for the usage of their resource in a Data Space. The policies regulate the permissible actions and behaviours related to the utilisation of the accessed data/application/infrastructure. A usage policy defines what actions can be undertaken on a resource by what consumers and under what constraints
Simpl-Open Terminology	Please refer to the Simpl-Open glossary for all Simpl-Open complementary terminology.

Table 2. Glossary

Executive Summary

In order to support, promote and develop the European Union's major data initiatives, the European Commission has launched the Simpl programme with the aim of developing three products simultaneously. First, Simpl-Open, an open-source middleware that will enable interoperability in Data Spaces and increase data sharing. Second, Simpl-Labs, an experimental sandbox for testing the integration of the Simpl middleware in different Data Spaces. Third, Simpl-Live, in the form of specific integrations of Simpl-Open in Data Spaces defined and funded by the European Commission. This report presents the consolidated results of the Simpl-Live studies carried out by the contractors, Sovereign-X, during the year 2024, in the execution of the Specific Contract 1 (SC1) of the Simpl Framework contract.

The main objective of Simpl-Live was to analyse the feasibility of integrating Simpl-Open into six Data Spaces defined by the European Commission, namely, the Public Procurement Data Space, the European Health Data Space of Secondary Data, the Language Data Space, the European Open-Source Cloud Initiative, Destination Earth and the Smart Communities Data Space. The aim of the feasibility analysis was to provide input on the following three aspects: (1) Identification of shared requirements across Data Spaces; (2) List of additional (functional and non-functional) requirements per Data Space; (3) Integration strategy for each Simpl-Live Data Space.

This consolidated report provides the general considerations and comments to understand the overall methodology, overarching results, conclusions and limitations of Simpl-Live and must be read in conjunction with the specific Data Space feasibility study report. By enhancing interoperability, improving data governance, and fostering collaboration, Simpl-Open is well-positioned to support the EU's vision of a cohesive and secure digital ecosystem. For a successful integration, the integration scenario needs to be adapted to the Data Space's requirements, as they differ in maturity.

One of the key findings of this study is that the methodology used to analyse the feasibility of Simpl-Open integration proved to be adequate to engage with the Data Spaces, understand their needs towards Simpl-Open and increase their willingness and readiness to integrate the software. This methodology can also be used for further studies for the Data Spaces funded by the European Commission, but also for other European Data Spaces willing to integrate Simpl-Open into their daily operations.

As a result of the feasibility studies, this report provides the European Commission with a list of common requirements and needs of the selected Data Spaces towards Simpl-Open. This list of requirements could be included in the development backlog of Simpl-Open in order to further incorporate the needs of the Data Spaces into new functionalities of Simpl. Additionally, opportunities are identified for Simpl-Open to re-use existing solutions already developed and implemented by the selected Data Spaces, once their benefits for the wider Data Space community are validated.

In addition, the studies propose integration scenarios for all Data Spaces and integration roadmaps for all six Data Spaces. These integration scenarios were first discussed and socialised with representatives of the Data Spaces and are based on the current development of Simpl-Open and the feedback from the Data Spaces. The studies will serve as a guideline for the integration of Simpl-Open in the next phase of the programme.

1 Introduction

The Simpl programme represents a significant initiative within the European Union (EU) aimed at addressing the challenges posed by the rapid expansion of data in today's digital era. With data volumes growing exponentially, Simpl seeks to provide solutions that promote efficient data sharing, enhanced security, and effective governance.[2]

At its core, Simpl is aligned with the EU's objectives of fostering innovation, competitiveness, and societal progress. It aims to bridge the gap between the private and public sectors by facilitating collaboration and data exchange securely and transparently. By doing so, Simpl seeks to create an environment where stakeholders from various sectors can leverage data to drive innovation and address societal challenges.

One of Simpl's key objectives is to provide a common middleware to support the development of Common European Data Spaces, which are interconnected ecosystems where data can flow freely across borders and sectors. These Data Spaces are intended to serve as the foundation for Europe's digital future, enabling stakeholders to derive value from data while ensuring data sovereignty and privacy.

Simpl-Open, an open-source middleware platform designed to power Data Spaces and other cloud-to-edge federation initiatives, is at the centre of the Simpl programme. Simpl-Open provides a scalable and interoperable framework that allows organisations to share data securely and collaborate effectively. Additionally, Simpl-Open prioritises data sovereignty, ensuring that data providers retain control over their information.

Simpl also includes Simpl-Live, which serve as complementary component of the programme. Simpl-Live focuses on the practical deployment of Simpl-Open within specific Data Spaces, conducting feasibility studies and providing tailored solutions for integration.[3]

This consolidated report provides the general considerations and comments to understand the overall methodology, overarching results, conclusions and limitations of Simpl-Live and must be read in conjunction with the specific Data Space feasibility study report. As the name suggests, this consolidated document provides general information on how the studies were carried out, presents the methodology used, gives general considerations on the different studies, presents the general results related to the Simpl-Open operating model, the list of requirements proposed by the Data Spaces for the further development of Simpl-Open, among others. In the same way, this document refers to the specific studies of the selected Data Spaces in order to facilitate the joint reading of these two documents.[4] This document also presents the methodology and results of the Personal Data Handling Assessment (PDHA) conducted under these studies to precise the requirements from data spaces to exchange and process personal data. This document does not contain the details of each Data Space in relation to the integration scenario, the implementation roadmap and the resource plan developed. This information can be found in each of the specific feasibility studies. Links to feasibility study reports are provided in *Chapter 4 Feasibility Study Reports.*

[2] Cf. European Commission (EC), “Shaping Europe’s digital future”, (2024). Simpl: Cloud-to-edge federations empowering EU data spaces | Shaping Europe’s digital future

[3] Ibid.

[4] Note: The study's findings are based on information gathered up until July 2024, when the collection of inputs for Simpl-Open and Data Spaces was completed. Final alignment with the Data Spaces occurred in August and September to discuss integration scenarios.

2 Purpose and Content of the document

This document serves as the consolidated report for all conducted feasibility study reports on the Data Spaces in scope, representing the second deliverable of Task 2 within the Simpl-Live Feasibility Study of Specific Contract 1 under the Framework Contract CNECT/2022/OP/0132.

The primary objective of the feasibility study is to assess the viability of integrating Simpl-Open into six selected Data Spaces/initiatives:

- Public Procurement Data Space (PPDS).
- European Health Data Space for secondary use of data (EHDS2).
- Language Data Space (LDS).
- European Open Science Cloud (EOSC).
- Destination Earth (DestinE).
- Smart Communities Data Space (SCDS).

The feasibility studies aim as well to use the insights gathered to feedback to Simpl-Open and identify additional common requirements of the Data Spaces to consider in the requirement definition process of Simpl-Open. It plays an integral role in facilitating decision-making and planning for the integration of Simpl-Open into the selected Data Spaces, contributing to the advancement of data interoperability and collaboration within the European Union.

The document serves as a primary reference for stakeholders involved in the Simpl-Live project, offering insights into the status and progress of the feasibility study. *Chapter 4* contains the list of individual Feasibility Study Reports per Data Space, including links to the respective reports, which provide detailed overviews of each Data Space, and the scenario suggested to integrate Simpl-Open.

Consequently, this document presents the comprehensive synthesis of the analysis, and results of the Simpl-Live feasibility studies conducted for the selected Data Spaces in scope, culminating in recommendations for an effective integration of Simpl-Open. This document structured into eight chapters and additional appendices, described below.

The chapter *1 Introduction*, outlines the ambition behind Simpl-Open and its integration into the selected Data Spaces. The chapter *2 Purpose and Content of the document* contextualise this report in the overall programme of Simpl-Open and briefly outlines the chapters contained in this document. The chapter *3 Methodology* outlines the strategic approach to the assessments conducted. The chapter *4 Feasibility Study Report* comprises all studies including the reference to respective accompanying materials. Indicative findings across all Data Spaces that need to be addressed as an identified common ground will be elaborated in the chapter *5 Overarching Results*.

This document concludes with the chapters *6 Conclusions, 7 Limitations,* and *8 Recommendations and Outlook* to empower respective decision-making toward an Simpl-Open integration. Finally, additional appendices round out the consolidated study report with additional material that was generated over the course of the feasibility study report creation (i.e., Inception Report, Simpl-Live Integration Operating Model, Integration Roadmap, List of requirements).

3 Methodology

The feasibility study of integrating Simpl-Open into selected Data Spaces operates on a meticulous methodology outlined in the Inception Report.

This strategic approach ensures a thorough assessment through documentation review, workshop insights, and surveys. Continuous collaboration with Simpl-Open drives project efficiency and aligns goals across teams. Sequential actions – Collect, Assess, Map, Conclude, and Define – guide the evaluation process, focusing on fit-gap analysis and practical implementation strategies. Regular alignments with Simpl-Open facilitate feedback integration and ensure coherence with project objectives. *Figure 1* summarises the methodology.

The Feasibility Study Roadmap delineates a structured plan across five phases, building on iterative methodology to drive progress. This comprehensive approach promises a holistic assessment and sets the stage for the seamless integration of Simpl-Open into diverse Data Spaces.

Further details are available in the Inception Report provided in ***Error! Reference source not found.***.

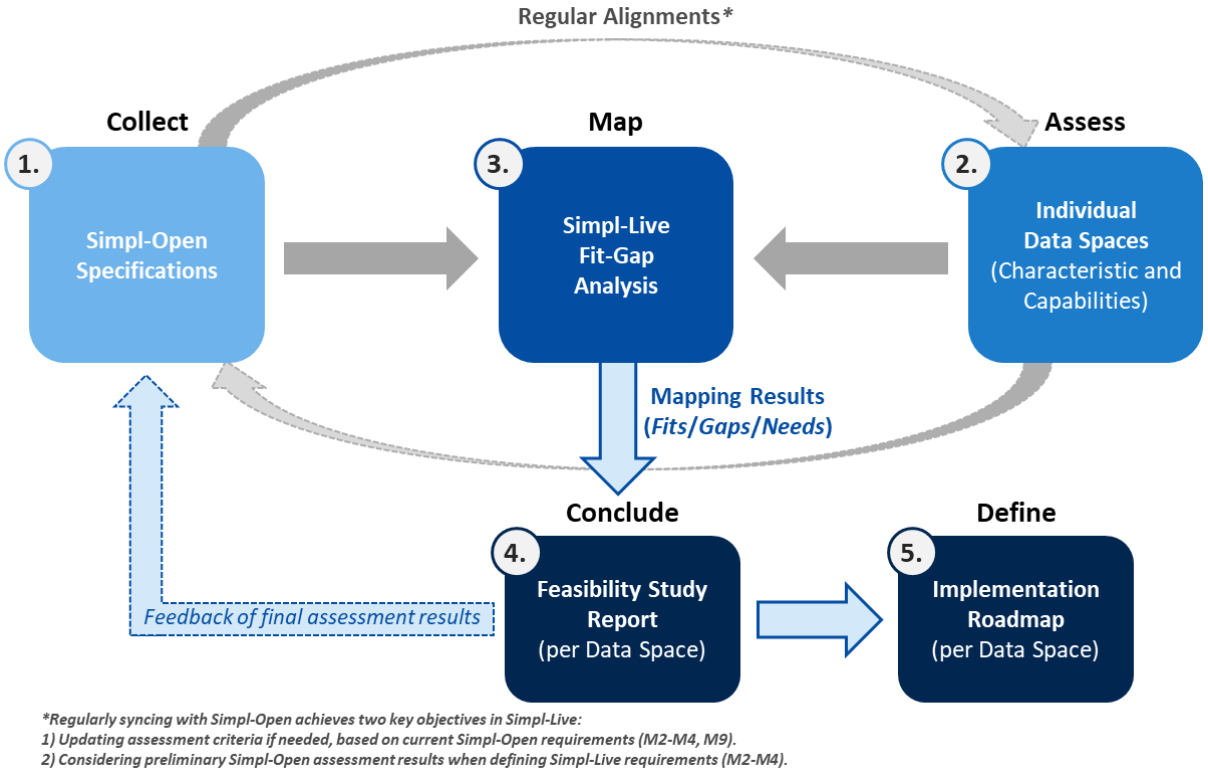

Figure 1. Simpl-Live Methodology

3.1 Simpl-Live Integration Operating Model

In the absence of an Integration Operating Model to outline the roles and responsibilities for integrating Simpl-Open into the Simpl-Live Data Spaces, Sovereign-X took the initiative to develop a high-level draft model, stepping beyond its formal responsibilities to address this critical gap. In close collaboration with Simpl-Open, and with feedback from DG Connect and the PSO team, Simpl-Live refined the model. Upon approval, this model was used as the foundation to define integration roadmaps and estimate the necessary resources. The Operating Model is a blueprint for the integration of Simpl-Open into a Data Space. It is not a one size fits all approach. The blueprint needs to be adapted based on the Data Space's requirements to ensure a smooth integration.

This chapter outlines the Simpl-Live Integration Operating Model, providing a structured approach to the tasks and activities essential for integrating the Simpl-Open middleware into a Data Space. The model highlights four primary stakeholders: *Data Space Governance Authority*, *Contractors delegated to undertake tasks/activities relevant to the Simpl-Open integration, Simpl-Live (Implementation) SCx Contractors and DG Connect (Simpl).* The *Table 3* presents the high-level roles of these main actors.

Table 3. Simpl-Live Integration Operating Model Main Actors and High-level Roles

Main Actor	High-level Roles
Data Space GovAuth	The organisation(s) leading the data space initiative and/or assuming the implementation, the governance and the management of the data space. For EC-funded data spaces, these organisations may include, among others, relevant EC's services (DGs). The Governance Authority / Data Space Owners will be responsible for defining the integration scenarios of Simpl-Open into the data space.
Contractors delegated to undertake tasks/activities relevant to the Simpl-Open integration	Are those contractors falling under the responsibility of the Governance Authority (e.g. implement and operate the data space).
Simpl-Live (Implementation) SCx Contractors	The organisations contracted under the Simpl Programme for the integration of Simpl-Open in the infrastructure of selected data space
DG Connect (Simpl)	the Contracting Authority of the Simpl Programme, responsible for monitoring, controlling and decision-making activities related to the Simpl-Live Implementation projects. In this role, DG Connect may be supported by the Simpl Programme Support Office. For EC-funded data spaces, the decision-making tasks related to the Simpl-Open integration will be carried out in alignment with the relevant services (DGs) in the EC.

The outlined activities are categorised into 12 key tasks, including areas such as Project Planning, Organisation, and Governance and Compliance. The RASCI Matrix assigns specific roles to each stakeholder for every task, indicating who is responsible, accountable, consulted, supportive, and informed throughout the process. The matrix also clarifies whether the key tasks are in scope or out of scope (but a prerequisite) for the integration project. Tasks out of scope (but a prerequisite) for the integration project are those tasks that must be implemented in advance by the Data Space as a prerequisite and are not the responsibility of the Simpl-Live Contractor during the Simpl-Open integration project. Conversely, tasks in the scope of the integration project are those that are specifically considered to be implemented in the Simpl-Open integration project for the respective Data Space.

For a comprehensive overview of the Simpl-Live Integration Operating Model and a detailed description of tasks, please refer to *Appendix 1. Simpl-Live Integration Operating Model and Responsibilities*.

3.2 Simpl-Open High-Level Description

Simpl-Open is the open-source software stack that powers data spaces and other cloud-to-edge federation initiatives[5]. Simpl-Open is the core of the three products of the Simpl programme, which aims to enhance data access and interoperability across European data spaces and initiatives[6]. Simpl-Open is publicly accessible, allowing anyone to view, modify, and distribute the software, promoting transparency and collaboration within the data space community. Its design is modular and enables the replacement or addition of components without affecting the rest of the system. Simpl-Open ensures trust, confidence, and regulatory compliance, enabling seamless data sharing across multiple data spaces and initiatives[7].

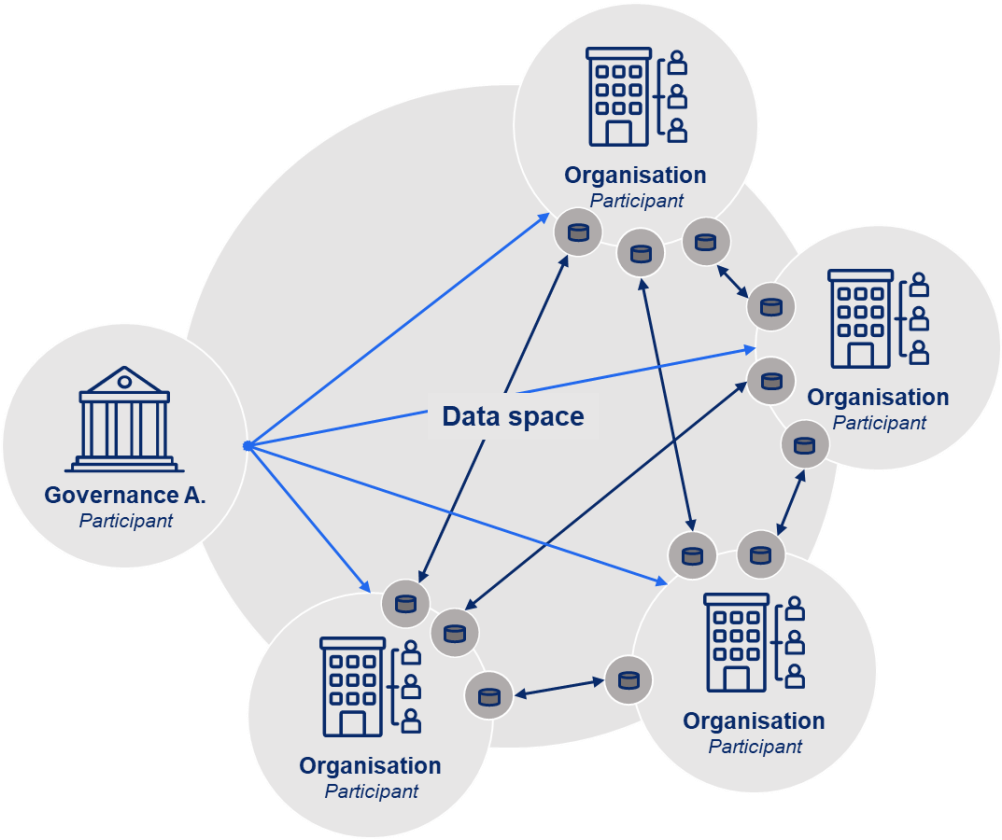

Figure 2. Basic structure of a data space

To understand how Simpl-Open enables data spaces to share data and services, it is first necessary to have a definition of a data space and to understand the basic requirements for using Simpl-Open. Data spaces are federated ecosystems consisting of different actors (individuals or entities) that interact with each other and define common rules for sharing data and services. These actors play different roles within a data space, including the governance authority of the data space, and organisations that provide and/or consume data and services. *Figure 2* shows the basic structure of a data space.

For a Simpl-Open enabled data space to exist, a data space initiative must consider the need for at least three participating actors: the governance authority, a provider and a consumer. In some cases, it may be necessary for one organisation to play two roles, e.g. Governance Authority and Provider. It is

[5] European Commission (EC), '' The Simpl programme'' (n,d.), https://simpl-programme.ec.europa.eu/book-page/simpl-programme

[6] European Commission (EC), '' Simpl: Cloud-to-edge federations empowering EU data spaces'' (2024), https://digital-strategy.ec.europa.eu/en/policies/simpl

[7] Ibid.

also required that each participant deploys the Simpl-Open agent on each node of the data space, which acts as a local gateway for secure communication within the data space.

Simpl-Open, deployed by the Simpl-Open Agent on each node, spans across these actors, enabling asset sharing between them. It provides common services on which data spaces can be built. Simpl-Open stays agnostic to the specifics of a particular data space, allowing additional data space specific services to be added on top of Simpl-Open.

In particular, Simpl-Open's unique value proposition allows Simpl-Open enabled data space initiatives to reuse identified suitable existing components, develop missing components from scratch and integrate them to simplify the deployment and set-up of a data space. In addition, the establishment of Simpl-Open secure communication is part of the onboarding of new participants. Each data space can configure numerous elements, such as onboarding rules, the definition of identity attributes, the metadata required for the publication of data sets/services, etc. Simpl-Open also takes into account infrastructure and application providers, allowing them to bundle infrastructure, applications and data sets according to their needs. Finally, Simpl-Open provides the ability to define access policies, usage policies and contracts, allowing for customised data sharing alternatives.

Figure 3 shows a Simpl-Open enabled data space with five different participants: a governance authority, a consumer, a data provider, an application provider and an infrastructure provider, and the Simpl-Open agent deployed on each node.

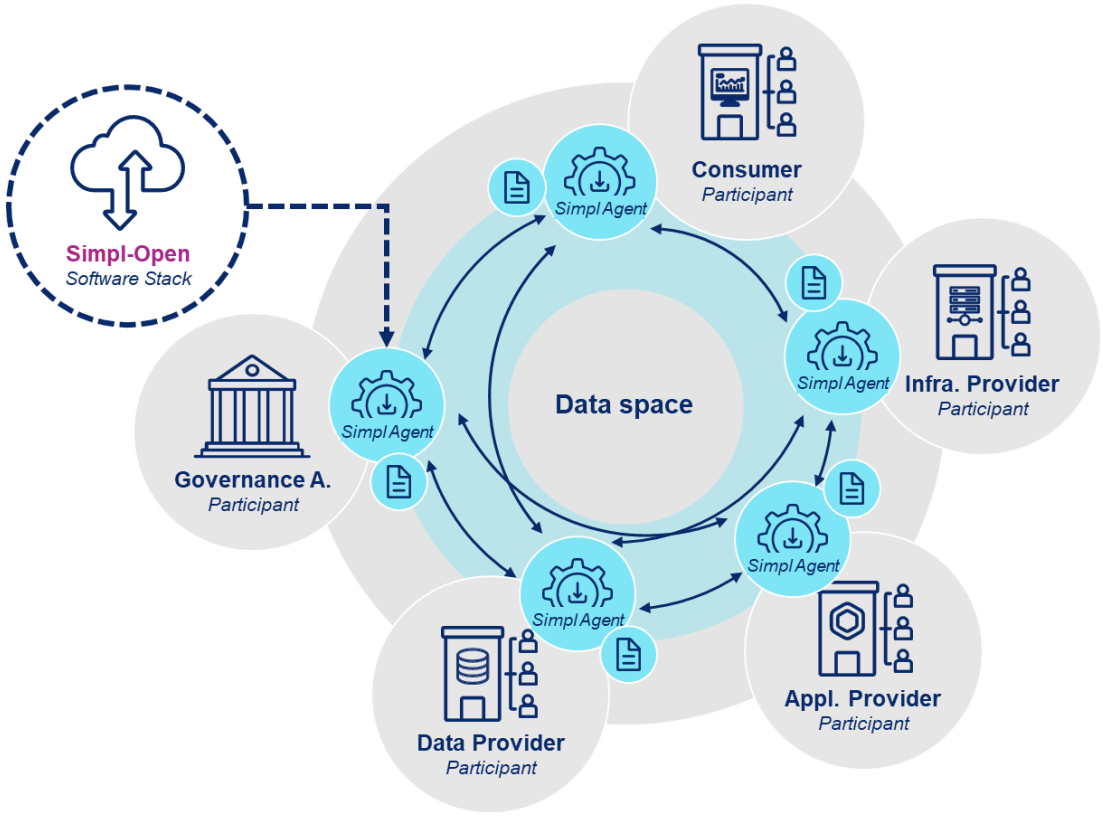

Figure 3. Simpl-Open approach to cover the full landscape of a data space

Simpl-Open Architecture and Business Processes

The architecture of Simpl-Open is developed to support robust data ecosystems. It includes several key components: the Integration Layer, which contains capabilities that enable participants to integrate with each other in a secure and trusted manner; the Data Layer, which includes capabilities to enable the exchange of data resources and applications; the Infrastructure Layer, which manages infrastructure resources and allows Simpl-Open to connect to third-party infrastructure resources; the Administration Layer, which spans the data, infrastructure, and integration layers, providing supporting capabilities for their well-functioning and the administration of Simpl-Open; and the Governance Layer, which addresses transversal capabilities that apply to all other layers, providing contingency measures against issues participants might encounter[8]. A visual representation of the Simpl-Open architecture can be found in *Figure 4* below. Further information on the Simpl-Open architecture and its layers can be found in the Simpl-Open architecture document.

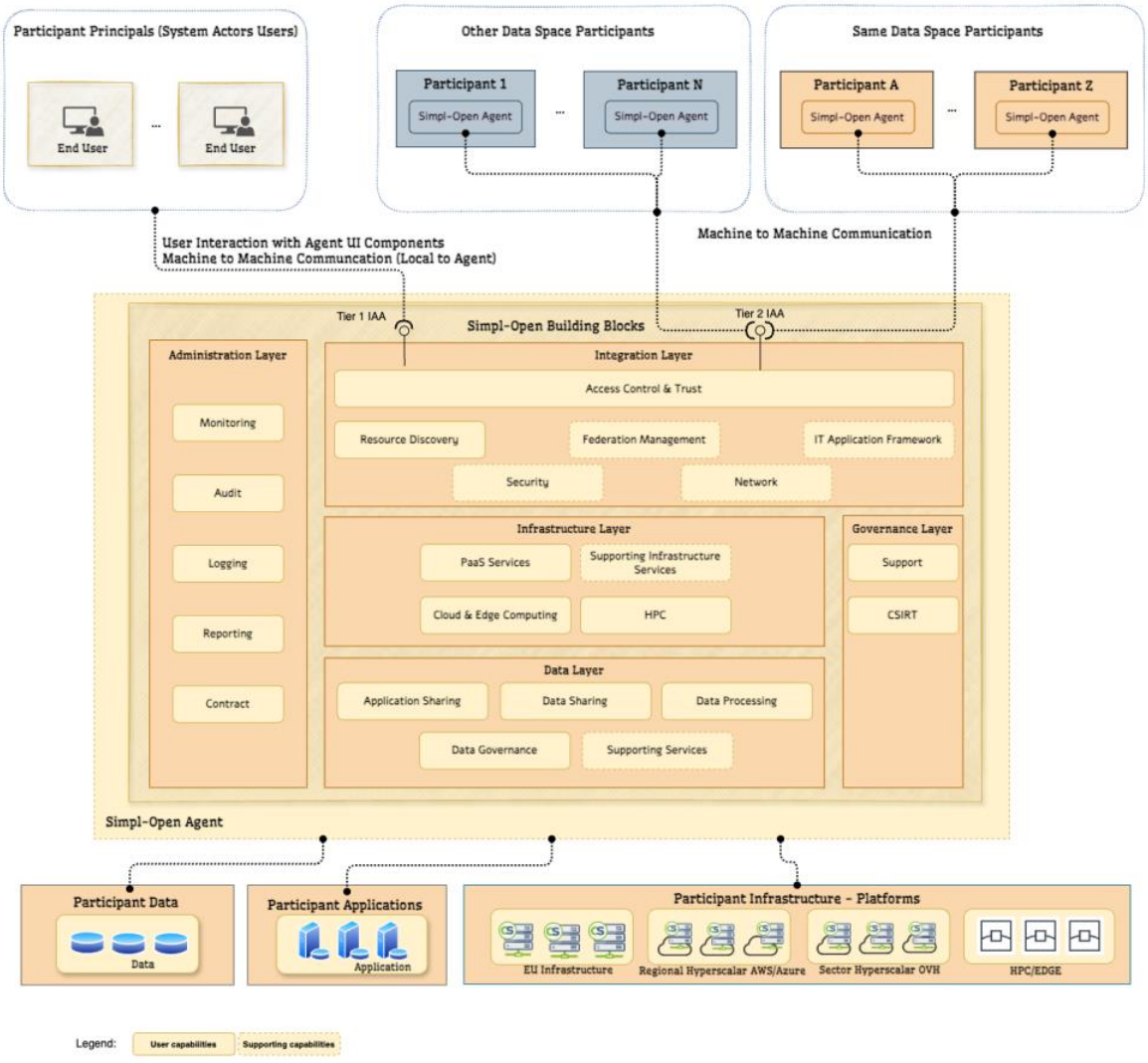

Figure 4: Simpl-Open architecture[9]

Simpl-Open supports a number of business processes that are crucial for the functioning of a data space. The list of functionalities that Simpl-Open will implement is a work in progress. At the time of the feasibility assessment, the following processes were in scope: the setup of data spaces, which involves

[8] European Commission (EC), ''D1.3.1.2 Functional and Technical Architecture Specifications'' (2024), Simpl-Open Functional and Technical Architecture Specifications.pdf

[9] Ibid.

the role of the governance authority; the setup of ID/trust; catalogues and vocabulary management; the onboarding of new data space participants, including providers (data, application, infrastructure) and consumers; providers adding new resources on data, applications, or infrastructure to the data space's catalogue; consumers searching for resources on the data space's catalogues; and consumers establishing contracts with providers for selected catalogue items. Processes added or redefined after May 2024 have not been subject to detailed analysis and were excluded from the scope of the feasibility study reports. However, further details on the Simpl-Open current business processes (showcased in *Figure 5*) can be found on the Simpl website[10].

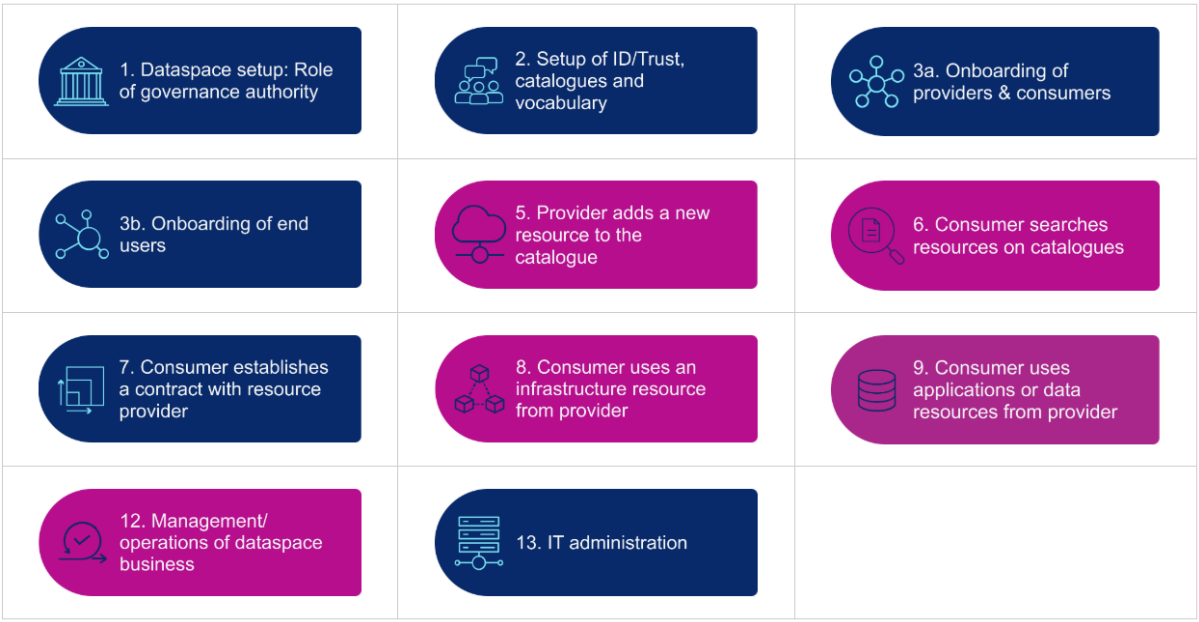

Figure 5: Simpl-Open business processes[11]

3.3 Personal Data Handling Assessment

The Simpl-Live feasibility studies assessed the need and requirements for Personal Data Handling components (GDPR consent management, GDPR rights exertion, etc) to enable interactions with data subjects when exchanging and processing personal data. The studies identified a list of 16 requirements (see *Table 12*) to enable personal data sharing from several inputs:

- The workshops conducted with the Simpl-Live Data Spaces to assess their needs;
- Sources like the DSSC, IDSA, Prometheus-X, Gaia-X, Data Space blueprints, that detail a series of key needed functionalities and components;
- The GDPR to ensure the personal data handling requirements were designed to cover all requirements that data controllers would have to interact with data subjects under GDPR (rights exertion, legal basis, privacy by design, etc).

The overall situation is that currently no Simpl-Live Data Space has addressed such requirements or functionalities yet, but they all have a high interest in integrating components enabling them to answer such requirements. The specific assessment for each Data Space can be found in the Data Space specific feasibility reports linked in *Table 4. Feasibility Study individual reports*.

[10] European Commission (EC), '' Simpl Requirements'' (n,d.): https://simpl-programme.ec.europa.eu/book-page/simpl-requirements

[11] Ibid.

The PDH assessment proposed for Simpl-Open to adopt a Personal Data Intermediary approach to personal data handling as it is the approach validated by the data space ecosystem. The list of requirements, components and the architecture proposed informs Simpl-Open for its further developments to enable end-to-end GDPR compliance. The full methodology, assessment and results can be found in *Appendix 5. Personal Data Handling Assessment*.

3.4 Integration Roadmap, Timeline and Resource Plan

The generic Simpl-Live Integration Roadmap outlines a structured and phased approach for integrating the Simpl-Open middleware into a Data Space. The purpose of this generic roadmap is to provide a flexible framework that highlights key tasks and milestones necessary for integration, while allowing for customisation based on the specific requirements, circumstances, and maturity of each Data Space. Since each Data Space has unique governance structures, technical infrastructures, security policies, and business objectives, the roadmap should serve as a guiding template rather than a prescriptive solution.

The roadmap reflects the development state of the Simpl-Open middleware between August and September 2024, drawing on insights from the Simpl-Live Feasibility Study conducted from May to September 2024. However, it is important to recognise that the roadmap's details must be refined and adapted as integration progresses within each specific Data Space. Continuous updates will be required as Simpl-Open evolves and as the specific needs of the Data Space are clarified. The specific roadmaps for each data space are presented in the respective Simpl-Live Integration (To-Be) chapters of the individual study reports (see *Table 4*).

The roadmap is divided into three distinct phases, starting with the *Proof of Concept (PoC)*. During this phase, Simpl-Open's core functionalities - such as governance, security, and technical elements - are tested in a controlled environment with a limited set of participants[12]. The objective of this phase is to validate the middleware's features, identify any necessary adjustments, and ensure that it meets the governance and data-sharing requirements of the Data Space. Once the Proof of Concept has been validated, the integration moves into the *Pre-Production (PRE-PROD)* phase. This phase focuses on scaling up the governance framework, and integrating more data providers, ensuring, that they can share their resources with consumers through the interfaces provided by the Data Space. In addition, infrastructure stress-tests are conducted to ensure operational readiness. In this phase, the emphasis is on ensuring that the technical infrastructure and governance structures are robust enough to support the system's full-scale operations. During the different phases, possible customisations of Simpl-Open and/or the infrastructure of the data space initiative will be required for a seamless integration.

The roadmap culminates in the *Production phase (PROD)*, where Simpl-Open becomes fully operational within the Data Space. Continuous monitoring and control activities are carried out to refine governance, security measures, and participant interactions. During this phase, all key systems are fully integrated, and the middleware supports long-term operations with full data-sharing and governance compliance in place.

Each phase builds progressively on the previous one, ensuring that the integration is executed in a structured and controlled manner, moving from initial validation to full-scale production. During this process, the Simpl-Live implementation team (contractors) will support the preparation of the data space infrastructure and address the Data Space Initiative customisations required to implement Simpl-Open. In addition, some of the gaps identified in the studies will later be addressed by Simpl-Open as common requirements that could be implemented in the future. For a more detailed breakdown of the integration roadmap please refer to *the Appendix 2.1 Integration Roadmap.*

In conjunction with the roadmap a generic high-level timeline is specified in *Appendix 2.2 Preliminary Timeline*, spanning over 24 months. This timeline serves as an adaptable guideline for integration of

[12] These phases and activities are generic. The phases and potential steps are to be adapted according to the needs, interests and status of each data space candidate for integration.

the Simpl-Open middleware and must be customised based on the specific requirements, state, and timeline of the selected Data Space.

Finally, the Resource Plan complementing the integration roadmap for the Simpl-Open middleware, aligns the necessary roles and resources with each task and phase outlined in the roadmap. Each Data Space has its own unique characteristics, including its governance structure, technical infrastructure, and level of maturity. Consequently, the resource requirements (including tasks and person-days) will vary depending on factors such as the number of participants, the complexity of the systems being integrated, and the overall scope of the Data Space. This generic resource plan provides indicative guidance on resource allocations, but it must be customised to reflect the circumstances of each Data Space, but specific details appear on the individual study reports (see *Table 4*). The assumptions underlying this resource plan, including the estimated person-days per role and task, are detailed in the *Appendix 2.2 Preliminary Timeline*.

4 Feasibility Study Reports

In addition to this report, the description, analysis and solution for the integration of Simpl-Open per data space are provided in individual reports. *Table 4* contains a summary of the data space initiative description, its scope of the integration of Simpl-Open, with tentative start date, and the link to the report.

Table 4. Feasibility Study individual reports

Name	Data Space Initiative Description	Summary of the scope of the integration	Start
PPDS	The PPDS aims to consolidate public procurement data across Europe and provides interoperability through common data semantics, specifically using the eProcurement Ontology (ePO) as a standard format.	Simpl-Open will integrate with the PPDS public knowledge graph, allowing PPDS to connect to other data spaces. Simpl-Open capabilities can complement the existing components of PPDS.	Q2 2025
EHDS2	The EHDS2 is an EU ecosystem comprised of standards, IT infrastructures and governance rules enabling cross-border utilisation of health data for research, innovation, policy, and regulation.	In addition to enabling interoperability with other data spaces, Simpl-Open can support EHDS2 in operational and functional processes defined by the data space (e.g. administrative, data and infrastructure services).	Q2 2025
LDS	The LDS aims to implement a platform and marketplace for the collection, creation, sharing, monetising and re-use of multilingual and multimodal language data to power the development of language technologies.	Simpl-Open will enable interoperability with other data spaces (e.g. Cultural Heritage and Trusted European Media), as well as enhancement through the use of building blocks that are not currently in the scope of LDS.	Q2 2025
EOSC	The EOSC aims to create a human-centric, trusted and secure digital environment, enabling researchers to seamlessly transition to a way of working to interconnect and share data and expand the borders of science.	Simpl-Open will integrate with enabled Simpl-Open data space initiatives via the EOSC proxy agent, with a focus on interoperability.	Q2 2025
DestinE	The DestinE aims to develop a highly detailed and interactive digital twin of the Earth to aid EU policymakers and other users in responding and adapting to environmental changes.	Simpl-Open will be integrated to enable interoperability with other data spaces (e.g. EOSC) via a pilot with at least a Governance Authority, a participant and a consumer agent.	Q2 2025
SCDS	The SCDS aims to empower European cities and communities to contribute to and benefit from shared cross-sectoral data resources to facilitate the development of interoperable national, regional, or local Data Spaces.	Simpl-Open will be integrated into SCDS to accelerate the operational and functional maturity of the data space and to reduce effort and cost through pilots that enhance the	Q2 2025

Name	Data Space Initiative Description	Summary of the scope of the integration	Start
		data space using building blocks that have not yet been developed.	

5 Overarching Results

Besides the individual study reports presented in last chapter. This section includes the list of requirements communicated by the Data Spaces for Simpl-Open to prioritise, as well as the analysis of the requirements from the handling of personal data that are relevant to be considered by Simpl-Open[13].

5.1 Simpl-Open Requirements

One of the main objectives of the Simpl-Live feasibility studies is to provide the Simpl-Open team with a list of common requirements and common needs of Data Spaces to be considered for the development of Simpl-Open. It was also required to provide a list of additional requirements (functional and non-functional) for Simpl-Open per Data Space as per the SC1 Terms of References. The idea of collecting these requirements is to allow Data Spaces to incorporate their prioritisation of requirements into the development of Simpl-Open. In this way, Simpl-Open will increase the likelihood of its adoption by Data Spaces, by developing features in line with the evolving needs of Data Spaces. *Table 5. Simpl-Live Requirements for Simpl-Open* presents the consolidated information of requirements raised by the data spaces to be considered by Simpl-Open. The descriptions of the requirements and their detailed information are provided on the specific data space's reports. The table distinguishes if the requirement is already included in some of the Simpl-Open business processes that are part of the Minimum Viable Product (MVP)[14], if it is in scope but needs to be developed, or if it needs to be assessed by the Simpl-Open team to be included in the development backlog. Due to the ongoing development of Simpl-Open, the information in this table is subject to change and must be validated with the Simpl-Open team to have updated information on the prioritisation, assessment and development of specific requirements.

To achieve this goal, during the feasibility assessment phase of the project, several workshops were held with the Data Spaces to gather and validate the necessary information. In addition, a capability survey was sent to the six Data Spaces requesting information on the requirements to be considered for further releases of Simpl-Open.

In this document SC1 presents the list of consolidated requirements (functional and non-functional) that the Data Spaces would like Simpl-Open to include in further development releases of the software (compare *Appendix 4. Common Data Space Requirements*), as well as the individual summary of requirements per Data Space (compare *Appendix 3. Data Spaces Requirements*). Finally, a more detailed explanation of all functional and non-functional requirements per Data Space is provided in the individual feasibility study reports.

[13] Although the persona data handling requirements should be treated as any other requirements, the Simpl-Live Inception report defined the need to highlight the personal data handling related content in the feasibility study reports.

[14] The distinction was made on the basis of the available public information on the Simpl-Open requirements and the proposed high-level L1 requirements, which were available at Simpl Requirements | Simpl Programme on 14 February 2024.

Table 5. Simpl-Live Requirements for Simpl-Open

Requirement ID	Requirement Name	In Scope *Included in MVP*	In Scope *To be developed*	Not yet in Scope *To be assessed*	Priority	Data Space
FR-101	Real-Time Monitoring of Data Usage	BP (12)	-	-	H	PPDS
FR-102	Monitoring of Usage Policies	BP (12)	-	-	H	PPDS
FR-103	Authentication Provider Federation	BP (1)	-	-	H	PPDS
FR-104	Role-Based Access Control	BP (3a)	BP (3b)	-	H	PPDS
FR-105	Metadata Management and Discovery	BP (5 and 6)	-	-	H	PPDS
FR-106	Metadata Search and Retrieval	BP (6)	-	-	H	PPDS
FR-107	SPARQL Query Support	-	-	To be assessed	H	PPDS
FR-108	Resource Description Framework (RDF) Data Handling	-	-	To be assessed	H	PPDS
FR-109	Compliance with GDPR	-	To be developed	-	H	PPDS
FR-110	Public Key Infrastructure (PKI) Support	BP (2)	-	-	H	PPDS
FR-CP-101	Data user account creation	-	BP (3)	-	H	EHDS2
FR-CP-102	Central Platform login	BP (1)	-	-	H	EHDS2
FR-CP-103	Data user account removal	-	-	To be assessed	M	EHDS2
FR-CP-104	IAA - Keycloak IAA	-	BP (13)		H	EHDS2
FR-CP-105	IAA - DG SANTE authorisation	-	-	To be assessed	H	EHDS2
FR-CP-106	IAA - EU login	-	BP (13)	-	H	EHDS2
FR-CP-107	IAA - eIDAS login	-	BP (13)	-	M	EHDS2

Requirement ID	Requirement Name	In Scope *Included in MVP*	In Scope *To be developed*	Not yet in Scope *To be assessed*	Priority	Data Space
FR-CP-201	Request for participation	BP (3a)	-	-	M	EHDS2
FR-CP-202	Approve or reject participation	BP (3a)	-	-	M	EHDS2
FR-CP-203	Request for disconnection	-	-	To be assessed	L	EHDS2
FR-CP-204	Approve disconnection	-	-	To be assessed	L	EHDS2
FR-CP-301	Get instructions for NCP configuration	-	-	To be assessed	H	EHDS2
FR-CP-302	Submit NCP Details	-	-	To be assessed	H	EHDS2
FR-CP-303	NCP Compliance Check	-	-	To be assessed	H	EHDS2
FR-CP-304	NCP Onboarding	-	-	To be assessed	H	EHDS2
FR-CP-401	Metadata models and validation rules management	BP (5)	-	-	H	EHDS2
FR-CP-402	Metadata models and rules versioning	-	-	To be assessed	M	EHDS2
FR-CP-403	EU metadata validation	BP (5)	-	-	H	EHDS2
FR-CP-501	EU Catalogues creation	BP (2)	-	-	H	EHDS2
FR-CP-502	Data access configuration	BP (5)	-	-	H	EHDS2
FR-CP-503	EU metadata publishing	BP (5)	-	-	H	EHDS2
FR-CP-601	Metadata versioning	-	-	To be assessed	H	EHDS2
FR-CP-701	Metadata-based search	BP (6)	-	-	H	EHDS2
FR-CP-702	Advanced search	BP (6)	-	-	H	EHDS2
FR-CP-703	Metadata display	BP (5)	-	-	H	EHDS2
FR-CP-704	Search by API	-	-	To be assessed	H	EHDS2

Requirement ID	Requirement Name	In Scope *Included in MVP*	In Scope *To be developed*	Not yet in Scope *To be assessed*	Priority	Data Space
FR-CP-801	EU Results publishing	BP (5)	-	-	H	EHDS2
FR-CP-901	Metadata models and validation rules management	BP (5)	-	-	H	EHDS2
FR-CP-1001	Metadata-based search	BP (5)	-	-	H	EHDS2
FR-CP-1002	Advanced search	BP (6)	-	-	L	EHDS2
FR-CP-1003	Usage results display	BP (6)	-	-	L	EHDS2
FR-CP-1004	Search by API	-	-	To be assessed	L	EHDS2
FR-NCP-101	NCP configuration	-	-	To be assessed	H	EHDS2
FR-NCP102	NCP Compliance Self-check	-	-	To be assessed	H	EHDS2
FR-NCP-201	National Metadata publishing	BP (05)	-	-	H	EHDS2
FR-NCP-202	National metadata validation	BP (05)	-		H	EHDS2
FR-NCP-203	Republishing of metadata	-	-	To be assessed	H	EHDS2
FR-NCP-301	National results publishing	BP (05)	-	-	H	EHDS2
FR-NCP-302	Republishing of results	-	-	To be assessed	H	EHDS2
FR-SPE-101	Health data upload	-	-	To be assessed	M	EHDS2
FR-SPE-102	Results flagging	-	-	To be assessed	L	EHDS2
FR-SPE-103	Privacy & content validation	-	-	To be assessed	H	EHDS2
FR-SPE-104	Authentication & authorisation	BP (1)	BP (13)	-	H	EHDS2
FR-CHDAB-101	HDAB onboarding	-	-	To be assessed	L	EHDS2
FR-CHDAB-102	HDAB disconnection	-	-	To be assessed	L	EHDS2

Requirement ID	Requirement Name	In Scope *Included in MVP*	In Scope *To be developed*	Not yet in Scope *To be assessed*	Priority	Data Space
FR-CHDAB-201	Forwarding of metadata	-	-	To be assessed	H	EHDS2
FR-CHDAB-202	Forwarding of results	-	-	To be assessed	H	EHDS2
FR-HDAB-101	Data holder onboarding	BP (3a)	-	-	H	EHDS2
FR-HDAB-201	Metadata publishing	BP (5)	-	-	L	EHDS2
FR-HDAB-202	Regional metadata validation	BP (5)	-	-	L	EHDS2
FR-HDAB-203	Forwarding of metadata-	-	-	To be assessed	L	EHDS2
FR-HDAB-301	Results publishing	BP (5)	-	-	L	EHDS2
FR-101	Resource Submission	BP (5)	-	-	H	LDS
FR-102	Mapping	-	-	To be assessed	H	LDS
FR-103	Metadata Validation	BP (5)	-	-	H	LDS
FR-104	Multilingualism	-	-	To be assessed	H	LDS
FR-105	Metadata Search, incl. free text search, faceted search, and auto-suggestion/completion	BP (6)	-	-	H	LDS
FR-106	Results Display, incl. relevance ranking, and resource relationships	BP (6)	-	-	H	LDS
FR-107	Real-time indexing	-	-	To be assessed	M	LDS
FR-108	Search history	-	-	To be assessed	M	LDS
FR-201	Connect between Asset and Actual Data	-	-	To be assessed	H	LDS
FR-202	Data Transfer	-	-	To be assessed	H	LDS
FR-203	Offering Monetisation	-	-	To be assessed	H	LDS

Requirement ID	Requirement Name	In Scope *Included in MVP*	In Scope *To be developed*	Not yet in Scope *To be assessed*	Priority	Data Space
FR-301	Authentication	BP (1)	-	-	H	LDS
FR-302	Role and Permission Assignment	BP (3a)	BP (3b)	-	H	LDS
FR-303	Policy Setup	BP (12)	-	-	H	LDS
FR-304	Policy Enforcement	BP (12)	-	-	H	LDS
FR-305	Audit Logging	BP (12)	-	-	H	LDS
FR-401	Registration			To be assessed	H	LDS
FR-402	Compliance Check and Approval	BP (1, 12)	-	-	H	LDS
FR-403	Credential Management	-	-	To be assessed	H	LDS
FR-404	Monitoring	BP (12)	-	-	H	LDS
FR-101	EOSC data space and federated services	-	-	To be assessed	H	EOSC
FR-201	User interface translation	-	-	To be assessed	L	EOSC
FR-301	Identification of superior data sets	-	-	To be assessed	H	EOSC
FR-302	Data curation	BP (5)	-	-	H	EOSC
FR-401	Promotion of superior data sets	-	-	To be assessed	H	EOSC
FR-402	Schema translation	BP (5)	-	-	H	EOSC
FR-403	Federated search model	BP (06)	-	-	M	EOSC
FR-404	Automated metadata harvesting	-	-	To be assessed	M	EOSC
FR-405	Support of various search types	BP (06)	-	-	M	EOSC
FR-406	Recommendation based on previous search	-	-	To be assessed	L	EOSC

Requirement ID	Requirement Name	In Scope *Included in MVP*	In Scope *To be developed*	Not yet in Scope *To be assessed*	Priority	Data Space
FR-407	Natural Language Processing	-	-	To be assessed	L	EOSC
FR-408	Knowledge graph	-	-	To be assessed	M	EOSC
FR-409	AI enhancement in search functions	-	To be developed	-	L	EOSC
FR-410	Persistent resource identifier	-	-	To be assessed	L	EOSC
FR-501	Role-based access control	BP (3a)	BP (3b)		H	EOSC
FR-502	Closed marketplace	-	-	To be assessed	M	EOSC
FR-503	User profiles for administration	BP (12)	-	-	L	EOSC
FR-504	Approval workflow for onboarding participants	BP (3a)	-	-	M	EOSC
FR-505	Self-management of participants groups	-	-	To be assessed	M	EOSC
FR-506	Authentication provider federation	BP (1)	-	-	H	EOSC
FR-507	Authorisation	BP (1)	-	-	H	EOSC
FR-508	User roles	BP (3a)	BP (3b)	-	H	EOSC
FR-601	Tier level management of providers	-	BP (12)	-	M	EOSC
FR-701	Credit based usage for consumers	-	-	To be assessed	H	EOSC
FR-702	Out of box contracting process compliant with European and national regulation within Europe	-	BP (7)	-	M	EOSC
FR-703	SLA management	BP (12)	-	-	H	EOSC
FR-801	Monitoring and logging user activities	BP (12)	-	-	H	EOSC
FR-901	Reporting the services provided by the nodes	BP (12)	-	-	H	EOSC

Requirement ID	Requirement Name	In Scope *Included in MVP*	In Scope *To be developed*	Not yet in Scope *To be assessed*	Priority	Data Space
FR-1001	Multi-tiered helpdesk	-	BP (12)	-	H	EOSC
FR-1002	Dedicated forums for providers and consumers	-	-	To be assessed	M	EOSC
FR-1003	Automated ticket assignment and distribution	-	BP (12)	-	M	EOSC
FR-1004	Advanced maintenance	-	BP (12)	-	M	EOSC
FR-1101	Threat monitoring	-	BP (12)	-	H	EOSC
FR-1102	Incident response	-	BP (12)	-	H	EOSC
FR-1201	User dashboard	-	-	To be assessed	M	EOSC
FR-101	Data Orchestration and Transformation	-	-	To be assessed	H	DestinE
FR-102	Data Validation and Quality Control	BP (1, 5, 6)	-	-	H	DestinE
FR-201	Metadata Management and Discovery	BP (6)	-	-	H	DestinE
FR-202	Metadata Search and Retrieval	BP (6)	-	-	H	DestinE
FR-301	Interoperability with Existing Systems	-	To be developed	-	H	DestinE
FR-401	Real-Time Monitoring and Reporting	BP (12)	-	-	H	DestinE
FR-501	Security and GDPR Compliance	-	To be developed	-	H	DestinE
FR-502	Data Governance and Auditability	BP (1, 12)	-	-	H	DestinE
FR-101	Authentication provider federation	BP (1)	-	-	H	SCDS
FR-102	Authorisation	BP (1)	-	-	H	SCDS
FR-103	Identity provider federation	BP (1)	-	-	H	SCDS
FR-104	Security attribute provider federation	BP (1)	-	-	H	SCDS

Requirement ID	Requirement Name	In Scope *Included in MVP*	In Scope *To be developed*	Not yet in Scope *To be assessed*	Priority	Data Space
FR-105	User roles	BP (3a)	BP (3b)		H	SCDS
FR-201	Federation orchestration	-	BP (13)	-	H	SCDS
FR-301	Guaranteed authenticity and integrity	-	BP (13)	-	H	SCDS
FR-401	Data catalogue	BP (2)	-	-	H	SCDS
FR-402	Metadata description	BP (6)	-	-	H	SCDS
FR-501	Data profiling	-	-	To be assessed	H	SCDS
FR-502	Data quality rules	BP (1, 5, 6)	-	-	H	SCDS
FR-601	Data streaming	-	-	To be assessed	H	SCDS
FR-602	Simple data transfer	-	-	To be assessed	H	SCDS

6 Conclusions

The Simpl-Live feasibility study explored the integration of the Simpl-Open middleware into six major European Data Spaces: Public Procurement Data Space (PPDS), European Health Data Space for Secondary Use of Data (EHDS2), Language Data Space (LDS), European Open Science Cloud (EOSC), Destination Earth (DestinE), and Smart Communities Data Space (SCDS). The study confirmed that Simpl-Open's capabilities align well with the unique requirements of each Data Space, establishing a solid foundation for future integration. **The study showed that integrating Simpl-Open is both feasible and beneficial.**

Using a methodology that included fit-gap analysis and stakeholder workshops, the study identified the specific needs and objectives of each Data Space. This approach allowed the creation of customised integration scenarios that are closely aligned with the operational goals of each initiative. However, it also highlighted that the Data Spaces differ significantly in their objectives, levels of development, and technical approaches. These variations present a potential challenge for harmonising the Data Space landscape in the future, as efforts will need to account for these disparities to achieve consistent integration across the board.

To address these differences, integration roadmaps were developed for each Data Space, tailored to their current development. These roadmaps, developed for each data space, are described in the respective individual study reports.

The study results are based on the information available up to a certain point in time and the integration projects should consider the changes that have occurred in each data space and their integration needs, as well as in Simpl-Open as a product.

This adaptive approach is crucial, as the diversity in governance structures, technical frameworks, and specific objectives across Data Spaces will require a flexible and responsive integration strategy.

In addition, the study identified several common requirements shared by the Data Spaces, which provide critical insights for further developing Simpl-Open. By addressing these shared needs, Simpl-Open can help bridge the differences between the various Data Spaces, promoting greater alignment and consistency within the broader EU data ecosystem. Moreover, the study revealed that Simpl-Open could benefit from the advanced developments already made by some more mature Data Spaces, by potentially re-using solutions proved to be successfully implemented and applicable to the wider Data Space community.

Based on these findings, several key recommendations emerged, which are listed in *Chapter 8 Recommendations and Outlook*. As Simpl-Open continues to develop, integration scenarios and roadmaps must be revisited and updated to ensure their relevance. This iterative process will help ensure that Simpl-Open's evolution aligns with the diverse and changing requirements of the Data Spaces. Additionally, maintaining consistent collaboration with stakeholders is essential to keeping them engaged and supportive of Simpl-Open's progress. This ongoing engagement is vital for building a cooperative environment that encourages successful adoption and harmonisation efforts.

By enhancing interoperability, improving data governance, and fostering collaboration, Simpl-Open is well-positioned to support the EU's vision of a cohesive and secure digital ecosystem. However, the challenge of harmonising a diverse range of Data Spaces remains significant, requiring continuous adaptation and a collaborative approach. With ongoing development and consistent stakeholder involvement, Simpl-Open can drive innovation, data sovereignty, and effective cooperation across Europe's digital landscape.

7 Limitations

The presented Feasibility studies aim for comprehensiveness. Nevertheless, it is important to note that factors, such as the evolving nature of the project environment, and availability of information influence the scope, depth, and accuracy of the findings. This chapter detail the limitations encountered during the study as well as and their implications.

The Data Spaces assessed in the study are categorised according to their expected go-live timelines. Brown Data Spaces, encompassing PPDS, EHDS2, LDS, EOSC, and DestinE, are expected to go live between 2024 and the first half of 2025, while green Data Spaces, which include SCDS, are anticipated to go live in the second half of 2025 or later. The maturity level of each Data Space significantly affected the Feasibility Study Report. Brown Data Spaces, being closer to implementation, often provided more detailed information, enabling a more thorough analysis. In contrast, green Data Spaces, which remain in their conceptual or early development phases, offered limited detail, constraining the study's depth and precision. This variation in development status resulted in discrepancies in the level of insight available for different Data Spaces, as documented and shown in the Feasibility Study Reports for the Data Spaces.

Access to essential documents was sometimes restricted, impacting the study's ability to comprehensively verify and evaluate the Data Spaces. In cases where crucial documents were unavailable - whether due to confidentiality constraints or delays in sharing—the analysis was hindered in its capacity to provide a complete assessment. For example, technical architecture plans or implementation roadmaps were not always accessible, which limited the study's ability to accurately evaluate readiness levels and technological alignment.

The findings of this study are based on information collected from Simpl-Open and the Data Spaces up to July 2024. In August and September, final alignment with Data Spaces took place to discuss integration scenarios. As development has continued beyond this period, any subsequent updates or modifications are not reflected in the analysis. This temporal constraint presents a risk that certain findings may become outdated or incomplete as technologies evolve and new components are developed.

Stakeholder engagement was critical to the study's progress, but significant delays in receiving feedback or responses to surveys impacted the timeline and depth of the analysis. Delays or incomplete responses from key stakeholders restricted the study's ability to fully assess certain technical and operational aspects within the intended timeframe. Although the study adapted to these challenges by incorporating new information as it was received, further input and validation from stakeholders will be needed to enhance and expand the analysis. The ongoing development of Data Spaces beyond the period covered in the provided documentation also posed a challenge. As development activities continued, certain information within the documentation became outdated, limiting the accuracy of the analysis. This issue suggests that the study may not fully represent the most recent technological developments or structural changes, particularly for green Data Spaces that remain in evolution.

Periodic updates and revisions of the study are essential to ensure its relevance and accuracy as these changes unfold.

By detailing these limitations, the study acknowledges the factors that may influence the reliability of its conclusions and underscores the importance of ongoing updates and stakeholder collaboration to keep the findings current and robust.

8 Recommendations and Outlook

Following the conclusions drawn from the Feasibility Study, the next phase of development focuses on ensuring the long-term growth and sustainability of the Data Space. This phase builds upon the insights already gathered, offering strategic guidance for the next steps. Key areas, such as the integration of Simpl-Open, coordination among stakeholders, and futureproofing, are central to maintaining the progress.

As each Data Space progresses in understanding Simpl-Open's benefits, it becomes evident that integrating this framework can enhance interoperability and standardisation within the EU-wide ecosystem, helping Data Spaces capitalise on synergies. This, in turn, improves their respective data assets and capabilities. The feasibility studies methodology developed during the SC1 of the Simpl Framework Contract provides the guidelines for the introduction of Simpl-Open into the operations of the Data Spaces. It promotes a consistent understanding of Simpl-Open functionalities among the Data Spaces, while simultaneously allowing the Data Spaces to provide feedback that informs the development or enhancement of Simpl-Open capabilities functionalities.

For the next phase of integration of Simpl-Open into the Data Spaces, and as well for further feasibility studies, the following recommendations are provided:

- The follow-up contract for the execution of Simpl-Open integration requires a detailed outlook, especially considering the insights from the Feasibility Study. This study has underscored the need for additional regular assessments to ensure the integration effort's success, and to continue to collect and evaluate data that was not available at the time of the studies. Given the development pace of Simpl-Open, it is essential to determine if further evaluations are necessary to integrate additional capabilities. The relevance of the latest Simpl-Open updates to the Data Space must be evaluated based on the information already gathered. Moreover, it is key to continue involving key stakeholders from the Data Space in the activities of the Simpl Community to maintain their interest and understanding of Simpl-Open developments. Since Simpl-Live was run in parallel to Simpl-Open development, it is important to provide the Data Spaces constantly updates on Simpl-Open's offering and progress. Additionally, gathering the most recent information about the Data Space that was not available or shared during the feasibility study is crucial to evaluate its current state at the time of implementation.
- To ensure Simpl-Open meets the needs of most data spaces, it is important to list both common and additional capability requirements and add the common requirements to Simpl-Open's development backlog for future prioritisation. Thus ensuring, that the platform evolves in line with user needs and technological advancements. Common requirements might include robust data security measures and seamless data integration capabilities. Additional capabilities could involve advanced data analytics tools, support for real-time data processing, and enhanced interoperability with other data platforms.
- To ensure Simpl-Open properly assesses the solutions already developed and successfully implemented by the Data Spaces, identifying their relevance for the wider Data Space community, deciding on their reusability by Simpl-Open, and integrate them, as appropriate.
- To ensure effective collaboration in the Data Space, it is essential to define the key stakeholders and establish clear roles for document sharing and feedback. This includes identifying who will be responsible for creating, reviewing, and approving documents. Additionally, it is important to address any limitations related to response delays by recommending solutions to streamline communication. Implementing clear deadlines and scheduling regular check-ins can help mitigate delays and ensure timely feedback and decision-making.
- To ensure the sustainability and futureproofing of the Data Space, it is crucial to recommend strategies that keep it adaptable to evolving regulatory and technical environments. Additionally, addressing any limitations highlighted in the specific feasibility study reports is essential.

By following these strategic recommendations, the Data Spaces will be well-positioned to navigate future challenges while maximising opportunities for long-term growth and sustainability.

Appendices

Appendix 1. Simpl-Live Integration Operating Model and Responsibilities

This Appendix chapter outlines the Simpl-Live Integration Operating Model, presenting the key areas of tasks, including actors, roles and responsibilities, essential for integrating the Simpl-Open middleware into a Data Space. This operating model cannot be considered exhaustive but serves as a common structure for defining and streamlining the integration efforts across different Data Spaces. Detailed tasks and activities must be specified depending on the state and requirements of the individual Data Spaces.

Key stakeholders considered in the model include *Data Space Governance Authority*, *Contractors delegated to undertake tasks/activities relevant to the Simpl-Open integration, Simpl-Live (Implementation) SCx Contractors and DG Connect (Simpl)*. The focus and scope of the tasks as well as the responsibilities of the stakeholders are presented in a RASCI Matrix (compare *Table 6: RASCI – Simpl-Live Integration Operating Model*). The presented RASCI-Matrix thereby assigns clear roles and responsibilities to each stakeholder involved in the integration. The matrix offers a structured way to clarify who is responsible ("R"), accountable ("A"), consulted ("C"), support ("S"), and informed ("I") for each task. An explanation of the RASCI can be found in *Table 7: RASCI Legend (as per PM2)* It is important to emphasise that the decision of the Go-Live, and all aspects associated to its security readiness, is the sole responsibility of the Data Space Governance Authority and/or the Data Space Participants involved and should not rely on DG-Connect or the associated contractors in this regard.

The operating model provides a framework for structuring the integration process, ensuring that each stakeholder is assigned a clear role and responsibility, and facilitating effective planning, management and communication of a detailed integration plan. It is the responsibility of the Simpl-Live SCx to implement the necessary adaptations and customisations for Simpl-Open components using the Data Space development environments, and to provide support for the integration and operation of the code provided.

Table 6: RASCI – Simpl-Live Integration Operating Model

Category Names	Task Names	Task Definition	Task scope for the integration project	Data Space GovAuth	Data Space Contractors [15]	Simpl-Live (Implementation) SCx Contractors	DG Connect (Simpl)
Project Planning	0. Project Planning	Define and establish a detailed plan for the integration of the Simpl-Open middleware into the Data Space. This includes for example setting up the project structure, developing a detailed integration plan, and aligning timelines, resource allocation, and key milestones. Coordinate with all key stakeholders to ensure roles, responsibilities, and expectations are clear.	In scope	A	I	R	A
Governance and Compliance	1. Organisation	Define and establish the operational structure, defining roles, responsibilities, and organisational procedures for participants in the Data Space, in line with Simpl-Open guidelines to enable the successful integration of the middleware into the Data Space governance framework.	In scope	A	S	C (R for proposal)	IR
Business Specifications	2. ID, Trust & Security	Define and establish security policies required for alignment with Simpl-Open that support the needs of the Data Space, including identification, authentication, authorisation, and trust mechanisms for participants. Implement access control policies and ensure the proper handling of security credentials to safeguard data. Align these policies with Simpl-Open requirements to enable a	In scope	A/R	S	C	I/C

[15] Refer to contractors delegated to undertake tasks/activities relevant to the Simpl-Open integration. They are those contractors falling under the responsibility of the Governance Authority (e.g. implement and operate the data space).

Category Names	Task Names	Task Definition	Task scope for the integration project	Data Space GovAuth	Data Space Contractors [15]	Simpl-Live (Implementation) SCx Contractors	DG Connect (Simpl)
		secure and trusted integration, employing data privacy mechanisms such as personal data intermediary or encryption as necessary to protect sensitive information.					
Governance and Compliance	3. Governance and Compliance	Define and establish the overarching governance framework to ensure compliance with legal, regulatory, operational, etc. requirements in alignment with Simpl-Open integration guidelines. This framework will include mechanisms for policy enforcement, establish clear contracts for participant responsibilities, and ensure adherence to SLA (Service Level Agreement) requirements. It will provide a compliant and secure environment for integrating and operating the middleware across the Data Space, incorporating a remediation process for addressing compliance issues.	In scope	A/R	I	S	I/C
Business Specifications	4. Standards and Policies (incl. Vocabularies, and Ontologies)	Define and establish data-specific vocabularies, standards, and ontologies to ensure consistent data sharing, quality, and privacy. These standards will facilitate seamless interoperability within and across Simpl-Open enabled Data Spaces. By implementing quality assurance measures and ensuring data provenance, these initiatives will promote effective usage policies that govern data access and sharing practices.	Out of scope, but prerequisite	A/R	S	C	I/C

Category Names	Task Names	Task Definition	Task scope for the integration project	Data Space GovAuth	Data Space Contractors [15]	Simpl-Live (Implementation) SCx Contractors	DG Connect (Simpl)
Business Specifications	5. Data Space Processes	Define and establish business processes, as well as the processes required to integrate data, applications, and infrastructure resources with the Simpl-Open middleware for the Data Space's consumption use cases. These processes will facilitate efficient operation and smooth integration of the middleware into the Data Space.	Out of scope, but prerequisite	A/R	S	C	I/C
Integration and Implementation	6. Platform and Infrastructure	Define and establish the foundational technologies and services to integrate with the Simpl-Open middleware to enable operation of the Data Space. This ensures that the Data Space's infrastructure can handle technical demands, enabling seamless integration and efficient operation within the entire Data Space. This type of task/activity is not the responsibility of the Simpl-Live Contractor.	Out of scope, but prerequisite	A/R	S	C	I/C
Integration and Implementation	7. Deployment, Configuration, Customisation	Define, establish and also deliver sufficient installation guides, ensuring an integration of Simpl-Open middleware with the existing IT systems of each participant to satisfy technical and operational needs of the Data Space.	In scope	A	S	R	I/C
Validation and Entry in Operation (EiO)	8. Qualification Services & Training	Define, and establish qualification services to ensure participants comply with Data Space standards and policies. Provide educational services, such as onboarding programs and training sessions, to equip participants with the necessary know-how for successful Data Space operational readiness for Simpl-Open integration.	Out of scope, but prerequisite	A/R	S	C	I/C

Category Names	Task Names	Task Definition	Task scope for the integration project	Data Space GovAuth	Data Space Contractors [15]	Simpl-Live (Implementation) SCx Contractors	DG Connect (Simpl)
		This type of task/activity is not the responsibility of the Simpl-Live Contractor.					
Validation and Entry in Operation (EiO)	9. Communications, Migration, and Entry in Operations (EiO)	Define and establish communication strategies, migration plans, and Entry-in-Operations procedures to facilitate the integration of Simpl-Open and the smooth transition of participants into operational use. This includes coordinating service introduction and ensuring readiness for ongoing operations. This type of task/activity is not the responsibility of the Simpl-Live Contractor.	Out of scope, but prerequisite	A/R	S	C/S	I/C
Operations	10. Operations and Maintenance (ITSM)	Establish and maintain IT services and infrastructure at the Data Space level, focusing on the transition from integration and deployment to ongoing operations and maintenance. Ensure effective IT service management (ITSM) practices are in place to support continuous operations, address post-deployment challenges, and facilitate seamless integration activities within the Simpl-Open framework. This type of task/activity is not the responsibility of the Simpl-Live Contractor.	Out of scope, but prerequisite	A/R	S	C	I/C
Operations	11. Change Management	Define, establish, and deliver a structured approach for overseeing alterations and updates specifically related to Simpl-Open integration activities within the Data Space. This includes ensuring that changes to data infrastructure,	In scope	A/R	S	R	I/S

Category Names	Task Names	Task Definition	Task scope for the integration project	Data Space GovAuth	Data Space Contractors [15]	Simpl-Live (Implementation) SCx Contractors	DG Connect (Simpl)
		policies, systems, and workflows are executed in a controlled, secure, and compliant manner as well as evolutions of the middleware to support business operations of the Data Space. The goal is to support seamless integration, changes, etc. while minimising disruptions to Data Space operations and ensuring alignment with Simpl-Open's standards and interoperability requirements. It is the responsibility of the Simpl-Live SCx to implement the necessary adaptations and customisations for Simpl-Open components using the Data Space development environments, and to provide support for the integration and operation of the code provided.					
Operations	12. Data Space Services Desk	Define and establish a centralised service desk to handle incidents, problems, changes, security, service requests and communication, etc. with participants in the Data Space. This ensures timely support and efficient issue resolution across the entire Data Space, supporting the smooth integration and future operation of the Simpl-Open middleware. This type of tasks / activities may involve the Simpl-Live Contractor in support to the data space Contractor for troubleshooting Simpl-Open related incidents.	In scope	A/R	I	C/S	I/C

Table 7: RASCI Legend (as per PM²)[16]

RASCI		Description
R	**R**esponsible	Does the work. Others can be asked to assist in a supporting role. There is just one responsible person for any given task.
A	**A**ccountable	Ultimately answerable for the correct and thorough completion of the work. There is just one accountable person for any given task.
S	**S**upports	As part of a team, roles with a support function work with the person responsible. The support role helps complete the task.
C	**C**onsulted	Those whose opinions are requested and with whom there is two-way communication. The consulted role does not help complete the task.
I	**I**nformed	Those who are kept informed of progress.

[16] Leclercq, P. (2018). "The PM² Governance Model." OpenPM² 2018 Conference. Retrieved from: https://joinup.ec.europa.eu/sites/default/files/inline-files/2.OpenPM2-2018Conference%5BGovernance-Model%5D.%5BPierre-Leclercq%5Dfinal.pdf.

Appendix 2. Integration Roadmap, Timeline and Resource Plan

This appendix provides a structured and phased integration roadmap of the Simpl-Open middleware into a Data Space. It is important to note that this roadmap serves as a general guide and must be customised based on the unique circumstances, requirements, and timeline of each individual Data Space (refer to *Chapter 4 Feasibility Study Reports*). Every data space may have its own development roadmaps, governance structures, technical infrastructures, security policies, and business objectives, all of which must be considered when planning the integration. This integration roadmap is based on the state of development of Simpl-Open between August and September 2024 and includes considerations and feedback from Data Spaces during our Simpl-Live Feasibility Study working sessions between May and September 2024.

While this roadmap outlines the key tasks and phases involved, it does not claim to be fully exhaustive or entirely applicable to every Data Space scenario. Specific tasks, timelines, and milestones may need to be adjusted and refined as the integration process unfolds in each Data Space, and certain tasks may require additional steps based on the evolving needs and conditions. It is essential to understand that this roadmap and the tasks outlined are not comprehensive and must be updated continuously in response to the evolving capability stack of Simpl-Open as well as the changing requirements of the Data Space. The details of this integration roadmap must be further defined during Phase 0 and subsequently reviewed and adapted as new needs or technical developments arise.

The scope and focus of each task together with the roles and responsibilities must be refined based on which participant node, whether a Governance Authority Node or a Participant Node (Consumer/Provider), the Simpl-Open middleware is being integrated into. For details on the specific roles and responsibilities please refer to *Appendix 1. Simpl-Live Integration Operating Model and Responsibilities*.

The percentage progress assigned to each task is intended to offer a high-level indication of how far along a task might be at different stages of the integration process. These percentages serve as general markers and may vary depending on the specific challenges and requirements of the Data Space being integrated.

This roadmap provides a foundation for planning the integration of the Simpl-Open middleware but should be considered a flexible, adaptable guide that requires further specification and detailing to meet the distinct needs of each Data Space. Regular updates and refinements will be necessary to align with the evolving offerings of Simpl-Open and the dynamic landscape of Data Space requirements.

Appendix 2.1 Integration Roadmap

The integration of the Simpl-Open middleware into a Data Space requires a structured and phased approach to ensure that the system's capabilities align with the specific governance, technical, and operational needs of the Data Space.

The Project Planning stage is essential for establishing the foundation for the Simpl-Live Integration into the Data Space. Building on the findings of the Simpl-Live Feasibility Study, this stage ensures that all stakeholders and systems are fully prepared for the upcoming technical and operational demands. It focuses on e.g., refining requirements, aligning roles, and developing a detailed, Data Space-specific integration plan.

Examples of key tasks include requirements refinement, where technical and business needs are assessed and aligned with Simpl-Open's capabilities. Integration planning involves defining the integration scenario, detailing the roadmap and determining the resource allocation based on the Operating Model. Stakeholder onboarding ensures that all participants are fully briefed through workshops, gaining a clear understanding of their roles, responsibilities, and the technical infrastructure necessary for the integration.

In addition to Project Planning, continuous Project Management is crucial throughout the integration process, ensuring effective coordination of activities, adherence to timelines, and seamless communication among stakeholders. Key tasks include monitoring progress, and aligning both technical

and business objectives with the integration goals of each data space. Another relevant task is to conduct a comprehensive risk assessment, based on which the generic IT Security Plan[17] (provided to Simpl-Live in M12 2024) will be adapted to meet the data space's specific needs. Regular reporting and stakeholder engagement will keep all parties informed and involved in decision-making. This clear oversight at each phase will help ensure smooth execution and the successful achievement of integration milestones.

The integration roadmap can be divided into three main phases[18]: Phase 1: Proof of Concept (PoC), Phase 2: Pre-Production (PRE-PROD), Phase 3: Production (PROD).

In the **Proof-of-Concept** phase, the focus is on integrating instances of the Simpl-Open middleware within a controlled testing environment selected by the data space initiative. This phase emphasises validating governance workflows, security protocols, and initial technical integrations with selected participants.

The ***Pre-Production*** phase involves finalising the governance and compliance activities related to the Operating Model and facilitating the onboarding of data providers and establishing the necessary infrastructure to enable them to share their data with consumers. In addition, this phase encompasses conducting stress tests to ensure that the Simpl-Open middleware infrastructure is operationally ready.

The final ***Production*** phase transitions the middleware to a live environment, where full integration of governance, security, and technical systems, as detailed in the tasks of the Operating Model, is achieved. Continuous monitoring is implemented to ensure stable performance, while managing operations, updates, and necessary changes.

Each phase builds on the previous one, with tasks being refined as the integration progresses to full implementation. This structured process enables a seamless, controlled deployment of the Simpl-Open middleware, considering other technical, security and governance aspects at each stage that are necessary to manage resource sharing (data, application, infrastructure) across diverse participants within the Data Space. This includes harmonising data standards, enforcing governance policies, ensuring security protocols and integrating the necessary technical infrastructure to manage data exchange. At each stage, these objectives are addressed by focusing on specific high-level tasks that contribute to operations of the Simpl-Open middleware in the Data Space and ensure it meets the evolving needs.

Phase 1: Proof of Concept (PoC)

The **Proof of Concept (PoC)** phase aims to validate the core functionalities of the Simpl-Open middleware within the controlled test environment selected by the data space initiative. This phase focuses on testing key elements of the governance, security, and technical infrastructure on a limited scale. The PoC will allow stakeholders to evaluate the system's performance, compliance, and scalability as well as other non-functional requirements based on the Data Space's needs before moving to operations. The objective is to identify and address any issues early in the integration

[17] Note: The IT Security Plan for Simpl-Live provides a risk assessment of Simpl-Live considered as the deployment of the Simpl-Open stack in a generic Simpl-Live Data Space to cover common scenarios and topologies of a Data Spaces compliant with the Simpl-Open requirements. The Risk Assessment is being built by means of the GovSec tool and along the ITSRM2 methodology of the European Commission. It will serve as a common base for future data space-specific Risk Assessments once the Simpl-Open feasibility has opened the way to business domain-specific data spaces, each one with its own governance. The Simpl-Live IT Security Plan provides an asset model, coupled with a thread model and security measures for Simpl-Open runtime in the generic Simpl-Live Data Space, whereas the Simpl-Open IT Security Plan provides a risk assessment for the source code of the Simpl-Open stack. From this plan, an IT security implementation plan will be deduced to reduce the inherent risk to an acceptable residual risk regarding Simpl-Open runtime components. Once actual data spaces are created based on the Simpl-Live feasibility study, specific instantiation of the Simpl-Live IT Security Plan will have to be created per data space and following the guidance of the data space Governance Authority.

[18] These phases and steps are generic. The phases and potential steps are to be adapted according to the needs, interests and status of each data space candidate for integration.

process, ensuring the Simpl-Open middleware's capacity to handle Data Space's governance and data consumption and sharing requirements.

Organisation (25%)

During the PoC phase, the foundational governance structure will be established and tested an available testing environment selected by the data space initiative. This task focuses on defining the roles and responsibilities of participant managing in the Data Space and enforce governance compliance. Initial testing will be carried out using a subset of participants to validate governance workflows. The aim is to assess how well the governance authority can monitor compliance and enforce data-sharing agreements under controlled conditions. This task will also involve the implementation of audit logs and basic compliance reporting, ensuring that the governance structure is aligned with the operational goals of the data space. The data space is responsible and has the final decision on these tasks.

Key Activities:

- Define roles and responsibilities for participant management and governance compliance;
- Test governance workflows with a subset of participants;
- Implement audit logs and basic compliance reporting;
- Ensure alignment of governance structure with the operational goals of the Data Space.

ID, Trust & Security (25%)

The PoC phase involves deploying and testing initial security features, including identity verification, trust mechanisms, and basic encryption. These features ensure that only authorised participants can access data and that all transactions are secure. The security framework will be tested in a testing environment selected by the data space initiative to verify its effectiveness in protecting sensitive data and ensuring compliance with GDPR and other relevant regulations. The results of these tests will inform adjustments needed to scale security features in subsequent phases. The data space is responsible and has the final decision on these tasks.

Key Activities:

- Deploy identity verification mechanisms and encryption capabilities;
- Test trust mechanisms in a testing environment selected by the data space initiative to ensure secure transactions;
- Validate the security framework's compliance with GDPR and other regulations;
- Assess results and identify adjustments for scaling security in later phases.

Governance and Compliance (25%)

In this phase, basic governance enforcement mechanisms will be tested in a testing environment selected by the data space initiative. This involves validating that the governance policies defined in the preparation phase are properly enforced in practice. Compliance monitoring will ensure that all participants in the Data Space adhere to data-sharing agreements and governance rules, helping the Governance Authority manage participant onboarding, data use, and agreements. The early focus will be on ensuring that the governance processes align with Data Space objectives while allowing for adjustments based on the pilot participants. The data space is responsible and has the final decision on these tasks.

Key Activities:

- Implement and test compliance monitoring mechanisms;
- Validate the enforcement of data-sharing agreements with pilot participants;
- Monitor the governance policies to ensure alignment with Data Space goals;
- Identify and address any discrepancies in governance enforcement.

Standards and Policies (50%)

Metadata standards, including preliminary metadata schemas and vocabularies, will be specified and deployed to ensure that participants can discover, access and share data consistently. The focus in this phase will be on testing the prototype metadata catalogue, allowing participants to explore resources (data, application, infrastructure) in a controlled environment. This task will also involve ensuring that participants' metadata schemas are aligned with Simpl-Open's standards. Policies regarding e.g., access rights will be tested to ensure that all participants adhere to governance rules. Feedback from this testing will guide the refinement of standards in the next phases. The data space is responsible and has the final decision on these tasks.

Key Activities:

- Specify and deploy preliminary metadata structures and vocabularies;
- Test the prototype metadata catalogue with participants in a controlled environment;
- Ensure participants' metadata schemas align with Simpl-Open's standards;
- Test policies on e.g., access rights, using feedback to refine standards.

Data Space Processes (25%)

In the PoC, preliminary business processes related to metadata management, application integration, and infrastructure coordination will be tested. These processes ensure that resource-sharing workflows operate smoothly and are compliant with the agreed standards and policies. Additionally, the Data Space processes will be aligned with Simpl-Open's technical requirements, enabling participants to interact with metadata and share resources effectively. The data space is responsible and has the final decision on these tasks.

Key Activities:

- Test preliminary business processes for metadata and application management;
- Validate resource-sharing workflows between participants;
- Ensure alignment of Data Space processes with **Simpl-Open** capabilities;
- Adjust processes to address any operational inefficiencies identified during testing.

Platform and Infrastructure (50%)

Simpl-Open will be deployed in a testing environment selected by the data space initiative to validate its ability to support moderate data volumes and participant interactions. This task will involve configuring the necessary infrastructure components, such as storage and processing capabilities, to support initial resource exchanges (data, application, infrastructure). Performance testing will ensure the handling of the technical demands of the Data Space under controlled conditions. The focus will be on evaluating how well the Simpl-Open middleware integrates with existing systems and whether adjustments are needed before scaling the Simpl-Open middleware for more data sources.

Key Activities:

- Deploy and configure infrastructure components for data storage and processing;
- Validate the Simpl-Open middleware's performance through controlled performance testing;
- Ensure compatibility of the Simpl-Open middleware with existing systems;
- Identify potential adjustments needed before scaling up for larger data volumes.

Simpl-Open Deployment, Configuration, and Customisation (50%)

Initial deployment and configuration of the Simpl-Open middleware will focus on integrating it with a limited number of data sources and systems. This task will involve customising the Simpl-Open middleware to meet the specific needs of the participants involved in the PoC phase, such as tailoring security protocols and adjusting data-sharing workflows. Testing will ensure managing metadata discoverability, and access across systems. The results from this phase will guide further customisation and optimisation in Pre-Production.

Key Activities:

- Deploy and configure Simpl-Open with selected data sources;
- Customise capabilities to meet participant-specific needs;
- Test the Simpl-Open middleware's ability to manage e.g., metadata ingestion, discoverability and access;
- Use results to guide further customisation in MVP/Pre-Production.

Communications, Migration, and Entry into Operations (25%)

During this phase, communications strategies will be initiated to prepare stakeholders for integration into Simpl-Open. Migration activities will begin on a small scale, focusing on moving specific metadata from test systems into a testing environment selected by the data space initiative. These processes will be carefully monitored to ensure that any migration-related challenges are identified early, allowing for adjustments before the full-scale implementation in later phases.

Key Activities:

- Develop communication strategies for participant interaction;
- Initiate small-scale metadata migration into a testing environment selected by the data space initiative;
- Monitor initial migration activities and identify issues for further optimisation.

Phase 2: Pre-Production (PRE-PROD)

Phase 2 focuses on expanding and refining the Simpl-Open middleware's capabilities, preparing the system for full-scale, real-world Data Space operations. The objective of this phase is to deploy the Simpl-Open middleware across a wider participant base, scale up the governance and compliance frameworks, and ensure that the technical infrastructure can handle larger data volumes and more complex workflows. This phase is critical for finalising metadata standards, security protocols, and governance rules that will be applied in the production environment. During Pre-Production, the system needs to be stress-tested and optimised for performance, allowing for seamless integration of live data sources and operational readiness. By the end of this phase, the system should be fully prepared for the demands of the production environment, with all major components tested and validated. Finally, the roll-out of Simpl-Open is strictly under the responsibility of the Data Space initiative. The Simpl-Live Implementation team should be in supporting role of this task.

Organisation (50%)

In the Pre-Production phase, the governance framework established during PoC will be scaled to accommodate a broader range of participants and data flows. This task will involve refining governance workflows to manage participant interactions and compliance enforcement. The Governance Authority Node will be responsible for overseeing participant compliance with data-sharing agreements, and the system will now handle more complex governance tasks such as dispute resolution and conflict management. The ability to scale governance rules while maintaining compliance will be key in this phase, ensuring that the system can support the growing number of participants and data exchanges.

Key Activities:

- Scale the governance framework to manage more participants and complex data flows;
- Refine governance workflows to handle compliance enforcement and participant interactions;
- Oversee participant compliance and manage conflict resolution;
- Ensure the system can support an increasing number of participants while maintaining compliance.

ID, Trust & Security (50%)

Security protocols will be expanded and tested under real-world conditions in Pre-Production. This task includes e.g., deploying authentication mechanisms and access controls, as well as encryption for all data exchanges. Security audits verify that the system can withstand potential threats and handle for example sensitive data securely. Monitoring aims to detect and mitigate security risks when the Simpl-

Open middleware for the Data Space scales. The security framework aims to ensure that participants can securely access the system while maintaining compliance with governance policies.

Key Activities:

- Deploy and test authentication and access controls;
- Conduct security audits to validate the system's ability to handle potential threats;
- Implement monitoring systems to detect and mitigate security risks;
- Ensure participants can securely access the system while maintaining compliance.

Governance and Compliance (50%)

In Pre-Production, the governance and compliance framework will be rolled out to accommodate a broader range of participants. As more participants are integrated, compliance enforcement and governance monitoring mechanisms will need to be more robust. Automated tools for monitoring adherence to data-sharing agreements, compliance reporting, and governance workflows will be implemented to support the increasing complexity of interactions in the Data Space. These measures will ensure that the governance processes can handle the expanded number of participants and data-sharing activities.

Key Activities:

- Scale governance workflows and compliance enforcement mechanisms;
- Implement automated tools for monitoring compliance and governance adherence;
- Expand governance reporting and audit functions to support increased participant numbers;
- Ensure the governance framework can manage more complex governance challenges, such as conflict resolution and dispute management.

Standards and Policies (75%)

Metadata standards and vocabularies will be finalised in this phase, with participants required to align metadata schemas with the Simpl-Open standards. The metadata catalogue will be fully populated, enabling participants to query resources. Data-sharing policies will be enforced to ensure compliance with governance rules. This task will also involve testing of e.g., access rights, and quality under the established governance framework. Any necessary adjustments to data standards or governance policies will be made before moving into Production.

Key Activities:

- Finalise metadata standards and vocabularies for the production environment;
- Populate the metadata catalogue with metadata from participants;
- Enforce data-sharing policies for compliance with governance rules;
- Test and adjust governance frameworks for metadata management.

Data Space Processes (50%)

As the middleware transitions into Pre-Production, Data Space processes, including metadata management, application integration, and infrastructure coordination, will be fully optimised to accommodate a larger participant base. The workflows that were tested during the PoC phase will be refined and extended to handle increased data volumes and interactions. Resource-sharing processes (data, applications, infrastructure) will be scaled to ensure that all participants can interact with the system efficiently, while ensuring adherence to metadata and governance standards.

Key Activities:

- Refine and scale data-sharing workflows for increased participant interactions;
- Optimise metadata management processes for higher data volumes;
- Ensure alignment of processes with the governance and compliance framework;
- Conduct stress tests to ensure processes can handle real-world, large-scale operations.

Platform and Infrastructure (75%)

The Simpl-Open middleware's infrastructure will be scaled to support data exchanges with additional data sources and higher data volumes. This task will involve optimising the infrastructure components, such as metadata storage, processing capacity, and networking resources, to ensure the effective handling of productive participant interactions. Stress tests ensure that the system can manage peak data flows without performance degradation. This phase will focus on integrating existing data sources and systems into the Simpl-Open middleware, ensuring that the infrastructure can support full-scale operations in Production.

Key Activities:

- Scale infrastructure components to manage live data exchanges and interactions;
- Optimise metadata storage, processing, and networking for peak data flows;
- Conduct stress tests to ensure the system handles high workloads without degradation;
- Integrate live data sources and systems into the Simpl-Open middleware for full-scale operations.

Simpl-Open Deployment, Configuration, and Customisation (75%)

The Simpl-Open middleware will be fully configured to meet the operational needs of participants, with APIs, data connectors, and workflows deployed and tested. This task involves customising the Simpl-Open middleware to support diverse use cases, including national regulations and cross-border data-sharing requirements. Integration testing will ensure that the Simpl-Open middleware can seamlessly interact with participants' systems, and any remaining customisations will be implemented to optimise data-sharing workflows.

Key Activities:

- Fully configure the Simpl-Open middleware with APIs, data connectors, and workflows;
- Customise the Simpl-Open middleware to accommodate diverse use cases and regulatory requirements;
- Test the integration of the Simpl-Open middleware with participants' systems;
- Implement final customisations to optimise data-sharing workflows.

Qualification Services and Training (50%)

Participant qualification services will be fully implemented. These services ensure that participants meet technical and governance standards before entering full operations. The training programme will be formalised, focusing on metadata standards, governance protocols, and Simpl-Open functionalities. Participants will receive onboarding and training, preparing them for the upcoming production environment.

Key Activities:

- Develop and implement qualification services to ensure participant compliance with standards;
- Deliver targeted onboarding and training programmes;
- Provide continuous support to participants preparing for production;
- Validate participant readiness for large-scale operations.

Communications, Migration, and Entry into Operations (50%)

This task becomes more critical in Pre-Production, as large-scale data migration from a testing environment selected by the data space initiative to the production environment is initiated. Communication strategies will also be expanded to ensure clear coordination among participants and stakeholders as data is migrated and workflows are finalised.

Key Activities:

- Scale up communications for broader participant interaction;
- Facilitate large-scale data and metadata migration;
- Finalise operational workflows for smooth entry into production;
- Ensure that all participants are informed of their roles and responsibilities during migration.

Operations and Maintenance (ITSM) (50%)

In the Pre-Production phase, operational procedures for maintaining Simpl-Open middleware will be defined. This includes monitoring system performance and providing technical support to ensure that the platform remains operational as data volume and complexity increase. Basic ITSM processes will be tested to ensure they are scalable and ready for full production.

Key Activities:

- Implement and test operational support procedures for middleware;
- Provide technical support during scaling operations;
- Monitor system performance and resource utilisation;
- Prepare ITSM processes for the production phase.

Data Space Services Desk (50%)

As more participants are onboarded, the establishment of a dedicated service desk becomes necessary. The service desk will serve as a central point of contact for participants needing support with Simpl-Open middleware, whether for technical assistance or governance clarification. This system will allow for seamless communication and issue resolution before the full production launch.

Key Activities:

- Establish a service desk for participant inquiries and technical support;
- Provide ongoing assistance to participants navigating Simpl-Open;
- Resolve administrative and operational issues efficiently;
- Monitor participant satisfaction with the service provided.

Phase 3: Production (PROD) – 6 Months

Phase 3 marks the final stage of the Simpl-Open middleware integration, transitioning the system into full production. The objective of this phase is to ensure that the Simpl-Open middleware is fully operational, supporting data exchanges, governance enforcement, and participant interactions at scale. In this phase, all governance, security, and technical systems will be fully deployed, with ongoing monitoring to ensure that the Simpl-Open middleware can handle peak workloads and large-scale data exchanges. The production phase will also involve continuous operations and maintenance to manage system updates, participant onboarding, and compliance monitoring. By the end of this phase, the Simpl-Open middleware will be fully integrated into the Data Space to support its long-term operational and governance needs. Finally, as mentioned for Phase 2, the roll-out of Simpl-Open is strictly under the responsibility of the Data Space initiative. The Simpl-Live Implementation team should be in supporting role of this task.

Organisation (100%)

The governance framework will be fully operational in the Production phase, with governance enforcement and compliance monitoring in place. The Governance Authority will manage e.g., participant onboarding, data-sharing agreements, and conflict resolution. Governance workflows will be automated to handle the increased scale of participants and data exchanges. This task will focus on ensuring that governance policies are applied consistently, with the system capable of managing governance tasks across all participants in the Data Space.

Key Activities:

- Fully operationalise the governance framework to manage participant onboarding and data-sharing agreements;
- Automate governance workflows to handle increased participants and data exchanges;
- Ensure consistent application of governance policies across all participants.

ID, Trust & Security (100%)

Security protocols will be fully enforced, with monitoring to detect and address potential security threats. The system will dynamically update security measures to adapt to emerging threats, ensuring that all data exchanges remain secure. This task will also involve regular security audits to verify compliance with legal and regulatory requirements such as GDPR. The security framework will protect sensitive data throughout its lifecycle, from ingestion to exchange.

Key Activities:

- Enforce full security protocols to protect sensitive data;
- Implement real-time monitoring to detect and mitigate security threats;
- Perform regular security audits to ensure compliance with GDPR and other regulations;
- Dynamically update security measures to adapt to new threats.

Governance and Compliance (100%)

The governance and compliance framework will be fully integrated, enabling consistent oversight of participant interactions and data-sharing agreements. Automated workflows will be in place to support governance enforcement, compliance reporting, and the resolution of disputes. The integration of these governance structures ensures that the system can continuously monitor adherence to governance rules, supporting the smooth onboarding of new participants while maintaining compliance across all stakeholders. Procedures for managing participant compliance and enforcing governance will be aligned with operational demands, allowing for adaptable oversight as the Data Space evolves.

Key Activities:

- Integrate governance and compliance monitoring to manage participant interactions;
- Automate workflows for governance enforcement and compliance reporting;
- Continuously monitor compliance with data-sharing agreements;
- Address governance issues, such as disputes, in a structured manner.

Standards and Policies (100%)

Metadata standards will be fully enforced across all participants, ensuring that data exchanges comply with the governance framework. The metadata catalogue will be populated with metadata, allowing participants to discover, access and share data seamlessly. This task will involve monitoring data-sharing policies to ensure compliance and determine necessary adjustments to data governance rules. The aim is to maintain metadata quality and consistency across the Data Space while ensuring participants adhere to the established governance standards.

Key Activities:

- Fully enforce metadata standards across all participants in the Data Space;
- Populate and maintain the metadata catalogue to enable seamless metadata discovery, access and sharing;
- Monitor data-sharing policies to ensure compliance with governance rules;
- Adjust governance policies as needed to maintain metadata quality and consistency.

Data Space Processes (100%)

During the Production phase, all processes e.g., metadata management, resource sharing, and application integration will be fully integrated to support the operational needs of the Data Space. The alignment of workflows with the technical and governance frameworks will enable efficient data-sharing and interaction between participants. These processes will be automated to ensure scalability and efficiency, with monitoring mechanisms in place to adjust as necessary, supporting ongoing optimisation as the Data Space grows. The integration of these processes will ensure the Data Space can adapt to changes while maintaining performance and compliance. These elements serve as examples of potential processes and workflows that may be implemented.

Key Activities:

- Integrate and scale e.g., metadata management, resource sharing, and application workflows;
- Automate processes to enhance efficiency and scalability;
- Monitor and optimise workflows in response to operational demands;
- Ensure alignment of processes with governance and technical frameworks.

Platform and Infrastructure (100%)

By the Production phase, the Simpl-Open middleware fully integrates data sources supporting live participant interactions. The Simpl-Open middleware handles e.g., resource sharing (data, application and infrastructure), and specified workflows, ensuring monitoring of the infrastructure to manage the operational demands of the Data Space. The system will be fully integrated into existing systems, ensuring seamless data-sharing and resource management across all participants.

Key Activities:

- Participant interactions through the Simpl-Open middleware;
- Handle resource sharing and workflows with full infrastructure integration;
- Continuously monitor system performance to manage operational demands;
- Ensure seamless data-sharing and integration with participant's existing systems.

Simpl-Open Deployment, Configuration, and Customisation (100%)

The deployment and configuration of the Simpl-Open middleware will be fully integrated with the participant's IT systems, ensuring operational alignment with the Data Space's technical and procedural requirements. Customisation of the middleware will enable it to support specific workflows and business needs, while maintaining flexibility for future adjustments or updates. This integration of middleware, aligned with the operational structures of participants, ensures that e.g., data exchanges, metadata management, and participant workflows are streamlined and adaptable. Ongoing monitoring will be implemented to adjust configurations as necessary, supporting the evolving needs of the Data Space.

Key Activities:

- Complete integration of Simpl-Open middleware with participants' IT systems;
- Customise middleware to meet specific operational and technical requirements;
- Monitor system performance and adjust configurations as needed;
- Ensure the middleware remains adaptable to future updates and changes.

Qualification Services (100%)

Qualification services will be fully integrated into the Production phase to ensure participants meet all technical, operational, and governance requirements. These services will provide continuous support through training programs, onboarding procedures, and certification processes. Qualification ensures that participants are equipped with the necessary knowledge and skills to operate within the Data Space, enabling consistent compliance with policies and standards. These services will also adapt to new regulatory requirements or changes within the Data Space environment. The descriptions here represent examples of services rather than a comprehensive scope.

Key Activities:

- Deliver continuous onboarding, training, and certification programs;
- Ensure participants meet and maintain operational and governance standards;
- Monitor compliance and adjust qualification services based on evolving needs;
- Provide support for ongoing participant engagement and adaptation.

Communications, Migration, and Entry into Operations (100%)

The finalisation of migration and entry into full-scale operations will be a critical element in the Production phase. This includes ensuring that all communications strategies are in place for participants, and supporting coordination throughout the Data Space. Full-scale data migration will be completed, and operational processes will be streamlined to ensure efficiency and prevent disruption.

These measures are essential for the smooth transition of all participants into the fully operational system.

Key Activities:

- Finalise communication strategies for all participants;
- Complete full-scale data migration and ensure operational continuity;
- Streamline processes to support entry into the operational phase;
- Address any migration challenges and provide ongoing support.

Operations and Maintenance (ITSM) (100%)

IT operations and maintenance processes and services will be in full effect to ensure the stable functioning of the Simpl-Open middleware. This includes continuous monitoring of the middleware's performance, regular updates, and incident management. ITSM will ensure that the middleware remains functional as participant interactions scale and that any issues are addressed quickly to maintain operational efficiency.

Key Activities:

- Maintain and monitor the operational performance of the middleware;
- Implement ITSM processes to handle system updates and incident management;
- Provide continuous technical support to participants;
- Ensure the middleware remains scalable and adaptable as operations grow.

Change Management (50%)

Change management processes will ensure that any updates or modifications to the Simpl-Open middleware, governance structures, or operational processes are implemented smoothly without disrupting ongoing operations. These processes will include system updates, feature releases, and the onboarding of new participants, ensuring that the Data Space can continue evolving while maintaining operational stability.

Key Activities:

- Manage system updates and feature releases without disruption;
- Onboard new participants and manage evolving governance rules;
- Maintain system adaptability to respond to technical or operational changes.

Data Space Services Desk (100%)

The service desk will be fully operational, providing participants with a centralised point for resolving technical issues, clarifying governance concerns, and addressing operational queries. The services desk will be vital in ensuring the continuous flow of information and support between the governance authority and participants.

Key Activities:

- Provide full-scale participant support through the service desk;
- Resolve technical and governance-related queries promptly;
- Ensure effective communication between participants and governance authorities;
- Continuously monitor service desk performance and participant satisfaction.

Hypercare (Post-Integration)

After the Simpl-Open middleware Go-Live is completed a transition into a Hypercare (post-integration phase) is recommended focussing on enhanced support and proactive monitoring to ensure a seamless and continuous full-scale operation. During this phase, additional measures such as regular audits and compliance checks should be implemented to ensure that governance and data-sharing agreements are adhered to. Continuous security monitoring is crucial to safeguard against emerging threats, and protocols should be updated accordingly. It is advisable to maintain robust qualification services,

including participant onboarding and ongoing training programs, to facilitate the smooth integration of new participants and ensure they meet operational standards.

The technical infrastructure should undergo intensified performance monitoring to handle the increased data volumes and ensure system stability. Proactive change management will be key during Hypercare, enabling seamless updates to workflows and system configurations, and incorporating feedback from participants to optimise operations. Additionally, a dedicated service desk should remain in place to provide ongoing technical and governance support, resolving any issues efficiently. The introduction of periodic audits will further strengthen governance enforcement and compliance.

By extending these support mechanisms, the Hypercare phase will ensure the Simpl-Open middleware remains scalable, secure, and adaptable to the evolving needs of the Data Space, paving the way for long-term operational success. For the Hypercare phase it is also key to consider that the roll-out of Simpl-Open is strictly under the responsibility of the Data Space initiative. The Simpl-Live Implementation team should be in supporting role of this task.

Appendix 2.2 Preliminary Timeline

In order to coordinate the efforts toward a Simpl-Open integration, the generic preliminary timeline indicates the duration for each of the three integration phases. Each Data Space follows an individual timeline to conduct its specified integration scenario. The timeline also accounts for potential overlaps between project phases and highlights regular alignments with Simpl-Open in order to ensure a smooth overall integration. The template used for this timeline is displayed in *Figure 6: Generic preliminary timeline*.

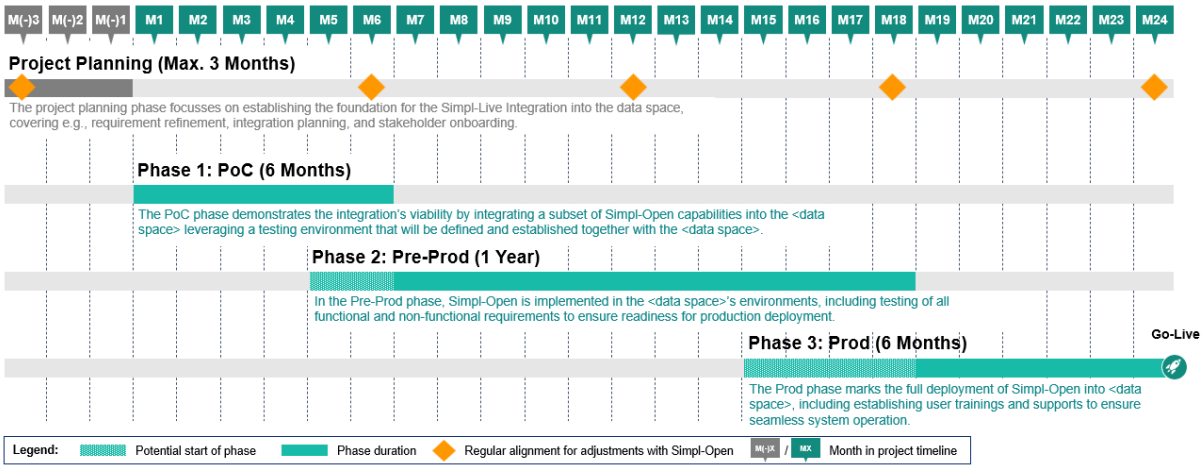

Figure 6: Generic preliminary timeline

The integration of Simpl-Open middleware into a Data Space is planned over a **24-month** period, following an initial 3-month *Project Planning* phase. This timeline is generic and intended for integration into an unspecified Data Space; it must be customised based on the state, specific requirements, and timeline of the selected Data Space. The integration itself is structured into three distinct phases detailed in *Appendix 2.1 Integration Roadmap* : *Proof of Concept (PoC), Pre-Production (PRE-PROD)*, and *Production (PROD)*. Continuous *Project Management* supports the process to maintain progress and alignment with project goals.

The *Project Planning* stage occurs before the main 24-month integration period and lasts for **three months**. This phase builds the foundation for Simpl-Open middleware integration by focussing on defining requirements of the Data Space, stakeholder roles, and establishing a detailed integration roadmap. Key tasks include resource allocation, timeline development, and risk management strategies to prepare for technical and operational demands. Stakeholder workshops and briefings ensure all participants are aligned and ready for the integration process.

The ***Proof of Concept (PoC)*** phase spans the **first six months** of the integration period and focuses on testing the middleware's functionalities within a controlled testing environment selected by the data space initiative.

The ***Pre-Production (PRE-PROD)*** phase, covering **12 months**, is focused on scaling the middleware infrastructure to handle live data sources and an expanding participant base.

The final ***Production (PROD)*** phase **lasts six months** and transitions the middleware into a fully operational state within the live environment.

Throughout the entire 24-month integration period, ***Project Management*** is essential for coordinating activities, meeting timelines, and ensuring seamless communication among stakeholders. This ongoing oversight is critical for ensuring each phase progresses on schedule and that integration milestones are achieved.

This generic timeline provides a high-level indication for an integration plan of an estimated 24 months, following the 3-month preparatory phase. It must be customised based on the state, specific requirements, and timeline of the selected Data Space.

Appendix 2.3 Integration Resource Plan and Assumptions

Several key considerations and assumptions influence the estimations of the individual recourse plans. Besides others, this includes the maturity of the Data Space, the complexity of the systems involved, governance and regulatory environments, stakeholder involvement, and security requirements. Each of these elements affects how resources may be distributed across tasks and phases within the roadmap. Below, these key assumptions guiding this resource plan are discussed in detail, offering insight into how they shape the resource needs for both brownfield (mature) and greenfield (conceptual) Data Spaces.

Key Considerations and Assumptions

Integration Scope and Participant Involvement

When reviewing the individual resource plans for each Data Space, it is essential to understand that they are structured for the initial integration of Simpl-Open specifically at the Governance Authority node level, focusing on just one node. In cases where the integration scenario extends to participants, only a selected number of pilot nodes are included. Consequently, the resource plan accounts for the integration of Simpl-Open middleware with limited, pre-defined group of participants, which must be identified and agreed upon with relevant stakeholders before the integration process begins. As per the RASCI matrix, the contractors are positioned to support these participant nodes but are not responsible for carrying out the actual integration at the participant level.

Maturity State

The distinction between brownfield (more mature, existing systems) and greenfield (rather conceptual, newly developed) Data Spaces plays a fundamental role in shaping the resource requirements for the integration process.

Brownfield Data Space:

In a mature, brownfield Data Space, there are often many pre-existing systems, data sources, and legacy infrastructures. This introduces complexity in tasks such as *Platform and Infrastructure*, *Configuration and Customisation*, and *Change Management*. Integrating the Simpl-Open middleware into established systems may involve compatibility challenges, updating technology, and managing technical debt. As a result, more person-days are typically allocated to roles such as *Cloud Architect, SysOps Engineer*, and *DevOps Engineer*. The nature of this integration requires careful planning, incremental deployment, and significant resources to ensure seamless system transitions without disruptions to existing operations.

Greenfield Data Space:

A greenfield Data Space, on the other hand, offers more flexibility as there are few or no existing systems to integrate with the Simpl-Open middleware. In this case, the focus may be on establishing frameworks, designing governance models, and building systems supported by Simpl-Open middleware capabilities. The complexity of integration is likely to be lower, and tasks like *Customisation and Platform Deployment* can be approached with more flexibility. Here, roles like *Solution Architect* and *Business Analyst* are more prominent, as they focus on the conceptual and architectural aspects of the system, while fewer person-days are required for integration and technical complexity management.

Generic Roadmap Assumption:

It is assumed that the Data Space lies somewhere between a greenfield and brownfield scenario. There is a need for integration of some existing systems, but also considerable flexibility in designing and building solutions or potential integration with the Simpl-Open middleware.

Integrated Data Sources and Systems

The number of existing systems and data sources that need to be integrated with the Simpl-Open middleware is a key factor influencing resource needs, especially for tasks related to *Platform and*

Infrastructure and *Data Space Processes*. This task is fully under the responsibility of the Data Space Initiative and the Simpl-Live team should support this activity.

Brownfield Data Space:

In a brownfield Data Space scenario, numerous pre-existing systems and data sources need to be integrated into the new middleware. This increases the complexity of integration tasks for the Simpl-Open middleware, as careful management is required to ensure compatibility, maintain functionality, and avoid system conflicts. As a result, more person-days are allocated to roles such as *DevOps Engineer*, *SysOps Engineer*, and *Cloud Architect*. These technical roles are critical for identifying and solving integration issues, managing system dependencies, and ensuring that existing systems work seamlessly with the Simpl-Open middleware.

Greenfield Data Space:

In a greenfield Data Space, there are fewer pre-existing systems, which simplifies the integration process. In some cases, these Data Spaces have existing system architecture documentation, for example from preparatory actions, which could provide valuable information for the Simpl-Open integration exercise. The focus shifts towards setting up Data Space systems and infrastructure, reducing the need for intensive troubleshooting and system management. As such, fewer person-days are required for integration tasks, while more effort is allocated towards conceptual tasks such as designing system architecture and governance models.

Generic Roadmap Assumption:

It is assumed that the Data Space involves a moderate number of existing systems and data sources. The resource allocation balances between integration tasks (requiring technical expertise) and the design of additional systems (requiring more conceptual work). The specific individual reports present more details in the delimitation and task between the data space initiative and the Simpl-Live integration team.

Governance and Regulatory Environment

The governance and regulatory requirements of the Data Space influence the tasks related to *Governance and Compliance*, *ID, Trust & Security*, and *Standards and Policies*. This task is fully under the responsibility of the Data Space Initiative and the Simpl-Live team should support this activity.

Brownfield Data Space:

In a mature brownfield Data Space, it is likely that existing governance frameworks and regulatory standards must be maintained during the integration process. This increases the complexity of compliance tasks, as new systems must adhere to established governance structures. More person-days are therefore allocated to roles such as *Data Lawyer(s)*, *Security and Compliance Specialist*, and *Legal/Compliance Officer* to ensure that integration efforts align with existing regulations and standards. Moreover, the ongoing nature of governance and compliance tasks demands continuous resource allocation, particularly as more systems and participants are integrated.

Greenfield Data Space:

A greenfield Data Space offers greater flexibility in establishing governance frameworks and regulatory compliance. This simplifies governance-related tasks since the system can be designed to meet current regulatory requirements without needing to adapt to legacy frameworks harmonising them with the Simpl-Open requirements. As a result, fewer person-days are required for roles focused on compliance, and more emphasis is placed on creating new policies and standards.

Generic Roadmap Assumption:

It has been assumed that the Data Space operates in a moderately regulated environment, requiring governance and compliance measures but with room for flexibility. The resource plan allocates sufficient person-days to establish governance processes while managing compliance in a relatively straightforward regulatory environment.

Technical Complexity and Infrastructure

The complexity of the technical infrastructure of a Data Space directly influences resource requirements, particularly for tasks involving *Platform and Infrastructure* and *Customisation*.

Brownfield Data Space:

A brownfield Data Space is likely to present more and more complicated technical challenges due to the need to integrate existing systems and data sources with the Simpl-Open middleware. Legacy systems may require higher customisation efforts and an increased need for troubleshooting to work seamlessly with the Simpl-Open middleware. Additional person-days are allocated to roles such as *Cloud Architect*, *Enterprise & Big Data Architect*, and *SysOps Engineer* to handle these complexities. The process involves ensuring that new platforms integrate smoothly with existing infrastructure while maintaining performance, scalability, and system stability.

Greenfield Data Space:

In contrast, a greenfield Data Space will not need to consider legacy systems when integrating Simpl-Open. This fact likely has a great impact on the technical requirements and allows for more flexible and innovative infrastructure design choices. While the initial setup and architecture design still require technical expertise, the absence of legacy constraints reduces the need for complex integrations. Fewer person-days are required for testing and legacy system management, and more focus is placed on designing scalable, future-proof systems.

Generic Roadmap Assumption:

For the generic roadmap it has been assumed that the Data Space involves moderate technical complexity, with some legacy systems requiring integration alongside new infrastructure. The resource plan balances these needs, ensuring that technical roles are sufficiently resourced to handle both integration and new system development.

Stakeholder Involvement and Communication

The degree of stakeholder involvement and the complexity of communication across participants influences tasks such as *Communications, Migration, and Entry into Operations* and *Change Management*.

Brownfield Data Space:

A mature brownfield Data Space often involves numerous stakeholders, including system owners, data providers, and Data Space participants / end users. Managing communication and coordination across these groups adds complexity to the integration process. More person-days may be allocated to roles such as *Communications Manager*, *Project Manager*, and *Service Manager* to ensure that stakeholders are informed, aligned, and engaged throughout the process.

Greenfield Data Space:

In a greenfield Data Space, the number of stakeholders is typically smaller, and communication processes are likely to be more streamlined. While stakeholder engagement remains important, the coordination and communication requirements are rather simpler, reducing the number of person-days required for these tasks.

Generic Roadmap Assumption:

It is assumed that the Data Space involves a moderate level of stakeholder interaction. The resource plan provides adequate staffing for communication and coordination tasks, without requiring excessive stakeholder management efforts.

Security and Data Privacy

The security and data privacy requirements of the Data Space influence tasks such as *ID, Trust & Security* and *Compliance Monitoring*.

Brownfield Data Space:

In a brownfield Data Space, likely existing security protocols need to be revised and harmonised with Simpl-Open standards. Data Space's existing security measures may need to be updated, and Simpl-Open security protocols must ensure compatibility with existing data privacy frameworks, adding complexity to the process. More person-days may be allocated to roles like *Data Security Engineer* and *Security and Compliance Specialist* to manage these challenges. These roles are essential for reviewing and retrofitting legacy security architectures to meet modern security standards and to comply with regulations such as GDPR. Additionally, ongoing compliance monitoring becomes an important task to ensure data privacy standards are upheld, especially when scaling to multiple users and systems.

Greenfield Data Space:

In a greenfield Data Space, the effort of harmonising and integrating measures security policies can be assumed to be significantly less, reducing overall integration complexity. Simpl-Open middleware security and data privacy protocols may be aligned with the Data Space's requirements and be embedded in the architecture, simplifying both implementation and compliance management. As a result, it is likely that fewer person-days must be allocated for the integration including e.g., testing, resolving integration challenges and the focus remains on ensuring that the security framework is robust, and Data Space's and Simpl-Open's requirements are being addressed.

Generic Roadmap Assumption:

For the generic roadmap it is assumed that the Data Space requires moderate but evolving security and data privacy capabilities. The resource plan reflects the need for strong initial security measures as well as ongoing compliance monitoring, with sufficient person-days allocated to roles such as *Data Security Engineer* and *Security and Compliance Specialist*. The complexity of retrofitting existing systems is accounted for, while the flexibility of security architecture reduces the integration effort.

Appendix 3. Data Spaces Requirements

This list of requirements has been collected between July and September 2024. Due to the continuous development and evolution of both Simpl-Open and the Data Spaces, it is imperative to revise the requirements provided before using them for the next phases of the project. Specific details and a higher granularity of their description are included at the end of this appendix. A consolidated document of cross-Data Spaces requirements is provided in the following *Appendix 4. Common Data Space Requirements*.

(1.) PPDS

Functional Requirements

- Capability 1: Monitoring and Reporting
  - FR-101 – Real-Time Monitoring of Data Usage
  - FR-102 – Monitoring of Usage Policies
- Capability 2: Access Control and Trust
  - FR-201 – Authentication Provider Federation
  - FR-202 – Role-Based Access Control
- Capability 3: Data and Metadata Management
  - FR-301 – Metadata Management and Discovery
  - FR-302 – Metadata Search and Retrieval
- Capability 4: Interoperability Services
  - FR-401 – SPARQL Query Support
  - FR-402 – Resource Description Framework (RDF) Data Handling
- Capability 5: Security
  - FR-501 – Compliance with GDPR
  - FR-502 – Public Key Infrastructure (PKI) Support

Non-Functional Requirements

- NFR-01 – Security and GDPR Compliance
- NFR-02 – Scalability and Performance
- NFR-03 – Reliability and Fault Tolerance
- NFR-04 – Data Governance and Auditability

(2.) EHDS2

Functional Requirements

- Capability 1: User management
  - FR-CP-101 – Data user account creation
  - FR-CP-102 – Central Platform login
  - FR-CP-103 – Data user account removal
  - FR-CP-104 – IAA - Keycloak IAA
  - FR-CP-105 – IAA - DG SANTE authorisation
  - FR-CP-106 – IAA - EU login
  - FR-CP-107 – IAA - eIDAS login
- Capability CP-2: Participant onboarding
  - FR-CP-201 – Request for participation
  - FR-CP-202 – Approve or reject participation
  - FR-CP-203 – Request for disconnection
  - FR-CP-204 – Approve disconnection
- Capability CP-3: NCP onboarding
  - FR-CP-301 – Get instructions for NCP configuration
  - FR-CP-302 – Submit NCP Details
  - FR-CP-303 – NCP Compliance Check
  - FR-CP-304 – NCP Onboarding
- Capability CP-4: Dataset Catalogue - Dataset validation
  - FR-CP-401 – Metadata models and validation rules management
  - FR-CP-402 – Metadata models and rules versioning
  - FR-CP-403 – EU metadata validation
- Capability CP-5: Dataset Catalogue - Dataset publication
  - FR-CP-501 – EU Catalogues creation
  - FR-CP-502 – Data access configuration
  - FR-CP-503 – EU metadata publishing
- Capability CP-6: Dataset Catalogue - Metadata lifecycle
  - FR-CP-601 – Metadata versioning
- Capability CP-7: Dataset Catalogue - Metadata search & discovery
  - FR-CP-701 – Metadata-based search
  - FR-CP-702 – Advanced search
  - FR-CP-703 – Metadata display
  - FR-CP-704 – Search by API
- Capability CP-8: Analyses results Catalogue - Results publication

    - FR-CP-801 – EU Results publishing
- Capability CP-9: Analyses results Catalogue - Results validation
    - FR-CP-901 – Metadata models and validation rules management
- Capability CP-10: Analyses results Catalogue - Results search & discovery
    - FR-CP-1001 – Metadata-based search
    - FR-CP-1002 – Advanced search
    - FR-CP-1003 – Usage results display
    - FR-CP-1004 – Search by API
- Capability NCP-1: NCP management (NCP)
    - FR-NCP-101 – NCP configuration
    - FR-NCP102 – NCP Compliance Self-check
- Capability NCP-2: National Dataset catalogue
    - FR-NCP-201 – National Metadata publishing
    - FR-NCP-202 – National metadata validation
    - FR-NCP-203 – Republishing of metadata
- Capability NCP-3: National results catalogue
    - FR-NCP-301 – National results publishing
    - FR-NCP-302 – Republishing of results
- Capability SPE-1: Data access
    - FR-SPE-101 – Health data upload
    - FR-SPE-102 – Results flagging
    - FR-SPE-103 – Privacy & content validation
    - FR-SPE-104 – Authentication & authorisation
- Capability CHDAB-1: HDAB onboarding
    - FR-CHDAB-101 – HDAB onboarding
    - FR-CHDAB-102 – HDAB disconnection
- Capability CHDAB-2: Republishing
    - FR-CHDAB-201 – Forwarding of metadata
    - FR-CHDAB-202 – Forwarding of results
- Capability HDAB-1: Data holder onboarding
    - FR-HDAB-101 – Data holder onboarding
- Capability HDAB-2: Regional data catalogue
    - FR-HDAB-201 – Metadata publishing
    - FR-HDAB-202 – Regional metadata validation
    - FR-HDAB-203 – Forwarding of metadata
- Capability HDAB3: Regional results catalogue

- FR-HDAB-301 – Results publishing

Non-Functional Requirements

- NFR-01 – UI internationalisation
- NFR-02 – UI compliance
- NFR-03 – Usability
- NFR-04 – Compliance with DG SANTE Authorisation
- NFR-05 – Keycloak support
- NFR-06 – Compliance with EU login
- NFR-07 – Compliance with EIDAS login
- NFR-08 – Easy navigation & understanding
- NFR-09 – Metadata Compliance
- NFR-10 – Onboarding conformance
- NFR-11 – Onboarding performance
- NFR-12 – Mandatory anonymisation info
- NFR-13 – Versioning of data and metadata
- NFR-14 – Search performance
- NFR-15 – Search scalability
- NFR-16 – Regulatory Compliance
- NFR-17 – eDelivery compliance
- NFR-18 – NCP Conformance

(3.) LDS

Functional Requirements

- Capability 1: Metadata Management and Discovery
  - FR-101 – Resource Submission
  - FR-102 – Mapping
  - FR-103 – Metadata Validation
  - FR-104 – Multilingualism
  - FR-105 – Metadata Search, incl. free text search, faceted search, and auto-suggestion/completion
  - FR-106 – Results Display, incl. relevance ranking, and resource relationships
  - FR-107 – Real-time indexing
  - FR-108 – Search history
- Capability 2: Data Exchange
  - FR-201 – Connect between Asset and Actual Data
  - FR-202 – Data Transfer
  - FR-203 – Offering Monetisation
- Capability 3: Security and Compliance
  - FR-301 – Authentication
  - FR-302 – Role and Permission Assignment
  - FR-303 – Policy Setup
  - FR-304 – Policy Enforcement
  - FR-305 – Audit Logging
- Capability 4: Governance and Monitoring
  - FR-401 – Registration
  - FR-402 – Compliance Check and Approval
  - FR-403 – Credential Management
  - FR-404 – Monitoring

Non-Functional Requirements

- NFR-01 – Security
- NFR-02 – Scalability
- NFR-03 – Performance
- NFR-04 – Compliance
- NFR-05 – Auditability
- NFR-06 – Interoperability
- NFR-07 – Usability
- NFR-08 – Metadata Integrity/Validation
- NFR-09 – Metadata Quality

(4.) EOSC

Functional Requirements

- Capability 1: EOSC federation
  - FR-101 – EOSC data space and federated services
- Capability 2: User interface
  - FR-201 – User interface translation
- Capability 3: Data governance
  - FR-301 – Identification of superior data sets
  - FR-302 – Data curation
- Capability 4: Data/Application/Infrastructure Discovery and Data sharing
  - FR-401 – Promotion of superior data sets
  - FR-402 – Schema translation
  - FR-403 – Federated search model
  - FR-404 – Automated metadata harvesting
  - FR-405 – Support of various search types
  - FR-406 – Recommendation based on previous search
  - FR-407 – Natural Language Processing
  - FR-408 – Knowledge graph
  - FR-409 – AI enhancement in search functions
  - FR-410 – Persistent resource identifier
- Capability 5: Access control and Trust
  - FR-501 – Role-based access control
  - FR-502 – Closed marketplace
  - FR-503 – User profiles for administration
  - FR-504 – Approval workflow for onboarding participants
  - FR-505 – Self-management of participants groups
  - FR-506 – Authentication provider federation
  - FR-507 – Authorisation
  - FR-508 – User roles
- Capability 6: Federation management
  - FR-601 – Tier level management of providers
- Capability 7: Contracting
  - FR-701 – Credit based usage for consumers
  - FR-702 – Out of box contracting process compliant with European and national regulation within Europe
  - FR-703 – SLA management

- Capability 8: Monitoring
  - FR-801 – Monitoring and logging user activities
- Capability 9: Reporting
  - FR-901 – Reporting the services provided by the nodes
- Capability 10: Support
  - FR-1001 – Multi-tiered helpdesk
  - FR-1002 – Dedicated forums for providers and consumers
  - FR-1003 – Automated ticket assignment and distribution
  - FR-1004 – Advanced maintenance
- Capability 11: CSIRT
  - FR-1101 – Threat monitoring
  - FR-1102 – Incident response
- Capability 12: User space
  - FR-1201 – User dashboard

Non-Functional Requirements

- NFR-01 – Security
- NFR-02 – Scalability
- NFR-03 – Usability
- NFR-04 – Auditability
- NFR-05 – Reliability
- NFR-06 – Discoverability
- NFR-07 – Performance
- NFR-08 – Quality
- NFR-09 – Training
- NFR-10 – Financial sustainability
- NFR-11 – FAIR principles

(5.) DestinE

Functional Requirements

- Capability 1: Data Integration
  - FR-101 – Data Orchestration and Transformation
  - FR-102 – Data Validation and Quality Control
- Capability 2: Data Cataloguing and Metadata Management
  - FR-201 – Metadata Management and Discovery
  - FR-202 – Metadata Search and Retrieval
- Capability 3: System Interoperability
  - FR-301 – Interoperability with Existing Systems
- Capability 4: Monitoring and Reporting
  - FR-401 – Real-Time Monitoring and Reporting
- Capability 5: Data Governance and Security
  - FR-501 – Security and GDPR Compliance
  - FR-502 – Data Governance and Auditability

Non-Functional Requirements

- NFR-01 – Security and GDPR Compliance
- NFR-02 – Scalability and Performance
- NFR-03 – Reliability and Fault Tolerance
- NFR-04 – Data Governance and Auditability
- NFR-05 – Usability and Accessibility

(6.) SCDS

Functional Requirements

- Capability 1: Access control & trust
  - FR-101 – Authentication provider federation
  - FR-102 – Authorisation
  - FR-103 – Identity provider federation
  - FR-104 – Security attribute provider federation
  - FR-105 – User roles
- Capability 2: Federation management
  - FR-201 – Federation orchestration
- Capability 3: Security
  - FR-301 – Guaranteed authenticity and integrity
- Capability 4: Data discovery
  - FR-401 – Data catalogue
  - FR-402 – Metadata description
- Capability 5: Data governance
  - FR-501 – Data profiling
  - FR-502 – Data quality rules
- Capability 6: Data sharing
  - FR-601 – Data streaming
  - FR-602 – Simple data transfer

Non-Functional Requirements

- NFR-01 – Explainability (User ask for transparency)
- NFR-02 – Accessibility
- NFR-03 – Interoperability
- NFR-04 – Compliance
- NFR-05 – Usability

Appendix 4. Common Data Space Requirements

The following chapter presents the identified shared functional and non-functional requirements. The identification of 'common' requirements based on the same terminologies as well as on shared characteristics of the requirements, hence, does not require the exact same naming due to differences in the structural embodiment of the requirements within the Data Space. This assessment of requirements was conducted between July and September 2024. Due to the continuous evolution of the Data Spaces initiatives, this list must be considered as dynamic and must be updated to reflect the current state of development. Specific details and a higher granularity of their description can be found in the specific feasibility study reports of the Data Space References to individual reports can be found in *Chapter 4 Feasibility Study Reports.*

Common Functional Requirements

Table 8: Common summarises the core functional requirements identified across the six Data Spaces[19]. The identified requirements highlight the need for Simpl-Open capabilities around metadata and data management, security and interoperability. While these requirements can be considered as shared, the table presents also the differences. Besides, it includes a mapping to current Simpl-Open business process that are related to the respective requirements.

Table 8: Common Functional Requirements

Explanation	Simpl-Open BPs	PPDS	EHDS2	LDS	EOSC	DestinE	SCDS
Monitoring data usage and user activities is a common requirement across Data Spaces, ensuring efficient management and compliance. Real-time monitoring is highlighted in PPDS, DestinE, and EOSC, reflecting the importance of time-sensitive tracking in these environments.	12. Management / Operations of data space business	FR-101 – Real-Time Monitoring of Data Usage		FR-404 – Monitoring	FR-801 – Monitoring and logging user activities	FR-401 – Real-Time Monitoring and Reporting	-

[19] After the end of the information-gathering phase, the LDS indicated its interest in including an "on-the-fly translation" requirement in Simpl-Open, which could benefit several data spaces (e.g. the LDS, but also the Cultural Heritage Data Space). The rationale behind this requirement is to address scenarios of multilingual access to resources in live services. This requirement could be considered as a common requirement by different data spaces.

Explanation	Simpl-Open BPs	PPDS	EHDS2	LDS	EOSC	DestinE	SCDS
Authentication and authorisation mechanisms are essential across all Data Spaces to ensure secure access control. This includes verifying identity and managing permissions to regulate access and interactions. Differences in implementation, such as the use of external authorisation providers (e.g., Keycloak in EHDS2), reflect the unique needs of each space.	1. Data space setup: Role of Governance Authority 3a. Onboarding of providers and consumers	FR-201 – Authentication Provider Federation, FR-202 – Role-Based Access Control	FR-CP-104 – Keycloak IAA, FR-CP-106 – EU login, FR-CP-107 – eIDAS login	FR-301 – Authentication, FR-302 – Role and Permission Assignment	FR-506 – Authentication provider federation, FR-508 – User roles	FR-501 – Security and GDPR Compliance	FR-101 – Authentication provider federation, FR-105 – User roles
Metadata management and search capabilities are shared across Data Spaces to enable efficient resource discovery and cataloguing. Each Data Space incorporates metadata handling, but some, like EHDS2, place more emphasis on validation rules, while LDS focuses on multilingual metadata management.	5. Provider adds a new resource to the catalogue 6. Consumer searches resources on catalogues	FR-301 – Metadata Management and Discovery, FR-302 – Metadata Search and Retrieval	FR-CP-401 – Metadata models & validation rules management, FR-CP-501 – EU Catalogues creation	FR-101 – Resource Submission, FR-105 – Metadata Search	FR-404 – Automated metadata harvesting	FR-201 – Metadata Management and Discovery	FR-401 - Data catalogue

Explanation	Simpl-Open BPs	PPDS	EHDS2	LDS	EOSC	DestinE	SCDS
Data exchange and interoperability services are required for effective data integration and sharing across systems, supporting the seamless exchange of data between platforms. Methods such as SPARQL (PPDS) and schema translation (EOSC) demonstrate varied technical approaches to achieving this common goal.	9. Consumer uses applications or data resources from provider	FR-401 – SPARQL Query Support, FR-402 – RDF Data Handling	FR-CP-401 – Metadata validation	FR-202 – Data Transfer	FR-402 – Schema translation	FR-301 – Interoperability with Existing Systems	FR-402 - Metadata description
Data governance, including compliance checks and audit logging, is a shared requirement aimed at maintaining data integrity and regulatory adherence across Data Spaces. While these functions differ - such as audit logging in LDS and compliance validation in EHDS2 - they collectively ensure adherence to governance policies and data tracking.	5. Provider adds a new resource to the catalogue 9. Consumer uses applications or data resources from provider	FR-501 – Compliance with GDPR	FR-CP-303 – NCP Compliance Check, FR-SPE-103 – Privacy & content validation	FR-305 – Audit Logging	FR-503 – Data curation	FR-502 – Data Governance and Auditability	FR-501 - Data profiling FR-502 - Data quality rules

Explanation	Simpl-Open BPs	PPDS	EHDS2	LDS	EOSC	DestinE	SCDS
Access control mechanisms, such as role-based access, are implemented across Data Spaces to secure data interactions. SCDS, EOSC, and PPDS emphasise the need for managing user roles and permissions, though each may have different methods for integrating these controls, such as using identity provider federations.	3a. Onboarding of providers and consumers 3b. Onboarding of end users	FR-202 – Role-Based Access Control	FR-CP-102 – Central Platform login, role-based access	FR-302 – Role and Permission Assignment	FR-508 – User roles	-	FR-105 – User roles

Common Non-Functional Requirements

Non-Functional Requirements are crucial for ensuring that the Data Spaces operate effectively, securely and efficiently. This section presents (compare *Table 9: Common Non-functional Requirements*) the shared non-functional requirements identified across the six assessed Data Spaces. It shows common requirements such as security, compliance, and interoperability, underlining the overarching objective to ensure a high standard of data integrity and facilitate trust in the Data Spaces. While the table cannot be considered exhaustive, it provides a comprehensive perspective on the shared Data Space's needs and can serve as an indication of which Simpl-Open requirements are likely to be of high relevance and priority.

Table 9: Common Non-functional Requirements

Explanation	PPDS	EHDS2	LDS	EOSC	DestinE	SCDS
Security and GDPR compliance are shared non-functional requirements across all Data Spaces, ensuring data privacy and regulatory adherence. Each Data Space specifies measures like GDPR compliance and secure authentication to maintain these standards.	NFR-01 – Security and GDPR Compliance	NFR-04 – Compliance with DG SANTE Authorisation	NFR-01 – Security	NFR-01 – Security	NFR-01 – Security and GDPR Compliance	NFR-04 – Compliance
Scalability and performance are essential non-functional requirements for ensuring systems can handle increased usage efficiently. All Data Spaces prioritise scalable infrastructures and performance optimisation to maintain system efficiency.	NFR-02 – Scalability and Performance	NFR-11 – Onboarding performance	NFR-02 – Scalability	NFR-02 – Scalability	NFR-02 – Scalability and Performance	NFR-05 – Usability
Data governance and auditability are critical for maintaining transparency and regulatory compliance in data processes. Data Spaces implement tracking and monitoring mechanisms to ensure adherence to data governance policies.	NFR-04 – Data Governance and Auditability	NFR-16 – Regulatory Compliance	NFR-05 – Auditability	NFR-04 – Auditability	NFR-04 – Data Governance and Auditability	NFR-03 – Interoperability

Explanation	PPDS	EHDS2	LDS	EOSC	DestinE	SCDS
Interoperability is a non-functional requirement essential for enabling seamless data exchange and integration across systems. Each Data Space incorporates measures to support interoperability, ensuring consistent and efficient data interactions. While not explicitly stated, it can be assumed that also EOSC thrives for interoperability, indicated by the requirement for *Discoverability*, allowing e.g., Consumers to discover the provided resources of other participants, and thereby directly facilitating interoperability.	NFR-04 – Interoperability	NFR-03 – Interoperability	NFR-06 – Interoperability	NFR-03 – Discoverability	NFR-03 – Interoperability	NFR-03 – Interoperability

Appendix 5. Personal Data Handling Assessment

Personal data handling in Data Spaces

As the handling of personal data in Simpl-Open has not yet been developed or clarified, the Simpl-Live Feasibility Study conducted a Personal Data Handling Assessment (PDHA), notably to evaluate how Simpl-Open should develop Personal Data Handling components to automate and standardise interactions of Data Space participants with data subjects. This process could later support the business process and lower-level requirements elicitation.

Personal Data Handling (PDH) has been addressed and considered in Data Spaces by the inclusion of the Personal Data Intermediary (PDI) role and associated components.

The PDI is a Data Governance Act (DGA) data intermediation service that allows data subjects to independently and from a single point:

- be informed on the usage of their data across the Data Space;
- receive requests for consent and agreements on the usage of their data;
- manage their consent and agreements on the usage of their data;
- be informed on the risks and values of sharing their data;
- exercise their rights to their data;
- be proposed data and services relevant to them.

The PDI allows data controllers to automate interactions with data subjects and the compliance of personal data processing. A PDI can be centralised, federated or decentralised. It is a tool for the data subject to manage their personal data independently from data providers and consumers and is regulated by the DGA. The PDI role and concept is addressed and integrated into several Data Space documentations and specifications as the most efficient way to handle personal data processing and GDPR compliance in data spaces.

The PDI approach presents several advantages:

- For data subjects to have a single point from where to manage all their consents and rights across the data space rather than managing their rights and consents on the data by provider, this will allow more transparency and agency of data subjects of their personal data.
- For the data space participants to have a neutral organisation ensuring ~~the~~ trust in the data protection management rather than relying on each participant.
- For the data space participants not to have to deploy themselves these personal data handling components and benefit from a professional service.
- For the data space to ensure trust in personal data processing and sharing by leveraging the Data Governance Act and proposing a neutral data intermediary responsible for personal data transactions.

From a governance point of view

PDIs are a guarantee of trust and neutrality in the network. As they are a certified Data Governance Act Data Intermediary Service, they don't process or provide services on the data, so they are the best positioned to help people control their data as they have no conflict of interest. A data provider or a service provider is not neutral in the data space use case, a PDI acts as a trusted third party between the players. Moreover, PDIs act as the official representative of the person in the data space. This means request, exertion of rights or consents coming from them are coming from the person which gives the person a great tool to truly control their data. Finally, the PDI will allow people to set their conditions and preferences on the use of their data, to be applied the whole data space.

From a business point of view

PDIs serve as an entry point for people into the data spaces. They will be able to be matched with relevant service and data providers through the PDI interface which will enable service discovery and

thus more services being used by people. Only the PDI can allow such discovery as other participants will only be recommending their services or their partner's.

From a UX point of view

PDIs offer a smooth individual UX for data sharing. People can be presented consents, value, and risks of sharing their data in a consistent manner across the data space. Moreover, they can easily manage their data from a single point without having to log into each provider.

From a technical point of view

PDIs allow to implement a single protocol for personal data sharing based on authorisations from the individual. It lowers the technical burden of data space participants to share personal data as they need to interact only with the PDI and not with each data space participant. It also ensures compliance with relevant personal data protection regulations.

Alternatively, GDPR compliance and personal data handling could theoretically be handled by each participant separately, which would suppose the following constraints:

- No automatic and common way to verify GPDR compliance, exercise data subjects, GDPR consents: reducing overall trust and compliance of the data space.
- No way for data subjects to automatically exercise their rights in data spaces and manage their personal data, reducing usability and transparency compliance.
- No possibility to dynamically process personal data as all consents and processing need to be defined in advance, reducing possible use cases.

For these reasons all data space initiatives and organisations have opted for the PDI approach. *Table 10* presents the data spaces organisations that have chosen this approach.

Table 10: PDIs in relevant Data Space documentations

Data Space organisation	Comment
Data Space Support Centre (DSSC)	The DSSC has defined the PDI in its glossary and in its Data Intermediary building block; moreover, the technical components of the PDI are described in the technical building blocks of the DSSC blueprint (such as GDPR consent management).
International Data Space Association (IDSA)	IDSA has opened a working group about personal data sharing and is integrating the PDI and GDPR consent management into the IDS Data Space protocol.
Gaia-X	Gaia-X describes the PDI and its interactions in its conceptual model and data exchange working group.
DS4Skills, DATES, DS4SSCC blueprints	Several Data Spaces blueprints, Coordination and Support Actions, describe the PDI as a core element of their Data Space.
Prometheus-X	Prometheus-X is a non-profit organisation developing open-source building blocks for personal data sharing and PDIs in Data Spaces. It lists and develops a series of core PDI components.

Methodological approach

To assess if Personal Data Handling components should be developed and integrated into Simpl-Open, the Simpl-Live Team conducted a series of workshops with the Simpl-Live Data Spaces and established a proposition of architecture and components for Simpl-Open to include. *Table 11* explains the methodology taken to build the PDHA, with the different steps, iterations, and participants.

Table 11: High level steps of the PDHA methodology

PDHA Methodology Step	Description
Via workshop sessions, identify needs, requirements and components for personal data processing and sharing with Simpl-Live Data Spaces.	These workshops had the objectives: 1) **Identify stakeholder needs and barriers:** To identify Data Spaces needs, use cases and the barriers they face in implementing GDPR-compliant personal data use cases. 2) **Develop and assess requirements:** Based on those needs and barriers, develop and assess requirements that would allow GDPR-compliant personal data sharing, processing and storing for Data Spaces. 3) **Evaluate and recommend Architecture components:** To evaluate existing technologies and standards used for GDPR-compliant personal data sharing and processing in Data Spaces, in alignment with Task 1 team and the overall technology selection and recommend components to support this personal data sharing and processing to augment the current Simpl-Open requirements. This work was carried out thanks to the inputs collected during the Simpl-Live Feasibility workshops conducted with the Simpl-Live Data Spaces as described in the Simpl-Live Inception Reports. In parallel, a *Data Protection Document* has been prepared for Simpl-Open.
Elaboration of the data	From the result of these workshops, elaborate new requirements and precise how they fit into the overall Simpl-Open Architecture as well as propose a timeline for development. The results of this assessment are presented in this current section of the Simpl-Live Feasibility Study.

Overall assessment of Personal Data Handling Requirements

From the workshops conducted with the listed Data Spaces the Simpl-Live Feasibility Study assessed their need and requirements for Personal Data Handling components. The Simpl-Live study identified a list of 16 requirements to enable personal data sharing and processing. These requirements were identified from several inputs:

- The workshops conducted with the Simpl-Live Data Spaces to assess their needs;
- The several sources listed above (DSSC, IDSA, Prometheus-X, Gaia-X, Data Space blueprints) that detail a series of key needed functionalities and components;
- The GDPR to ensure that the requirements for handling personal data are designed to cover all the needs that data controllers have when interacting with data subjects (rights exertion, legal basis, data protection by design, etc).

At the moment, none of the Simpl-Live Data Spaces have addressed such requirements or functionalities, but they all have a strong interest in integrating components that allow them to address such requirements. The more mature data space, amongst the Simpl-Live Data Spaces, that is enabling personal data processing and sharing is the LDS: it relies on the self-declaration

of each participant that it has obtained the consent of the data subject. This does not allow automatic collection, verification and traceability of consent, nor dynamic data exchange or efficient revocation. *Table 12* summarises the high-level requirements for the handling of personal data and the interest shown by the data spaces.

The specific assessment for each Data Space can be found in the Data Space specific feasibility reports linked in *Chapter 4: Feasibility Study Reports.*

Table 12: Personal Data Handling requirements and Data Space interest

ID	High level needs/requirements[20]	High interest	Medium interest
PDH1	Presenting Data Space providers and use cases to data subjects: Simpl shall enable participants to describe data products and services on the catalogue in a human friendly way to ensure data subjects understand the data shared or used. Simpl shall enable participants to provide functionalities to data subjects to be presented with available data sources and services, to discover the data space use cases and services. Simpl shall enable participants to provide functionalities to data subjects to also access this catalogue from their Personal Data Intermediary to have a complete view across all data spaces.	EHDS2, LDS, SCDS	
PDH2	Establishing GDPR compliant data sharing agreements: Simpl shall enable participants to: - be able to generate GDPR compliant data sharing agreements to exchange personal data in the data space - be able to tie personal data sets to a GDPR legal basis and automate the check of said legal basis to help their GDPR compliance and traceability - be able to attach specific GDPR policies to personal data sets (authorised processing, type of controllers, authorised legal basis, etc) and to automate the verification of such policies to help their GDPR compliance and traceability - to provide functionalities to data subjects to be able to be informed on the legal basis of each data processing in the data space - to provide functionalities to data subjects to find all data sharing agreement information and management concerning them from their PDI	EHDS2, EOSC, LDS, DestinE, SCDS	
PDH3	Allowing the exertion of GDPR rights of data subjects on personal data processed in the Data Space: Simpl shall enable participants to: - to be able to automate the data subject's rights exertion (access, deletion, information, portability) on the personal data transactions happening in the data space to facilitate their GDPR compliance. - provide data subjects with functionalities to be able to easily exercise their GDPR rights on their personal data in the data space - provide data subjects with functionalities to exercise their GDPR rights across all data space participants also from their PDI	EHDS2, EOSC, LDS, DestinE, SCDS	

[20] A detailed description of each high-level need/requirement is provided in section 6. Proposed Personal Data Handling Requirements on this Appendix.

ID	High level needs/requirements[20]	High interest	Medium interest
PDH4	Managing data subject's consent and opt-outs on the use of their data in the Data Space: Simpl shall enable participants to: - be able to generate consents and/or opt-outs for data transactions towards data subjects - verify validity of consents and opt-outs - provide data subjects with functionalities to manage their consents and/or opt-outs from a single place - provide data subjects with functionalities to give consent and/or opt-outs on the data transactions happening in the data space - provide data subjects with functionalities to have control over their personal data, be informed of where it is used, why and by who - provide data subjects with functionalities to be able to revoke their consent and/or opt-outs easily and at any time - provide data subjects with functionalities to manage all their consents and/or opt-outs across all participants and data spaces from their PDI	EHDS2, EOSC, LDS, DestinE, SCDS	
PDH5	Enforcing GDPR policies, opt-outs and consents in data exchange: Simpl shall enable participants to: - automatically enforce the consent, opt-outs and GDPR rights exertions on the data transactions and data access in the data space - provide data subjects with functionalities to automatically exchange their data based on their consents and GDPR rights exertions	EHDS2, EOSC, LDS, DestinE, SCDS	
PDH6	Manage user identity in the Data Space: Simpl shall enable participants to: - authenticate users with a valid and recognised identity - provide data subjects with functionalities to authenticate to participants applications with their wallet - provide data subjects with functionalities to manage their identity providers from their PDI.	EHDS2, EOSC, LDS, DestinE, SCDS	
PDH7	Managing monitoring of personal data usage in the Data Space: Simpl shall enable participants to: - to be warned about breaches or failures or expirations of data agreements regarding the personal data that they have accessed or provided - provide data subjects with functionalities to track their personal data usage and ensure its security and privacy - provide data subjects with functionalities to be notified if their personal data has been compromised - provide data subjects with functionalities to be notified if their personal data has been compromised - provide data subjects with functionalities to follow this monitoring from their PDI Simpl shall enable data space governance authorities to be warned about breaches or failures or expirations of data agreements in the data space they manage		LDS

ID	High level needs/requirements[20]	High interest	Medium interest
PDH8	Enabling Secure, Decentralised and Consent-based AI Model Training with Personal Data: Simpl shall enable participants to: - to provide data subjects with a storage capacity of their personal data, - to provide data subjects with functionalities to import their personal data into their own personal data store - to be able to access personal data from a personal data store - to ensure interoperability across personal data stores to maximise business opportunities, streamline operations, and enhance collaboration - to be able to access personal data from a personal data store - ensure interoperability across personal data stores to maximise business opportunities, streamline operations, and enhance collaboration - provide data subjects with functionalities to easily access and manage their data across different platforms and services	EOSC, LDS	DestinE
PDH9	Communicating the Value and Benefits of Data Space Participation to Data Subjects: Simpl shall enable participants to: - be able to train a model on various personal data sources without importing the data in their own systems - be able to provide access to personal data to train AI models without the data leaving their system. - provide data subjects with functionalities to securely contribute their data to train AI models without compromising their privacy, ensuring that their personal information remains confidential and is not shared with any central entity - provide data subjects with functionalities to have control over their data contributions for AI training, allowing them to give or revoke consent through an intuitive interface	EOSC, SCDS	LDS
PDH10	Informing Individuals About Personal Data Usage and Protection in Data Spaces: Simpl shall enable participants to: - To be able to clearly explain and present the value of their data space use case to people. - Provide functionalities to data subjects to be able to understand the generic benefits of data sharing and consumption in a data space through being provided concrete and relatable examples of participation		LDS
PDH11	Enabling Personal Data Management and Interoperability Across Personal Data Stores: Simpl shall enable data space participants to: - to clearly inform people about data usage policies and data protection measures when they onboard their use cases - provide data subjects with functionalities to inform on service policies and contracts in data spaces, supported by intuitive onboarding features, to understand data spaces and make informed decisions	EOSC, SCDS	
PDH12	Personal Data-Driven Matching of Applications and Individuals in Data Spaces: Simpl shall enable participants to provide data subjects with functionalities to inform their criteria, policies and preferences for the processing of their personal data.		EOSC

ID	High level needs/requirements[20]	High interest	Medium interest
	Simpl shall enable participants to match personal data offerings with providers proposing the appropriate level of policies and privacy criteria, matching with the data subject's preferences.		
PDH13	Visualising Personalised Recommendations and Insights with Data Privacy and Control: Simpl shall enable participants to: - seamlessly integrate data visualisation of personalised recommendations and insights from different providers of the data space into their tools and applications, enhancing their service offerings and customer experience, - provide functionalities to data subjects to easily visualise recommendations and insights derived from their personal data across different applications and interfaces within the data space - provide functionalities to data subjects to compare results from various AI providers and data sources in a single interface, simplifying their decision-making process and enhancing their user experience within the data space - provide functionalities to data subjects to maintain control and privacy over their personal data by storing it securely on the client-side, ensuring GDPR compliance and maximum data protection while accessing relevant recommendations and insights		EOSC
PDH14	Ensuring and Managing Data Veracity and Quality Agreements for Personal Data: Simpl shall enable participants to: - easily understand and agree to data veracity agreements with organisations, ensuring that their data will meet specified quality standards and be used appropriately according to their preferences - provide functionalities to data subjects to have confidence in the quality of their personal data when sharing it with organisations within the data space, so that they can trust that their information will be used responsibly and effectively - provide functionalities to data subjects to manage this data veracity checks from their PDI		EOSC
PDH15	Transparent Fair Value Distribution and Compensation for Personal Data Contributions: Simpl shall enable participants to: - to implement fair data and value distribution policies with transparent transactions - provide data subjects with incentives and compensation for the use of their personal data - provide data subject with functionalities to ensure fair compensation for their personal data contributions through decentralised incentivisation - provide data subjects with functionalities to be informed on these value exchanges from their PDI	EOSC	
PDH16	Ensuring Fairness, Privacy, and Explainability in AI Decision-Making for Personal Data: Simpl shall enable participants to: - to maintain fairness, privacy, explainability, and security in decision-making processes made by their applications and algorithms		EOSC, LDS

ID	High level needs/requirements[20]	High interest	Medium interest
	- provide data subjects with functionalities to be informed on the fairness, privacy, and explainability in the AI / algorithm decision-making made by participants in the data space - provide data subjects with functionalities to be informed of the AI decision making processes through their PDI		

Addressing the requirements in Simpl-Open

The Simpl-Live Feasibility study has identified that Personal Data Handling components are needed by most of the Data Spaces (see *Table 16: Components mapped to PDH requirements*).

The current architecture of Simpl-Open (as software to be used case by case on Simpl-Live implementation), as described in the Technology Study today does not yet include any specific requirement, neither capability to help the participants to handle their responsibilities towards data subjects and personal data handling in an automated way.

The scope of Simpl-Open as software stack used in Data Space is summarised in *Figure 7*.

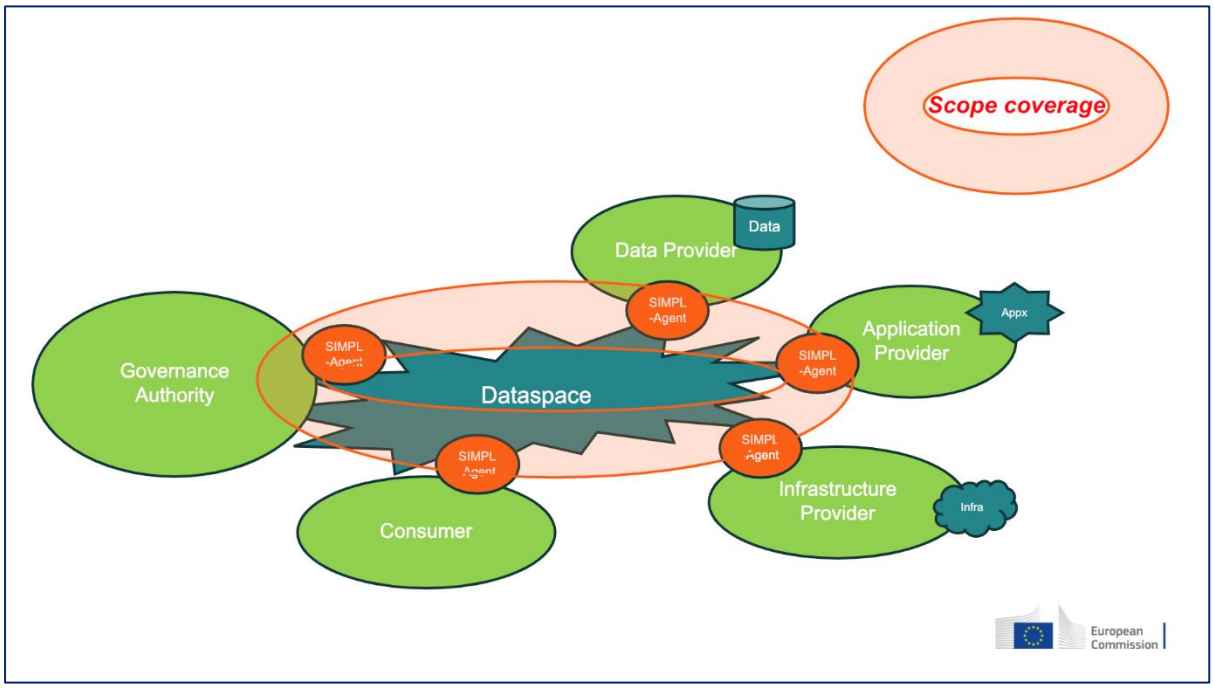

Figure 7: Scope of Simpl-Open as software stack used in Data Space

It is represented in *Figure 7* that Simpl-Open covers the interactions between different roles (governance authority, data provider, application provider, infrastructure provider and consumer).

The requirements of Simpl-Open / Simpl-Live do not yet detail requirement and capabilities for providing tools to help Data Provider to fulfil their obligations related to 3rd party's dataset regarding data subjects as this role is never mentioned, neither in SC01 nor in the Preparatory Study.

This is why the Simpl-Live Feasibility Study proposes to enlarge the scope of Simpl-Open to include a new role, the Personal Data Intermediary (PDI) that would operate Personal Data Handling components to interact with the data subject and allow the management of their rights on their data. *Figure 8* represents this proposal.

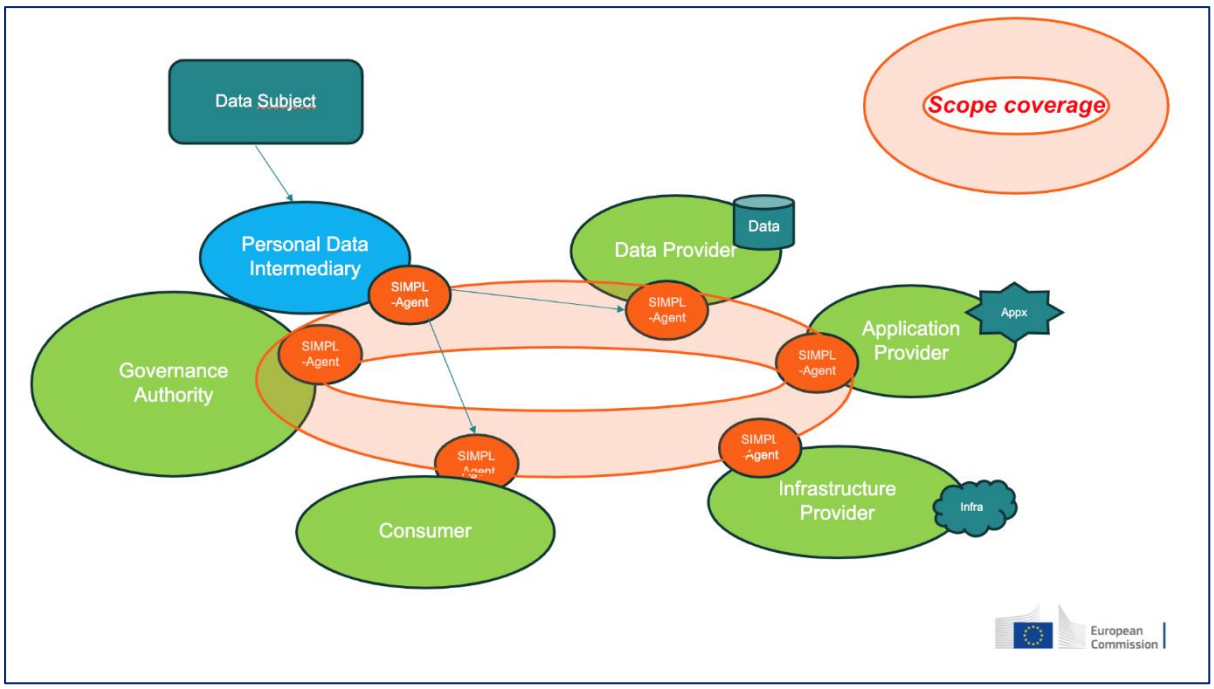

Figure 8: Simpl-Open Framework with PDI

From the assessment and workshops conducted in the Simpl-Live study, were derived a more precise architecture, requirements, user stories and components to answer these needs and a proposed timeline for development by Simpl-Open so that it fits with the Data Spaces timeline and development needs.

Simpl-Live has identified a list of core requirements on this Personal Data Handling topic and associated components that are needed pressingly by the Data Spaces and a series of optional requirements and components that can be developed after the core ones.

Proposed architecture

To integrate such components into Simpl-Open and eventually the Data Spaces, the Simpl-Live Feasibility Study recommends an approach that would enable each Data Space governance authority to also become a Personal Data Intermediary. Therefore, the Simpl-Live Feasibility Study proposes to include this new role of a PDI. This PDI would set up and operate a Simpl Agent that would enable personal data handling functions for the Data Space; the Data Space governance authority would then be considered a Personal Data Intermediary (PDI). This Simpl-Agent will operate a series of components that address the relevant requirements for the Data Space. The participants of the Data Space will also need to deploy their Simpl-Agent relevant components to enable such functionalities.

Figure 9 presents the architecture of the PDI approach, representing how the core components are deployed across Simpl-Agents. The complete description of components can be found in *Table 13*.

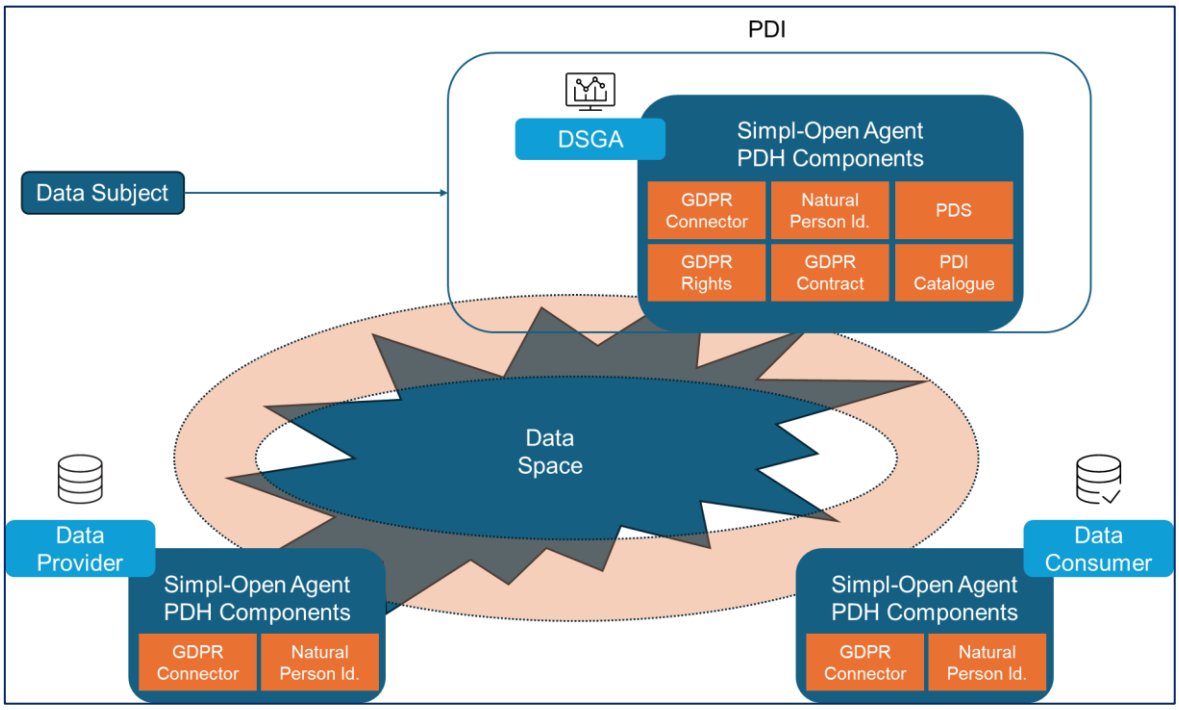

Figure 9: Representation of the deployment of PDH components

The Data Space Governance Authority (DSGA) would deploy most of the Personal Data Handling core components, the participants only a reduced set. This architecture of a Personal Data Intermediary operating personal data handling components for the Data Space participants is the architecture presented by the Data Space Support Centre in its blueprint [21] and is being applied by several Data Spaces, among others DS4Skills, EONA-X, DS4SSCC[22].

Full list of user stories, requirements and components for Personal Data Handling through PDI can be found in the next section of this appendix. The PDHA proposes to first focus on the core components to enable their integration into Data Spaces. This will allow to start deploying first personal data handling use cases before adding more secondary components based on Data Spaces' and use cases' needs.

Simpl-Open having as ambition to be the baseline software stack for data exchange and Data Spaces, it seems essential Personal Data Handling components are included and developed as all Data Spaces will require personal data handling. This will ensure a stronger adoption of Simpl-Open across data

[21] Data Space Support Centre Blueprint v0.5: https://dssc.eu/space/BBE/178422060/Data+Space+Intermediary

[22] See: DS4Skills - Data Space For Skills, EONA-X and European Data Space for Smart Communities

spaces as it will bring unique in demand functionalities and will serve to accelerate the realisation of the European Data Strategy.

Proposed Personal Data Handling Requirements

Below is a detailed description of the user stories and requirements identified during the Simpl-Live workshops that drove the design of the personal data handling components. These requirements are considered to be common to all data spaces. The specific remarks for each data space are documented in the specific feasibility study reports. In addition, the following levels have been used to define the priority of these requirements:

- H: High: the requirement is a MUST for the data space to implement a use case
- M: Medium: the requirement would highly facilitate the operations of the data space
- L: Low: the requirement is a “nice to have” for the data space

User story 1

"As a participant, I want to describe data products and services on the catalogue in a human friendly way to ensure data subjects understand the data shared and how it will be processed. ",

"As a data subject, I want a Data Space catalogue to present me with available data sources and services, to discover the Data Space use cases, participants and services."

"As a data subject, I can also access this catalogue from my Personal Data Intermediary to have a complete view across all Data Spaces."

PDH -01 - Presenting Data Space providers and use cases to data subjects

Req ID	PDH_01
Short Title	Presenting Data Space providers and use cases to data subjects
Description	Simpl shall enable participants to describe data products and services on the catalogue in a human friendly way to ensure data subjects understand the data shared or used. Simpl shall enable participants to provide functionalities to data subjects to be presented with available data sources and services, to discover the Data Space use cases and services. Simpl shall enable participants to provide functionalities to data subjects to also access this catalogue from their Personal Data Intermediary to have a complete view across all Data Spaces.
Priority	H
Related architectural components	Data Discovery, Metadata description, Data Catalogue, Search engine
Source	Simpl-Live Personal Data Handling Assessment (Simpl-Live feasibility study)

Req ID	PDH_01
Baseline technologies	JSON-LD, DCATv3, REST APIs, Gaia-X Self Descriptions
Baseline components	

User story 2

"As a participant, I want to be able to generate GDPR compliant data sharing agreements to exchange personal data in the Data Space."

"As a participant, I want to be able to tie personal data sets to GDPR legal basis and I want to automate the check of said legal basis to help my GDPR compliance and traceability. ",

"As a participant, I want to be able to attach specific GDPR policies to personal data sets and I want to automate the verification of such policies to help my GDPR compliance and traceability.",

"As a data subject, I want to be able to be informed on the legal basis of each data processing in the Data Space."

"As a data subject, I can find all data sharing agreement information and management concerning me from my PDI."

PDH-02 - Establishing GDPR compliant data sharing agreements

Req ID	PDH_02
Short Title	Establishing GDPR compliant data sharing agreements
Description	"Simpl shall enable participants to: - be able to generate GDPR compliant data sharing agreements to exchange personal data in the Data Space; - be able to tie personal data sets to a GDPR legal basis and automate the check of said legal basis to help their GDPR compliance and traceability; - be able to attach specific GDPR policies to personal data sets (authorised processing, type of controllers, authorised legal basis, etc) and to automate the verification of such policies to help their GDPR compliance and traceability; - to provide functionalities to data subjects to be able to be informed on the legal basis of each data processing in the Data Space; - to provide functionalities to data subjects to find all data sharing agreement information and management concerning them from their PDI."
Priority	H
Related architectural components	Data Sharing, Data store connector, Access control & trust, Security, Monitoring & Reporting, Audit, Governance, Usage contract
Source	Simpl-Live Personal Data Handling Assessment (Simpl-Live feasibility study)
Baseline technologies	ODRL, Smart Contracts, W3C standards

Req ID	PDH_02
Baseline components	Prometheus-X contract manager, Prometheus-X ODRL policy injection, Prometheus-X Data Space connector

User story 3

"As a participant, I want to be able to automate the data subject's rights exertion (access, deletion, information, portability) on the personal data transactions happening in the Data Space so as to facilitate my GDPR compliance."

"As a data subject, I want to be able to easily exercise my GDPR rights on my personal data in the Data Space."

"As a data subject, I can exercise my GDPR rights across all Data Space participants also from my PDI."

PDH-03 - Allowing the exertion of GDPR rights of data subjects on personal data processed in the Data Space

Req ID	PDH_03
Short Title	Allowing the exertion of GDPR rights of data subjects on personal data processed in the Data Space
Description	"Simpl shall enable participants to: - to be able to automate the data subject's rights exertion (access, deletion, information, portability) on the personal data transactions happening in the Data Space to facilitate their GDPR compliance; - provide data subjects with functionalities to be able to easily exercise their GDPR rights on their personal data in the Data Space; - provide data subjects with functionalities to exercise their GDPR rights across all Data Space participants also from their PDI."
Priority	H
Related architectural component	Data Sharing, Data store connector, Access control & trust, Security, Monitoring & Reporting, Audit, Governance
Source	Simpl-Live Personal Data Handling Assessment (Simpl-Live feasibility study)
Baseline Technologies	GDPR
Baseline Components	Personal Data Intermediary, Prometheus-X Consent Management, Prometheus-X Data Space Connector

User story 4

"As a data subject, I want to give consent on the data transactions happening in the Data Space."

"As a data subject, I want to manage my consents from a single place.",

"As a data subject, I want to have control over my personal data, be informed of where it is used, why and by who.",

"As a data subject, I want to be able to revoke my consent easily and at any time.",

"As a data subject, I can manage all my consents across all participants and Data Spaces from my PDI."

"As an organisation, I want to be able to generate consents for data transactions towards data subjects."

"As an organisation, I want to verify validity of consents."

PDH-04 - Managing data subject's consent and opt-outs on the use of their data in the Data Space

Req ID	PDH_04
Short Title	Managing data subject's consent and opt-outs on the use of their data in the Data Space
Description	"Simpl shall enable participants to: - be able to generate consents and/or opt-outs for data transactions towards data subjects; - verify validity of consents and opt-outs; - provide data subjects with functionalities to manage their consents and/or opt-outs from a single place; - provide data subjects with functionalities to give consent and/or opt-outs on the data transactions happening in the Data Space; - provide data subjects with functionalities to have control over their personal data, be informed of where it is used, why and by who; - provide data subjects with functionalities to be able to revoke their consent and/or opt-outs easily and at any time; - provide data subjects with functionalities to manage all their consents and/or opt-outs across all participants and Data Spaces from their PDI."
Priority	H
Related architectural component	Data Sharing, Data store connector, Access control & trust, Security, Monitoring & Reporting, Audit, Governance
Source	Simpl-Live Personal Data Handling Assessment (Simpl-Live feasibility study)

Req ID	PDH_04
Baseline Technologies	JSON-LD, Consent API, ISO/IEC TS 27560:2023
Baseline Components	Personal Data Intermediary, Prometheus-X Consent Management, Prometheus-X Data Space Connector

User story 5

"As a data subject, I want my data to be automatically exchanged based on my consents and GDPR rights exertions".

"As a participant, I want the consent and GDPR rights to be automatically enforced on the data transactions and data access in the Data Space".

PDH-05- Enforcing GDPR policies and consents in data exchange

Req ID	PDH_05
Short Title	Enforcing GDPR policies and consents in data exchange
Description	"Simpl shall enable participants to: - automatically enforce the consent, opt-outs and GDPR rights exertions on the data transactions and data access in the Data Space; - provide data subjects with functionalities to automatically exchange their data based on their consents and GDPR rights exertions."
Priority	H
Related architectural component	Data Sharing, Data store connector, Access control & trust, Security, Monitoring & Reporting, Audit, Governance, Usage policies
Source	Simpl-Live Personal Data Handling Assessment (Simpl-Live feasibility study)
Baseline Technologies	TLS, IDS Data Space Protocol
Baseline Components	Personal Data Intermediary, Prometheus-X Consent Management, Prometheus-X Data Space Connector

User story 6

"As a data subject, I want to authenticate to participants applications through the use of my wallet."

"As a participant, I want to authenticate users with a valid and recognised identity."

"As a participant, I can manage my different identity providers and wallets from my PDI."

PDH-06- Manage user identity in the Data Space

Req ID	PDH_06
Short Title	Manage user identity in the Data Space
Description	"Simpl shall enable participants to: - authenticate users with a valid and recognised identity; - provide data subjects with functionalities to authenticate to participants applications with their wallet; - provide data subjects with functionalities to manage their identity providers from their PDI."
Priority	H
Related architectural component	Identity Provider federation, authentication provider federation, user roles, authorisation, access control & trust
Source	Simpl-Live Personal Data Handling Assessment (Simpl-Live feasibility study)
Baseline Technologies	Identity management platforms, Digital wallet for organisations
Baseline Components	Walt ID

User story 7

"As a participant, I want to be warned about breaches or failures or expirations of data agreements regarding the personal data that I have accessed or provided."

"As a data subject, I want to track my personal data usage and ensure its security and privacy.",

"As a data subject, I want to be notified if my personal data has been compromised."

"As a Data Space governance authority, I want to be warned about breaches or failures or expirations of data agreements in the Data Space I manage".

"As a data subject, I can follow this monitoring from my PDI."

PDH-07- Managing monitoring of personal data usage in the Data Space

Req ID	PDH_07
Short Title	Managing monitoring of personal data usage in the Data Space
Description	"Simpl shall enable participants to: - to be warned about breaches or failures or expirations of data agreements regarding the personal data that they have accessed or provided; - provide data subjects with functionalities to track their personal data usage and ensure its security and privacy; - provide data subjects with functionalities to be notified if their personal data has been compromised; - provide data subjects with functionalities to be notified if their personal data has been compromised; - provide data subjects with functionalities to follow this monitoring from their PDI. Simpl shall enable Data Space governance authorities to be warned about breaches or failures or expirations of data agreements in the Data Space they manage."
Priority	H
Related architectural component	Administration Services & Data Services
Source	Simpl-Live Personal Data Handling Assessment (Simpl-Live feasibility study)
Baseline Technologies	Data anonymisation tools, Privacy-enhancing technologies (PETs)

Req ID	PDH_07
Baseline Components	Prometheus-X Monitoring component

User story 8

"As a participant, I want to allow data subjects to import their personal data into their own personal data store."

"As a participant, I want to be able to access personal data from a personal data store."

"As a participant, I want to ensure interoperability across personal data stores to maximise business opportunities, streamline operations, and enhance collaboration.",

"As a data subject, I to be able to retrieve all my personal data exchanged between the Data Space participants into my own personal data store."

"As a data subject, I want seamless integration between personal data stores to easily access and manage my data across different platforms and services."

PDH-08- Enabling secure and decentralised personal data storage

Req ID	PDH_08
Short Title	Enabling secure and decentralised personal data storage
Description	"Simpl shall enable participants to: - to provide data subjects with a storage capacity of their personal data; - to provide data subjects with functionalities to import their personal data into their own personal data store; - to be able to access personal data from a personal data store; - to ensure interoperability across personal data stores to maximise business opportunities, streamline operations, and enhance collaboration; - to be able to access personal data from a personal data store; - ensure interoperability across personal data stores to maximise business opportunities, streamline operations, and enhance collaboration; - provide data subjects with functionalities to easily access and manage their data across different platforms and services."
Priority	H
Related architectural component	Data store connector, Data sharing, Application sharing, Data discovery, Infrastructure layer architecture, Distributed execution, Data orchestration, Infrastructure discovery
Source	Simpl-Live Personal Data Handling Assessment (Simpl-Live feasibility study)
Baseline Technologies	Solid Protocol, CozyCloud, HTTP/HTTPS RESTful APIs

Baseline Components	Prometheus-X Consent Manager, Personal Data Intermediary

User stories 9

"As a data subject, I want to securely contribute my data to train AI models without compromising my privacy, ensuring that my personal information remains confidential and is not shared with any central entity.",

"As a data subject, I aim to have control over my data contributions for AI training, allowing me to give or revoke consent through an intuitive interface.",

"As a participant, I want to be able to train a model on various personal data sources without importing the data in my own systems."

"As a participant, I want to be able to provide access to personal data to train AI models without the data leaving my system."

PDH-09- Enabling Secure, Decentralised and Consent-based AI Model Training with Personal Data

Req ID	PDH_09
Short Title	Enabling Secure, Decentralised and Consent-based AI Model Training with Personal Data
Description	"Simpl shall enable participants to: - be able to train a model on various personal data sources without importing the data in their own systems; - be able to provide access to personal data to train AI models without the data leaving their system; - provide data subjects with functionalities to securely contribute their data to train AI models without compromising their privacy, ensuring that their personal information remains confidential and is not shared with any central entity; - provide data subjects with functionalities to have control over their data contributions for AI training, allowing them to give or revoke consent through an intuitive interface."
Priority	M
Related architectural component	Decentralised Machine Learning
Source	Simpl-Live Personal Data Handling Assessment (Simpl-Live feasibility study)
Baseline Technologies	xAPI, Pickle / Joblib, JSON

Req ID	PDH_09
Baseline Components	Prometheus-X Decentralised AI Training

User story 10

"As a data subject, I want to be able to understand the generic benefits of data sharing and consumption in a data space through being provided concrete and relatable examples of participation",

"As a Data Space governance authority or participant, I want to be able to clearly explain and present the value of my Data Space use case to people."

PDH-10- Communicating the Value and Benefits of Data Space Participation to Data Subjects

Req ID	PDH_010
Short Title	Communicating the Value and Benefits of Data Space Participation to Data Subjects
Description	"Simpl shall enable participants to: - to be able to clearly explain and present the value of their Data Space use case to people; - provide functionalities to data subjects to be able to understand the generic benefits of data sharing and consumption in a data space through being provided concrete and relatable examples of participation."
Priority	M
Related architectural component	Data Sharing, Data discovery, application sharing, monitoring
Source	Simpl-Live Personal Data Handling Assessment (Simpl-Live feasibility study)
Baseline Technologies	JSON-LD, DCATv3, REST APIs, Gaia-X Self Descriptions
Baseline Components	–

User story 11

"As a data subject, I want transparent service policies and contracts in Data Spaces, supported by intuitive onboarding features, to understand Data Spaces and make informed decisions."

"As a Data Space governance authority or participant, I want to clearly inform people about data usage policies and data protection measures when they onboard my use cases."

PDH-11- Informing Individuals About Personal Data Usage and Protection in Data Spaces

Req ID	PDH_011
Short Title	Informing Individuals About Personal Data Usage and Protection in Data Spaces
Description	"Simpl shall enable Data Space participants to: - to clearly inform people about data usage policies and data protection measures when they onboard their use cases - provide data subjects with functionalities to inform on service policies and contracts in Data Spaces, supported by intuitive onboarding features, to understand Data Spaces and make informed decisions"
Priority	H
Related architectural component	Contracts, Access control & trust, Security, Monitoring, Reporting, Audit, Ticketing System
Source	Simpl-Live Personal Data Handling Assessment (Simpl-Live feasibility study)
Baseline Technologies	REST APIs, JSON-LD, Logging standards (syslog, W3C)
Baseline Components	Personal Data Intermediary, Prometheus-X Consent Manager

User story 12

"As a data subject, I want to match my personal data available in the Data Space with relevant applications based on my needs and preferences, automating consents and permissions."

"As a data subject, I can receive these recommendations in my PDI."

"As a participant or Data Space governance authority, I want my Data Space applications to be matched with relevant people according to their situation and data available".

PDH-12- Personal Data-Driven Matching of Applications and Individuals in Data Spaces

Req ID	PDH_012
Short Title	Personal Data-Driven Matching of Applications and Individuals in Data Spaces
Description	Simpl shall enable participants to provide data subjects with functionalities to inform their criteria, policies and preferences for the processing of their personal data. Simpl shall enable participants to match personal data offerings with providers proposing the appropriate level of policies and privacy criteria, matching with the data subject's preferences.
Priority	L
Related architectural component	Data sharing, Application sharing, Data discovery, Data processing, Distributed execution, Data orchestration
Source	Simpl-Live Personal Data Handling Assessment (Simpl-Live feasibility study)
Baseline Technologies	REST APIs, JSON-LD, GraphQL, RDF
Baseline Components	Prometheus-X Consent Manager, Personal Data Intermediary, Prometheus-X Consent Agent

User story 13

"As a data subject, I want to easily visualise recommendations and insights derived from my personal data across different applications and interfaces within the Data Space."

"As a data subject, I aim to compare results from various AI providers and data sources in a single interface, simplifying my decision-making process and enhancing my user experience within the Data Space",

"As a data subject, I want to maintain control and privacy over my personal data by storing it securely on the client-side, ensuring GDPR compliance and maximum data protection while accessing relevant recommendations and insights.",

"As an organisation, I want to seamlessly integrate personalised recommendations and insights from different AI providers and data sources into our visualisation tools and applications, enhancing our service offerings and customer experience."

PDH-13- Visualising Personalised Recommendations and Insights with Data Privacy and Control

Req ID	PDH_013
Short Title	Visualising Personalised Recommendations and Insights with Data Privacy and Control
Description	"Simpl shall enable participants to: - seamlessly integrate data visualisation of personalised recommendations and insights from different providers of the Data Space into their tools and applications, enhancing their service offerings and customer experience, - provide functionalities to data subjects to easily visualise recommendations and insights derived from their personal data across different applications and interfaces within the Data Space - provide functionalities to data subjects to compare results from various AI providers and data sources in a single interface, simplifying their decision-making process and enhancing their user experience within the Data Space - provide functionalities to data subjects to maintain control and privacy over their personal data by storing it securely on the client-side, ensuring GDPR compliance and maximum data protection while accessing relevant recommendations and insights"
Priority	M
Related architectural component	Data sharing, Data processing, Infrastructure layer architecture, security
Source	Simpl-Live Personal Data Handling Assessment (Simpl-Live feasibility study)

Req ID	PDH_013
Baseline Technologies	D3, HTML5, JSON-LD
Baseline Components	Prometheus-X Distributed Data Visualisation, Prometheus-X Contract Management, Prometheus-X Consent Management, PDI

User story 14

"As a data subject, I want to have confidence in the quality of my personal data when sharing it with organisations within the Data Space, so that I can trust that my information will be used responsibly and effectively",

"As a data subject, I can manage this data veracity checks from my PDI."

"As a participant, I want to easily understand and agree to data veracity agreements with organisations, ensuring that my data will meet specified quality standards and be used appropriately according to my preferences."

PDH-14- Ensuring and Managing Data Veracity and Quality Agreements for Personal Data

Req ID	PDH_014
Short Title	Ensuring and Managing Data Veracity and Quality Agreements for Personal Data
Description	"Simpl shall enable participants to: - easily understand and agree to data veracity agreements with organisations, ensuring that their data will meet specified quality standards and be used appropriately according to their preferences; - provide functionalities to data subjects to have confidence in the quality of their personal data when sharing it with organisations within the Data Space, so that they can trust that their information will be used responsibly and effectively; - provide functionalities to data subjects to manage this data veracity checks from their PDI."
Priority	L
Related architectural component	Data Governance, data quality rules
Source	Simpl-Live Personal Data Handling Assessment (Simpl-Live feasibility study)
Baseline Technologies	YAML, JSON-LD, ISO 8000-61:2016, ISO/IEC 25000
Baseline Components	Prometheus-X Data Veracity, Prometheus-X Contract, Prometheus-X Consent, Prometheus-X Data Space Connector

User story 15

"As a data subject, I want fair compensation for my personal data contributions through decentralised incentivisation.",

"As a data subject, I can be informed on these value exchanges from my PDI."

"As a participant, I want to implement fair data and value distribution policies with transparent transactions."

PDH-15- Transparent Fair Value Distribution and Compensation for Personal Data Contributions

Req ID	PD_015
Short Title	Transparent Fair Value Distribution and Compensation for Personal Data Contributions
Description	"Simpl shall enable participants to: - to implement fair data and value distribution policies with transparent transactions; - provide data subjects with incentives and compensation for the use of their personal data; - provide data subject with functionalities to ensure fair compensation for their personal data contributions through decentralised incentivisation; - provide data subjects with functionalities to be informed on these value exchanges from their PDI."
Priority	L
Related architectural component	Contracts, Access control & trust, Security, Audit
Source	Simpl-Live Personal Data Handling Assessment (Simpl-Live feasibility study)
Baseline Technologies	DID, ISO 8000-117, EIP-1155, JSON-LD, ISO 8601
Baseline Components	Personal Data Intermediary, Prometheus-X Consent Management

User story 16

"As a participant, I want to prove and explain fairness, privacy, explainability, and security in decision-making processes made by my applications and algorithms".

"As a data subject, I want to be informed of the fairness, privacy, and explainability in the AI / algorithm decision-making made by participants in the Data Space."

"As a data subject, I can be informed of the AI decision making processes through my PDI".

PDH-16- Ensuring Fairness, Privacy, and Explainability in AI Decision-Making for Personal Data

Req ID	PD_016
Short Title	Ensuring Fairness, Privacy, and Explainability in AI Decision-Making for Personal Data
Description	"Simpl shall enable participants to: - to maintain fairness, privacy, explainability, and security in decision-making processes made by their applications and algorithms; - provide data subjects with functionalities to be informed on the fairness, privacy, and explainability in the AI / algorithm decision-making made by participants in the Data Space; - provide data subjects with functionalities to be informed of the AI decision making processes through their PDI."
Priority	M
Related architectural component	
Source	Simpl-Live Personal Data Handling Assessment (Simpl-Live feasibility study)
Baseline Technologies	-
Baseline Components	Personal Data Intermediary, Prometheus-X Consent Management

PDI Components

After the definition of the user stories and the persona data handling requirements, the PDHA considered the definition of PDI components. *Table 13* presents the name, description and type of component (core or secondary), to be considered for the PDI. The description includes a mapping as well to the Simpl-Open architecture.

Table 13: PDI Components

Component	Description
PDI Catalogue *Core component*	The PDI catalogue component allows the Data Space to present to data subjects the available personal data sources and services available to them and interact with them. It is the entry point of a data subject into the Data Space. **Simpl Architecture:** this is a component part of the Data Discovery capability. Illustration of the usage of this component in the skills Data Space: “As a job seeker, I can connect to my data subject Data Space catalogue, enter my situation (job seeker, age, what I'm looking for training / jobs, etc) and I will be recommended relevant participants to help me with my objectives (e.g. skills assessment tools, job boards, etc) that fit my profile, I can access them from this catalogue and manage the data exchanges needed.”
GDPR Contract Manager *Core component*	The GDPR Contract Manager component is an extension of the Simpl usage contract component. It is responsible for managing the creation, administration, and enforcement of both bilateral and ecosystem GDPR contracts within the data space. These contracts and agreements define precise roles, rights and obligations regarding personal data processing and ensure compliance with regulations such as GDPR. This extends the Simpl-Open contract capability and usage policy component with GDPR specific features, notably relationship with the GDPR consent manager component and GDPR related policies. **Simpl Architecture:** GDPR Contract Manager is an extension of the usage contract component. Illustration of the usage of this component in the skills Data Space: “As a job seeker, when I want to access one Data Space application for instance to match me with jobs based on my skills data, I can be presented the data sharing agreement information between the data and service providers on the type of data, the policies, the duration of usage, the legal basis, etc”
GDPR Consent Manager *Core component*	The Consent Manager is a component for managing GDPR consents in Data Spaces, ensuring compliance with privacy regulations. It generates, manages, and verifies data subject consent based on pre-existing GDPR data usage contracts between Data Space participants, allowing control and transparency. It offers a scalable, secure framework for ethical data management and user trust. **Simpl Architecture**: GDPR Consent Manager is a component part of the Access Control & Trust capability. Illustration of the usage of this component in the skills Data Space: “As a job seeker, when presented with a relevant Data Space application to match me with jobs, I can be presented, through my PDI, a consent to authorise transfer

Component	Description
	of my skills data from data providers in the Data Space (university, schools, employers, other service providers) towards that application, for a specific purpose. This information is clearly presented to me, and I can easily, with the same mechanism revoke my consent."
GDPR Rights exertion *Core component*	The GDPR Rights exertion component allows Data Space participants to generate interfaces for data subjects to exercise their GDPR rights and sends notifications to the provider's systems and/or Data Protection Officer to implement the exertion. It can also provide automatic responses and information to the data subject. **Simpl Architecture:** this component is part of the Access Control & Trust capability. Illustration of the usage of this component in the skills Data Space: "As a job seeker, for each data transfer that I authorised for several job boards and services, I can easily exercise my GDPR rights from my PDI to revoke the authorisation or retrieve my data."
Personal Data Storage *Core component*	Personal Data Store provides to data subjects a secure environment where to store all their personal data stored or generated in the Data Space. **Simpl Architecture**: This is a component of the PaaS services capability. Illustration of the usage of this component in the skills Data Space: "As a job seeker, I can retrieve all of my skills / education / employment data from all the different sources (universities, employers, institutions, job boards, skills assessment tools, EdTech's etc) into my own personal data store to have a full profile under my control that I can then reshare independently from the different providers."
GDPR Connector *Core component*	A Data Space connector enabling the management of GDPR policies, consent management and GDPR rights to validate the exchange or deletion of data based on those requests. **Simpl Architecture**: This is a component of the Data Sharing capability.
GDPR Monitoring *Core component*	GDPR monitoring extends the data usage, application usage and infrastructure usage components from the monitoring capability to be able to collect metrics regarding personal data sharing and usage and present metrics to the participants and data subjects. **Simpl Architecture**: This is an extension of the data usage, application usage and infrastructure usage components from the monitoring capability. Illustration of the usage of this component in the skills Data Space: "As a job seeker, I can have a full view of all job matching applications that hold and use their data, how long the agreement still stands and be informed if some data exchanges where breached or did not go through."

Component	Description
Natural person identity management *Core component*	The natural person identity management component allows to identify data subjects with the participants and when the data subject exercise their rights, manage their consents and uses other PDI functionalities, to ensure it is the right person. It builds on top of eIDAS regulations and will provide a decentralised approach to managing identity. **Simpl Architecture:** This is a component part of the Access Control & Trust capability. Illustration of the usage of this component in the skills Data Space: "As a job seeker, when I want to use one Data Space application to match me with jobs I can easily sign up and log in to it with my ID wallet."
Value proposition editor *Secondary component*	Value propositions component allows participants of the Data Space to describe their data, services and use cases in a human-friendly way so that it is presented to data subjects through their PDI or directly inside participant's interfaces, to inform them about the value of the Data Space service or use case that is presented to them. **Simpl Architecture**: This component is part of the Data Governance capability. Illustration of the usage of this component in the skills Data Space: "As a job seeker, when onboarding into the skills Data Space use cases, I have a UX/UI friendly way of understanding the different functionalities, data exchanges, the value of sharing my data and how I can control my data. For instance, I am given concrete examples of how it will benefit me in my job search."
Decentralised AI Training protocol *Secondary component*	Decentralised AI training is an innovative approach that allows AI models to be trained directly on personal data sources without exposing personal information, enhancing privacy and democratising AI development. This component addresses data privacy concerns, enabling the use of previously inaccessible data. It supports anonymous computations, consent-based participation, and trust distribution among different organisations, ensuring a reliable and privacy-preserving framework for AI development. **Simpl Architecture:** This component is part of the Application Sharing capability. Illustration of the usage of this component in the skills Data Space: "As a job seeker, I can receive requests from AI skills matching companies to use their data to train their models in a privacy preserving way."
Consent Contract Negotiating Agent *Secondary component*	The Consent/Contracts Negotiating Agent streamlines data consent and contractual agreements within data space ecosystems by automating consent preferences and responses and managing contracts between individuals and organisations. Data subjects can set personal data usage preferences and policies and are matched with providers that fit their criteria, automatically establishing the usage policies and consents. **Simpl Architecture:** This component is part of the Access Control & Trust capability.

Component	Description
	Illustration of the usage of this component in the skills Data Space: “As a job seeker, I can be matched with the most relevant job matching applications in the Data Space according to their location, needs, sector etc so that I'm not lost between all available applications, I can also define that I authorise all job boards to use their skills data for a certain amount of time to facilitate UX in the Data Space. I can also state that I only allow job boards that are based in a certain geographical area to process my skills data.”
Distributed Data Visualisation *Secondary component*	Distributed Data Visualisation is a reusable, portable, and multi-platform HTML5/JavaScript & D3.js component designed to create end-user UIs for displaying data. It is essential to support Data Space use cases that interact with data subjects to provide them with results of personal data processing. It allows providers to showcase analytics, predictions, and recommendations seamlessly across various platforms, ensuring data privacy and improving user control. This tool enables the integration of analytics results from the Data Space participants into different applications. It supports functionalities such as user journey mapping, data anonymisation, and real-time data processing. The component is ensuring compliance with consent and contract requirements. **Simpl Architecture**: This component is part of the Data Visualisation capability. Illustration of the usage of this component in the skills Data Space: “As a job seeker, I can see matchings with jobs coming from several job matching applications in one single place, no need to log into each job board separately to see the matchings.”
Data Veracity Assurance *Secondary component*	The Data Veracity Assurance (DVA) component ensures the quality of personal data exchanged within a Data Space by facilitating the creation and verification of Veracity Level Agreements (VLAs). These agreements define specific data quality aspects and evaluation schemes that data producers must meet. DVA supports various veracity assurance methods, including attestations and proofs of veracity, allowing data consumers to verify the credibility of data. **Simpl Architecture:** This component is part of the Data Governance capability. Illustration of the usage of this component in the skills Data Space: “As a job seeker, I can indicate the reliability of skills certificates depending on the data source providing it (university, skills assessment application, etc) and I can follow the integrity of the data when it is shared across applications, so as to be ensured the job matchings and propositions are relevant.”
Data Value Chain Tracker *Secondary component*	The Data Value Chain Tracker (DVCT) is a system designed to monitor both direct and indirect data usage, ensuring traceability and distributing digital incentives based on contractual agreements. It allows participants to provide and describe incentives in the form of tokens to data subjects for them to share their data with the Data Space. These tokens can be exchanged for different rewards offered by the Data Space, it allows a fair compensation of data subjects for the use of their data.

Component	Description
	Simpl Architecture: This component is part of the Contracts capability. Illustration of the usage of this component in the skills Data Space: “As a job seeker, when sharing their data for research purposes or to train models I can be compensated or I can receive other value exchange (free access to services, etc). This is presented to me and the data usage is tracked to enable fair value exchange.”
Trustworthy AI *Secondary component*	The Trustworthy AI component allows to audit the models of AI service providers to see if they respect ethical codes of conduct, privacy / security guidelines and regulations such as the AI act. It also allows to identify biases in the model or in the datasets it is trained upon. It can also assess the obligations of the AI provider under the AI act. It can present the result of the assessment to other participants and to data subjects before their data is used by the AI model. It allows to ensure trust and compliance in the Data Space. **Simpl Architecture:** This component is part of the Data Governance capability. Illustration of the usage of this component in the skills Data Space: “As a job seeker, when about to use one job matching application, I am informed of the criteria of the algorithm (what kind of data is used and how to match me with jobs) so I can be informed about the decision making in matching me with opportunities.”

Based on these defined components, *Table 14* shows which agent is responsible for deploying each component to enable PDH capabilities. The respective agents could be the PDI/DSGA agent or the participant agent.

Table 14: Agent that deploys the components to enable PDH capabilities

Component	PDI/DSGA Agent	Participant Agent
PDI Catalogue	X	
GDPR Contract Manager	X	
GDPR Consent Manager	X	
GDPR Rights exertion	X	X
Personal Data Store	X	
GDPR Connector		X
GDPR Monitoring		X
Natural person identity management	X	X

Next, to answer the requirements coming from the Data Spaces in Simpl-Open, the PDHA has defined a series of components that should be developed and proposes a timeline for their development. *Table* 15 shows the mapping of each PDH requirement to the components involved.

Table 15: Data Space requirements and components

Req ID	Requirements	Component(s) Involved
PDH1	Presenting Data Space providers and use cases to data subjects	PDI catalogue, Data catalogue
PDH2	Establishing GDPR compliant data sharing agreements	GDPR Contract manager, GDPR connector
PDH3	Allowing the exertion of GDPR rights of data subjects on personal data processed in the Data Space	GDPR Rights exertion, GDPR Contract manager, GDPR connector, Usage and policies, Natural person identity management
PDH4	Managing data subject's consent and opt-outs on the use of their data in the Data Space	GDPR consent manager, GDPR Contract manager, GDPR connector, Usage and policies, Natural person identity management
PDH5	Enforcing GDPR policies and consents in data exchange	GDPR connector, GDPR Contract manager, GDPR consent, Natural person identity management
PDH6	Manage user identity in the Data Space	Natural person identity management
PDH7	Managing monitoring of personal data usage in the Data Space	GDPR monitoring
PDH8	Enabling secure and decentralised personal data storage	Personal data storage, GDPR connector, GDPR consent manager, Natural person identity management
PDH9	Enabling Secure, Decentralised and Consent-based AI Model Training with Personal Data	Decentralised AI training protocol, GDPR consent manager, GDPR connector
PDH10	Communicating the Value and Benefits of Data Space Participation to Data Subjects	Value proposition editor, PDI catalogue
PDH11	Informing Individuals About Personal Data Usage and Protection in Data Spaces	Value proposition editor, PDI catalogue
PDH12	Personal Data-Driven Matching of Applications and Individuals in Data Spaces	Consent Contract Negotiating Agent, GDPR consent manager, Natural person identity management
PDH13	Visualising Personalised Recommendations and Insights with Data Privacy and Control	Distributed data visualiser, GDPR consent manager, GDPR connector, Natural person identity management

PDH14	Ensuring and Managing Data Veracity and Quality Agreements for Personal Data	Data Veracity Assurance, GDPR connector
PDH15	Transparent Fair Value Distribution and Compensation for Personal Data Contributions	Data Value Chain Tracker, GDPR Connector, GDPR Contract manager, GDPR consent manager, Natural person identity management, Data veracity Assurance
PDH16	Ensuring Fairness, Privacy, and Explainability in AI Decision-Making for Personal Data	Trustworthy AI assessment

Conversely, *Table 16* shows the mapping of each component to the PDH requirements involved.

Table 16: Components mapped to PDH requirements

Component	Requirements
PDI Catalogue	PDH1, PDH10, PDH11
GDPR Contract Manager	PDH2, PDH3, PDH4, PDH5, PDH15
GDPR Consent Manager	PDH2, PDH5, PDH8, PDH9, PDH12, PDH13, PDH15
GDPR Rights exertion	PHD3
Personal Data Store	PDH8
GDPR Connector	PDH2, PDH3, PDH4, PDH5, PDH8, PDH9, PDH12, PDH13, PDH15
GDPR Monitoring	PDH7
Natural person identity management	PDH3, PDH4, PDH5, PDH6, PDH12, PDH13, PDH15
Value proposition editor	PDH10, PDH11
Decentralised AI Training protocol	PDH9
Consent Contract Negotiating Agent	PDH12
Distributed Data Visualisation	PDH13
Data Veracity Assurance	PDH14, PDH15
Data Value Chain Tracker	PDH15
Trustworthy AI	PDH16

Finally, the PDHA proposes to first focus on the core components to enable their integration into Data Spaces. This will allow to start deploying first personal data handling use cases before adding more secondary components based on Data Spaces' and use cases' needs.

Simpl-Open having as ambition to be the baseline software stack for data exchange and Data Spaces, it seems essential Personal Data Handling components are included and developed as all Data Spaces will require personal data handling. This will ensure a stronger adoption of Simpl-Open across data spaces as it will bring unique in demand functionalities and will serve to accelerate the realisation of the European Data Strategy. *Table 17* shows the indicative delivery schedule for each component and concludes the assessment.

Table 17: Component-Specific Delivery Timelines

Component	Indicative delivery timeline if development starts in 04/25	Comments
PDI Catalogue	07/25	Core component, extends data catalogue and application catalogue
GDPR Contract Manager	07/25	Core component, extends usage policies component
GDPR Consent Manager	07/25	Core component
GDPR Rights exertion	07/25	Core component
Personal Data Store	09/25	Core component
GDPR Connector	06/25	Core component, extends data storage connector component
GDPR Monitoring	07/25	Core component, extends data usage and application usage
Natural person identity management	09/25	Core component
Value proposition editor	12/25	Secondary component, extends data catalogue and application catalogue
Decentralised AI Training protocol	12/25	Secondary component
Consent Contract Negotiating Agent	12/25	Secondary component
Distributed Data Visualisation	3/26	Secondary component, extends data visualisation component
Data Veracity Assurance	3/26	Secondary component
Data Value Chain Tracker	3/26	Secondary component
Trustworthy AI	3/65	Secondary component