**DATA SPACES
SUPPORT CENTRE**

# Starter Kit for the Data Space Designers
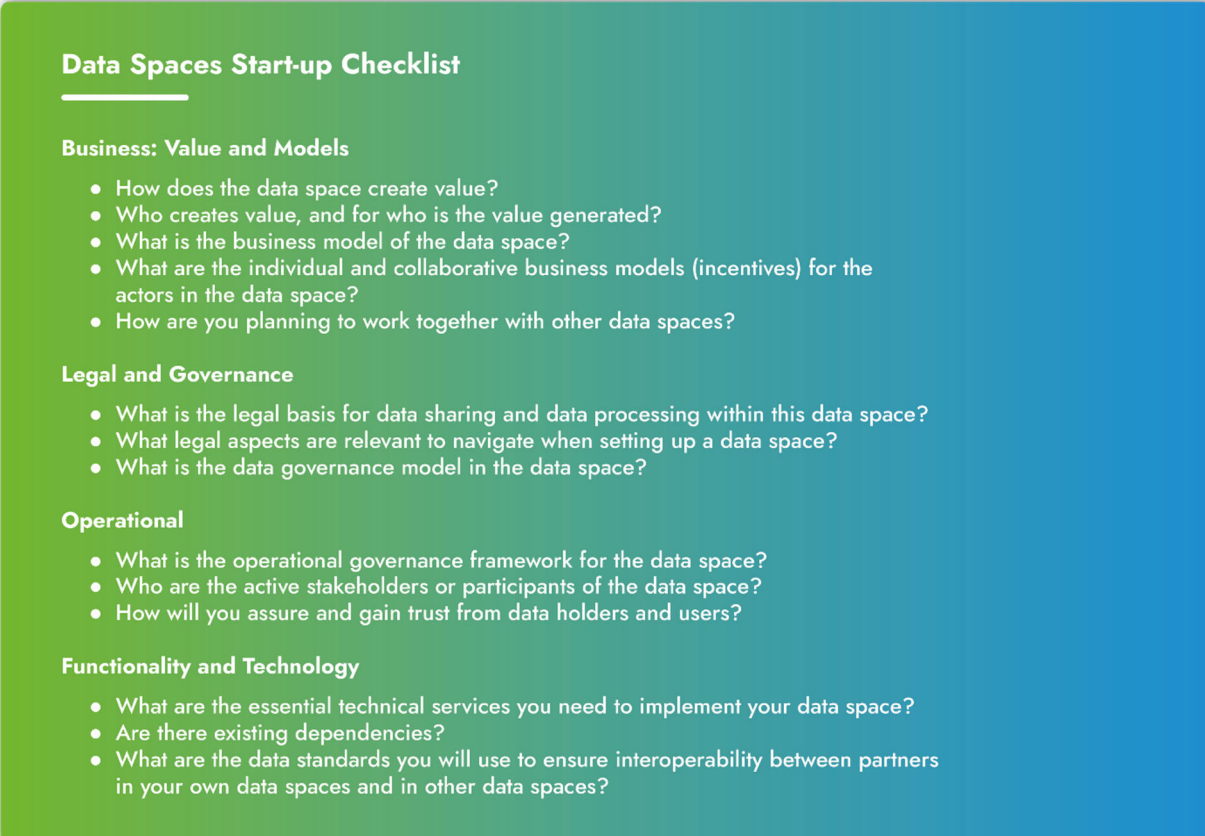
# Content

# 1    Data Spaces 101

The European data strategy aims to speed up the development of the European data ecosystem and economy and harness the value of data for societal benefit and ensure Europe's global competitiveness and data sovereignty[1]. The European Commission will invest in common European data spaces in strategic economic sectors and domains. A data space can provide a clear framework (from a business, legal and governance, technical, and operational perspective) to support data sharing within a data ecosystem. This creates the conditions for a marketplace competition among participants or enables collaboration among diverse, interconnected participants who depend on each other for mutual benefit. For example, industrial data spaces can support different levels of trusted and secure sharing and trading of commercial data assets with automated and robust controls on legal compliance and remuneration. Personal data spaces enforce legislation and allow data subjects and holders to control their data and its subsequent use. Many fundamental technical, organisational, legal, and commercial challenges exist in developing and deploying data spaces to support data ecosystems. This starter kit, developed by the Data Spaces Support Center (DSSC), is designed to help you on your journey to creating a data space.

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[1] https://digital-strategy.ec.europa.eu/en/policies/strategy-data

# 2    Data Spaces Start-up Check list

The following checklist follows the five disciplines in the BLOFT framework[2]: business, legal, operational, functional, technical.

**Data Spaces Start-up Checklist**

**Business: Value and Models**
- How does the data space create value?
- Who creates value, and for who is the value generated?
- What is the business model of the data space?
- What are the individual and collaborative business models (incentives) for the actors in the data space?
- How are you planning to work together with other data spaces?

**Legal and Governance**
- What is the legal basis for data sharing and data processing within this data space?
- What legal aspects are relevant to navigate when setting up a data space?
- What is the data governance model in the data space?

**Operational**
- What is the operational governance framework for the data space?
- Who are the active stakeholders or participants of the data space?
- How will you assure and gain trust from data holders and users?

**Functionality and Technology**
- What are the essential technical services you need to implement your data space?
- Are there existing dependencies?
- What are the data standards you will use to ensure interoperability between partners in your own data spaces and in other data spaces?

Figure 1: Data spaces start-ups checklist according to the BLOFT framework

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[2] https://datasharingcoalition.eu/our-approach-and-tools/use-case-blueprint

# 3    Business: Value and Models

Data spaces can be seen as a strong and collaborative alternative to platforms, or better multi-sided business models. An important driver of the value of multi-sided business models is the establishment of so-called network effects between "supply" and "demand" of data. Offering a useful collection of data sources will attract users of data, and vice versa a large user base will attract offering of additional data sources[3]. However, proper functioning of multi-sided business models is more an organizational than a technical challenge, as to create substantial value it requires efforts to achieve adoption by multiple users and organizations, e.g., by marketing, support etc. This applies no less for a data space. Furthermore, addressing such challenges are a joint effort for data spaces. Data spaces go through different life cycle stages[4], e.g., initialization, testing, deployment, use (including maintenance and improvement), growth, federation, (and disbanding). The value of data spaces, as with multi-sided business models, is most prominent in the growth and federation stage, since then the efforts put in configuring the data space technologies and organization are available to new data sources, uses and organizations at virtually zero marginal cost. Beyond the key objective of secure and sovereign data sharing, data spaces can be established for different purposes. For example, for reducing the overall cost of linking systems or collectively ensuring compliance with data regulations, typically in established industries. Or for example for joint value creation by creating a set of data and logic that cannot be achieved individually, e.g., as in end-to-end multi-modal mobility services. Another objective to operate it as a marketplace and the data space can be seen as a sales channel from data provider to data user.

Consequently, governance is needed to configure and coordinate the necessary actions by different organizations that make a data space work and meet its objectives and go through the different life cycle stages. Furthermore, to support economic sustainability of the data space, also a business perspective, or collaborative business model for those organizations is needed.  The following elements are important to data space business and governance models.

Design approach: Business and governance models in the context of data-driven applications and data sharing involve multiple choices that must be made in coherence by multiple organisations.

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[3] Stolwijk, C. C. M., and F. T. H. M. Berkers. Scalability and agility of the Smart Connected Supplier Network approach. No. TNO 2020 R11179. TNO, 2020

[4] Hedeler, Cornelia, et al. "Dataspaces." Search Computing. Springer, Berlin, Heidelberg, 2010. 114-134.

Think of the data sources, access conditions, algorithms, interfaces, onboarding rules, and service levels. It is too complex for a single person to make the correct choices for all available options and expect this to yield the desired outcomes and impacts, supported by all organisations involved. To deal with this, business and governance modelling is approached as a design process to develop a preparatory framework of business and governance models. First, templates are developed and used as models for making choices. Next, based on the understanding and interpretation of the relevant contexts and objectives, such templates are filled collaboratively by multiple stakeholders. This results in a complete draft design that is evaluated against chosen criteria. The evaluation process should aid in identifying improvement suggestions or critical assumptions, which should then be tested through explorative or validation experiments. Finally, the experiment results are incorporated into the overarching design until the evaluation yields satisfactory results to commit to implementation.

Business model radar for data-driven applications and data sharing: The business model radar tool[5] has proven helpful in the design of collaborative business models, such as data-driven services. The core of this tool is the value-in-use, the value created by the interactions of multiple organisations, including the end-user, and a single organisation cannot make that alone. An example is a seamless travel experience[5], for each actor involved in the value proposition (i.e., executive traveller, transport provider, accommodation provider, and insurance provider), its activities, costs, and benefits are specified. In this approach, it is crucial to keep an eye on the value creation and capture by individual participants and the overall value created. Collaborative business models for data sharing through a data space will have to address the above mentioned growth and network effects and reflect the different objectives, or patterns, like cost sharing, joint value creation or marketplaces.

Data and organisational governance for data spaces: In the context of data spaces, data governance cannot be separated from the governance of organisations and individuals. Abrahams[6] provides a synthesis of existing works and gives insight into the many factors to consider and the choices to make in setting up governance. Yet new works appear regularly. Alignment with the legal governance to come to one multidisciplinary governance structure will follow later based on a more extensive analysis/discussion. Conceptual frameworks (see Appendix 2) are not yet applicable in practice. We put forward two approaches that have proven helpful in the design of

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[5] Grefen, P. W. P. J. "Service-dominant business engineering with Base/X: business modeling handbook." BASE/X Handbooks 1 (2015).

[6] Abraham, Rene, Johannes Schneider, and Jan Vom Brocke. "Data governance: A conceptual framework, structured review, and research agenda." International Journal of Information Management 49 (2019): 424-438.

data space governance: (1) The data-sharing "use case blueprint" (Data Sharing Coalition), and (2) The templates for data space governance agreements from the Rulebook for a fair data economy (Sitra). The governance design will have to address, among many other aspects, the above mentioned objectives of the data space and the evolution of the data space through the different life cycle stages.

# 4 Legal and Governance: Models and Compliance

The legal aspects that affect the creation and operation of data spaces are multi-fold. From data protection to competition law, from contract law to intellectual property rights. Keeping track of the applicable legislation can thus be challenging, especially with the fast-paced regulatory agenda related to the European Data Strategy and the intricate interplay between different relevant regulatory instruments. Therefore, to help navigate the legal landscape pertaining to data spaces, the DSSC proposes to think about legal issues across different areas: (1) Substantive rights and obligations pertinent to data; (2) Data contracts; (3) Competition law; (4) Organisational aspects (e.g., business agreements, operational agreements, organisational agreements); (5) Techno-legal interoperability; and (6) Regulatory aspects.

The six areas identify aspects that need to be considered in data transactions and facilitating infrastructure, outline organisational enforcement and oversight tools, and provide an overview of data governance roles and responsibilities. Related to governance, the following building blocks (see Appendix 1) are important: business, operational and organisational agreements. Business agreements specify what kind of terms and conditions can regulate the sharing of data between participants and the legal framework supporting contracts established through the data space. Operational agreements regulate policies that must be enforced during data space operation, e.g., compliance with GDPR (General Data Protection Regulation) or the 2nd Payment Services Directive (PSD2) in the finance sector. They may also comprise the definition of tools that operators of cloud infrastructures or global services supporting data spaces must implement to enable the auditing of specific processes or the adoption of cyber-security practices. Finally, Organisational agreements establish the governance bodies (like ICANN for the Internet). They deal with identifying concrete specifications that products implementing technology building blocks in a data space should comply with and the business and operational agreements to be adopted.

The DSSC will further invest efforts to promote the full uptake of EU values in data spaces, which are set as a key feature of European data spaces. The different resources and building blocks should work towards data spaces that promote and safeguard human dignity, human rights, equality, and all other values that are core to the European way. These values should be enshrined in concrete settings and brought to the level of technical implementation to ensure individual and collective control of data and safeguard a human-centric and fair approach.
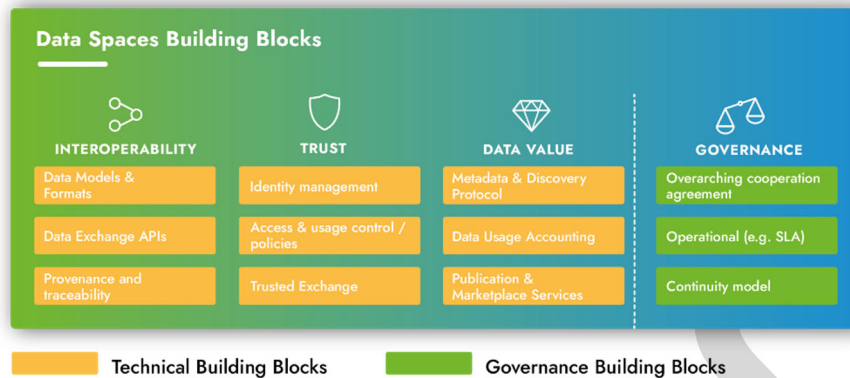
# 5    Functionality and Technology



Figure 2: Technical building blocks pertaining to interoperability, trust, and data value

In each data space present today, and the ones to be developed in the future, several building blocks need to be considered when setting up: they delineate areas where choices are required to enable effective and trusted sharing of data among participants that ultimately creates value. The assembly of building blocks for data spaces relies on reference architectures that specify a role model and the distribution of building blocks among roles. A data space is a distributed system where data providers and data consumers connect with each other and use optional third-party services. This is enabled by a soft data infrastructure that may lead to a centralised, a decentralised or a hybrid solution. The soft data infrastructure provides the trust framework for the data space instance or across different data space instances. In addition, it can support verifying identities and other required assertions, e.g., proof of certifications and verification of attributes. Figure 2[7] shows an overview of the taxonomy of these building blocks. From a technical perspective, several technology building blocks are required:

Interoperability: Data spaces should provide a solid framework for efficient data exchange among participants, supporting the complete decoupling of data providers and consumers. Interoperability between domain-specific data spaces is crucial for two reasons. First, an individual or organisation is never just part of one single space but operates in different data spaces simultaneously. If data spaces are organised in silos, users have to adopt different solutions. This results in fragmentation, high integration costs, and monopolistic behaviour of market participants. Second, use cases are not limited to a single data silo. Fragmentation of the data economy must be prevented to reap the maximum value for organisations and individuals in the EU. This requires the adoption of a "common lingua" every participant uses, which materialised in adopting interoperable APIs for

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[7] https://design-principles-for-data-spaces.org/

data exchange and the definition of compatible data models. Interoperable mechanisms for the traceability of data exchange transactions and data provenance are also required.

Trust: Data spaces should bring technical means for guaranteeing that participants in a data space can trust each other and exercise sovereignty over the data they share based on user-controlled consent. This requires the adoption of interoperable standards for managing the identity of participants, verifying their truthfulness, and enforcing policies agreed upon for data access and usage control.

Data value: Data spaces should provide possibilities for participants to generate value from sharing data (i.e., creating data value chains). Therefore, data spaces often can contain multi-sided markets if participants intend to trade, buy, and sell data as part of their business model. This requires the adoption of common mechanisms enabling the definition of terms and conditions (including pricing) linked to data offerings, the publication and discovery of such offerings and the management of all the necessary steps supporting the lifecycle of contracts that are established when a given participant acquires the rights to access and use data.

For each building block, a data space can make specific choices. For example: how certain bodies provide 'trust' in the ecosystem and the extent to which marketplace functionalities will be arranged will vary from one domain to the other. However, the underlying fundamental specifications and standards to define those can be the same. There can also be best practices and technology options. This is where the data spaces support centre seeks to achieve synergies. Besides adopting an interoperable technology foundation, data spaces also require governance building blocks that create the business, operational and organisational agreements participants agree to adopt (see sections 3 and 4).

One way to provide synergies between data spaces is by achieving a data space federation: allowing participants of one data space to connect to others: by using similar, compatible specifications, standards, and technologies for each of the building blocks. Ultimately this should allow for seamless 'roaming' of participants from one data space to the other.

# 6    Blueprint for Data Spaces

The DSSC will identify building blocks and provide further guidance for each building block through our common blueprint (see Appendix 1). This will provide detailed specifications and standards for each building block and their interrelationships. In addition, a toolbox will be provided with sample implementations, templates, instruction, and training materials — to get started quickly.

To start with, the blueprint will bundle existing best practices and ensure alignment towards interoperability and replicability. For new data spaces, this provides — once relevant domain-specific business objectives have been identified — an ability to start at a higher flight-level for implementing the various building blocks according to their needs. In addition, it will help to achieve interoperability between data spaces and provide significant economies of scale.

When defining the blueprint, the DSSC does not start from scratch and does not want to reinvent the wheel. Various European and global initiatives are already providing specifications and standards — and some pioneer data spaces are already using them. Through our Community of Practice (see Appendix 1), we will work with these initiatives to shape the blueprint and the supporting toolboxes. We will start by carefully listening to the requirements of data spaces in key selected areas where investments will take place through the Digital Europe program. We also welcome input and feedback from others.

Later, in 2023, an open governance process will be put in place to facilitate the decision-making process for the blueprint. Where possible, we will use a consensus-based decision-making process. We will show how different standards or technologies can work together where needed. The intent is to avoid vendor lock-ins and proprietary standards and to be fully transparent in how decisions are made.

# 7    Pioneering Use Cases

Today, many use cases have been pioneering and experimenting with data space approaches and technologies. The data space use cases and approaches taken have been evolutionary, with the research and industrial community learning the best ways to create a European data economy.

Due to this evolutionary approach, reflecting on what we expect from a data space in a perfect world is prudent. The EU data strategy's key objectives and values serve as a guideline in this work. Data will be the cornerstone of the European economy in the future. The EU ensures global competitiveness by providing vision and facilitating development with precise actions, including legal and funding. Use cases must eventually align with the regulatory frameworks provided by the EU and emerging technological standards to create interoperability between data spaces. The result will be a competitive European data economy scene for European industry and society, including a flourishing ecosystem of agile technology and service providers.

In the future European data economy arena, we will find interoperable cross-country European data spaces which can be trusted, supporting data sovereignty and fostering value in a previously unseen way. While data spaces can be sectoral with their nuances and requirements, there will be an ability to share data over sectoral boundaries. This synergy provides specific societal value. For example, reaching the goals of $CO_2$ reduction, sustainability, environment, and climate change will be based on real-time data from European sectoral activities. Furthermore, exemplary use cases could be the EU-wide prevention of money laundering and smart cities. Both are examples, which can convey the benefit of data spaces as described in the table below.

| Challenge | Benefit | Solution |
|---|---|---|
| Money laundering is a global problem and a complex issue to tackle for banks. While accounting for an estimated 1.7 to 4 trillion euros worldwide (2 to 5% of global GDP), money laundering operations usually go unnoticed from a single financial institution's perspective since fraudulent transactions occur over networks. This results in two significant issues for banks: these unlawful transactions stay undetected, and at the same time, they draw high costs for these institutions due to a high false positive rate of suspected fraud alerts. | Improved detection of fraud for banks sharing their data. | Banks share data to enable the execution of fraud detection algorithms. This leads to improved detection of fraud patterns and a reduced false positive rate at banks. |
| Many cities already use open standards to break the silos and integrate different verticals within the city platform. Many tech providers are developing smart solutions for multiple cities, and cities can avoid vendor lock-in. Cities are used to making their data public (open data), but it is still challenging to transition to a data ecosystem with other external organisations to share data that is not always public and implement a business model interesting for all the parties. This new scenario introduces additional challenges like defining clear access control policies over the data and services and precise monetisation mechanisms to motivate vertical solutions providers to participate. | Cities can be consumers of services and data and offer data and services to third parties. | Data spaces are the natural step for cities in their digitalisation journey. Thanks to them, they can move from a scenario of systems of systems in which they integrate verticals by sharing data within the city towards a scenario in which they can go beyond and improve processes by sharing data with other organisations. |

There is a considerable progress in all domains delineated by the European Data Strategy. This document provides an overview of use cases in the resources list, which provides most well-known data space use cases as a reference, but it is non-exhaustive. This list will be updated in later versions of this living document in the interaction with the Community of Practice and stakeholders.

Data space value can become, in many ways, from new businesses and business models that emerge through savings from optimisations and making better societal decisions. When studying the pioneering use cases, value is usually the first and most crucial criterion to justify the investments made. A data space is neither not only a technology you install into your computer system . It is a new way to understand and analyse your core business. How does the use case implement a data-driven business, how successful is it in the data ecosystem, and why?

Data economy emerges only by goal-oriented experimentation and evolution, including a design approach for standardisation and regulation. However, the value created through data spaces gives the ultimate justification for investing our precious time and money. Furthermore, a data space must align with regulation, laying the foundation for fair data economy creation. As regulation has been under development, there is still work ahead for all the pioneering data spaces to identify and put them into operation. Functionalities of data spaces are based on technology frameworks which must provide interoperability in a trusted manner, in a standardised and feasible way concerning investments and sustainability over time.

You can find a list of evolutionary approaches, lighthouse projects, and references to industrial use cases in the resources list. In addition, the data space radar (see Appendix 1) categorises nearly 80 use cases and provides a visual mapping to keep an overview. The assumption is that use cases will evolve, even if they may serve a particular purpose when piloting.

# 8    DSSC – Supports

The DSSC will support the data space community following a heartbeat and release cycle, creating many assets in collaboration with the Community of Practice (CoP). The Support Centre drives adoption through support activities, a platform [www.dssc.eu](http://www.dssc.eu) for knowledge and asset sharing, a help desk, toolboxes, and active engagement with this CoP. The support options are packaged to serve the needs of the data space initiatives of different maturity levels. The work of the DSSC will continuously evolve with a user-centric approach as the result of co-creation with the stakeholders and the sharing of lessons and experiences between data spaces.

Experts: The DSSC will offer expert consultation to any data space project, initially prioritising the sectors identified in the Digital Europe Programme. Specialist consultation is designed to support any candidate to move forward with their ideas and foreseen solutions following the approach developed in this Starter Kit. Data spaces experts are composed of members of this project for now. However, this group will soon be extended to externals willing to provide support and services to the community. Data space experts are organised around the building blocks to support any data space building endeavour. This support will be funnelled through the Support Platform. The Support Platform provides access to data space experts. They can already be reached via email at support@dssc.eu. More fine-grained interactions with the experts will be added in the future (ticketing system, knowledge base, webinars, events, etc.).

Support Platform: The Support Platform is accessible through the Portal at dssc.eu. It presents a minimal set of features at the moment. It will be enriched following the project's timeline and its assets' release. The Support Platform serves the following objectives:
- The Go-to-place to get information and learn about data spaces.
- Access point to join the co-creation process of the data spaces blueprint and other assets supporting the realisation of data spaces.
- An entry point to organise the support by data spaces experts (in priority for data spaces funded under the Digital Europe Programme).

Community of Practice (CoP): At the core of data space development are the existing and emerging data space initiatives in all sectors and the potential implementers of the data space building blocks. These form the CoP in data sharing, and they co-create and adopt the blueprint and its building blocks in sectoral data spaces. Initially, the DSSC CoP prioritises data space projects from the Digital Europe Programme and later expands to other data space initiatives.

Alignment and co-creation with the Network of Stakeholders: DSSC engages a broad spectrum of organisations and initiatives relevant to data space development. This includes the Public Sector Open Data for AI and Open Data Platform, the Cloud-to-Edge infrastructure and services projects, the AI on Demand platform, the AI TEFs, DIHs, Advanced Digital Skills, Digital Product Passport, and other initiatives under the DEP. It also includes the EuroHPC JU, EOSC, research and innovation initiatives, Horizon Europe partnerships and Space programmes, standardisation bodies and organisations, national initiatives, industry and SME associations, global and international initiatives, and any other relevant stakeholders.

# Appendix: DSSC Glossary

DSSC Glossary (set of selected terms from the DSSC Glossary under development. These definitions may be subject to change).

- Data Space: Decentralised, governed and standard-based structure to enable trustworthy data sharing between the data space participants on a voluntary basis. Data spaces may be purpose- or sector-specific, or cross-sectoral. Common European data spaces are a subset of data spaces within the scope of EU policies.
- DSSC assets: An open resource managed by the Data Spaces Support Centre that can be used to develop, deploy and operationalize data spaces. These resources need to be sustainable and have governance on how the resource is used, generated, and maintained.
- Data Space Support Centre: The combination of all activities and the output of the EU-funded project with the same name. It is the virtual organisation that promotes and coordinates all relevant actions on sectoral data spaces. It provides an overview of technologies, processes, standards, and tools that will support the deployment of common data spaces and will allow the reuse of data across sectors. The Data Spaces Support Centre manages DSSC assets and develops and executes strategies to provide continuity for the main assets also beyond the project funding.
- Data Space Building Block: A building block is a fundamental ingredient that can be implemented and combined with other building blocks to achieve the functionality of a data space. It encompasses at least the basic specifications, and evolves with more detailed specifications, sample implementations or templates, and with the instructions, training, testing and support elements that are required to facilitate the delivery of the essential ingredients of data spaces.
- Catalogue of building blocks: An organised inventory of recommended and approved data space building blocks. The catalogue defines the building blocks and provides references to multiple options for their implementation. The catalogue enables the reuse of common building block implementations across multiple data spaces. The Data Spaces Support Centre has a process to add building blocks to the catalogue and to evolve, maintain and approve them.
- Data Spaces blueprint: The data spaces blueprint describes possible ways to create data spaces, encompassing a catalogue of building blocks (both technical and non-technical), together with the guidelines for the combined use of these building blocks.

- **Community Heartbeat**: The community heartbeat refers to the regularly maintained interactions that engage the community of practice to a synergetic and predictable rhythm to help efficient communications, co-learning and steady progress towards developing data spaces constantly better. The community heartbeat is created based on the regular releases of the data spaces blueprint, data spaces building blocks, other DSSC assets and supporting activities, as outlined in the public roadmap.

- **Community of Practice**: The community of practice (CoP) consists of the existing and emerging data space initiatives in all sectors and the potential Data Space Building Block implementers.

- **Relationship Manager**: A dedicated contact person from the Data Spaces Support Centre towards a data space initiative or another member of the Community of Practice.

- **Data Spaces Radar**: A publicly accessible tool to provide an overview of the data space initiatives, their sectors, locations, and approximate levels of maturity ranging from initial use cases to data space pilots and actual data spaces in production. The Data Spaces Support Centre maintains the radar as one of the DSSC assets.

- **Data Space Governance**: Governance encompasses the system of rules, practices, and processes to direct and manage an organisation and the mechanisms by which it, and its stakeholders and people, are held to account. The four pillars of good governance are transparency, fairness, accountability, and security. One of the key objectives of governance in context of data spaces is to ensure data governance. Regarding data spaces, governance happens on different levels: laws and regulations; governance of common building blocks and assets; sector-specific and inter-data space governance; governance of a particular data space; and self-regulation of data space participants of a data space.

- **Data Interoperability**: According to the Data Act, interoperability means the ability of two or more data spaces or communication networks, systems, products, applications or components to exchange and use data in order to perform their functions. Generally, interoperability means the ability of different systems to work in conjunction with each other and for devices, applications, or products to connect and communicate in a coordinated way without effort from the users of the systems. High-level classification of interoperability categories: technical, semantic, and organisational (including legal) interoperability.

- **Data Sovereignty**: The capability of an individual or organisation to be self-determining with regard to their data.

- **Trust Framework**: A structure that lets people and organisations do business securely and reliably online.

- **Network of stakeholders**: All stakeholders and initiatives relevant to the data spaces development with whom the Data Spaces Support Centre engages. The network of stakeholders includes a wide spectrum of organisations, from industry players of various sizes and associations to related projects, standardisation bodies, regulators, digital innovation hubs, etc. The Community of Practice is the core subset of this network of stakeholders and the primary focus group for the Data Spaces Support Centre.

- **European Data Innovation Board**: A formal expert group to advise and assist the European Commission. The European Data Innovation Board (EDIB) is defined in the Data Governance Act with the task to propose guidelines for common European data spaces.

# Appendix: Resource Inventories

The resource inventories provide an overview of both the *state-of-the-art* and the *state-of-the-practice* in data spaces. Within this initial set of resources, we have taken an inclusive approach to showcase the breadth of ongoing work. The inclusion of a resource does not infer an official endorsement from the DSSC. Resources will be added and removed over time.

| Name | Description | Organisation |
|------|-------------|--------------|
| **Data Spaces 101** | | |
| Designing Data Spaces | It provides a comprehensive view of data ecosystems and platform economics, from methodical and technological foundations to reports from practical implementations and applications in various industries. (https://link.springer.com/book/10.1007/978-3-030-93975-5) | Fraunhofer |
| Data Spaces: Design, Deployment, and Future Directions | Data sharing and exchange techniques using data spaces. Theory, technologies, methodologies, and best practices. (https://link.springer.com/chapter/10.1007/978-3-030-98636-0_1) | BDVA |
| Data Sharing Canvas | The Data Sharing Canvas is the foundation for generic and harmonised agreements which, once implemented, enable data sharing at scale within and across domains and sectors. This has been created together with the 40+ Data Sharing Coalition participants from different domains that represent over 100.000 organisations. (https://datasharingcoalition.eu/app/uploads/2021/04/data-sharing-canvas-30-04-2021.pdf) | Data Sharing Coalition (DSC) |
| FIWARE for Data Spaces | This white paper brings a perspective on how data spaces enabling the trusted and effective exchange of digital twin data between smart applications can be achieved. Furthermore, it brings the first perspective on how FIWARE and IDS Reference Models can be reconciled and contribute to accelerate the materialisation of Gaia-X. (https://www.fiware.org/marketing-material/fiware-for-data-spaces/) | FIWARE |

| | | |
|---|---|---|
| Gaia-X Federation Services | Data Sovereignty Services enable the trustful and sovereign data exchange of Gaia-X participants by utilising mechanisms such as usage control. (https://www.gxfs.de/) | Gaia-X |
| How to build Data Spaces | The knowledge base (a.k.a. "How to build Data Spaces?") is the store of information that relies on IDS expertise that is meant to support building IDS components and contribute to the existing open source components based on a five-step approach. (https://docs.internationaldataspaces.org/knowledge-base/) | IDSA |
| Design Principals for Dara Spaces | It defines the design principles for data spaces, agreements on the building blocks for a soft infrastructure and governance for data spaces. (https://design-principles-for-data-spaces.org/) | OPEN DEI |
| Real-time Linked Dataspaces | The Real-time Linked Dataspace (RLD) is an enabling platform for data management for intelligent systems within smart environments that combines the pay-as-you-go paradigm of dataspaces, linked data, and knowledge graphs with entity-centric real-time query capabilities. (http://dataspaces.info/) | Insight |
| European-Governed data sharing space | It enables data exchange and unlocking AI potential to create the conditions for developing a trusted European data-sharing framework. (https://www.bdva.eu/sites/default/files/BDVA DataSharingSpaces PositionPaper V2_2020_Final.pdf) | BDVA |
| The European Common Data Space | Data.europa.eu and the European Common Data Spaces (ECDS). (https://internationaldataspaces.org/wp-content/uploads/dlm_uploads/EN_data_europa_eu_and _the_European_common_data_spaces_0.pdf) | EC |
| Business: Value and Models | | |
| Data Spaces Brochure 2021 | Use cases are cross-company business processes enabled by the IDSs standard. They help identify, analyse, and evaluate user requirements for IDS. (https://internationaldataspaces.org/wp-content/uploads/dlm_uploads/220812_Use-Case-Bro_2022_35-MB.pdf) | IDSA |

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|---|---|---|
| Fair Data Economy Rulebook | Designed to guide forming of trust-based data-sharing networks with a common mission, vision, and values. (https://www.sitra.fi/en/publications/rulebook-for-a-fair-data-economy/) | SITRA |
| New Business Models for Data Spaces Grounded in Data Sovereignty | This paper applies frameworks and methods, including the business model and business ecosystem canvases, to the IDS perspective. These support a structured approach and a checklist for business planning purposes. (https://internationaldataspaces.org/wp-content/uploads/IDSA-Position-Paper-New-Business-Models-sneak-preview-version.pdf) | IDSA |
| Legal and Governance: Models and Compliance | | |
| Analytical report on EU law applicable to sharing of non-personal data | A report focusing on a thorough analysis of EU legislation applicable to sharing non-personal data, aiming to provide a structured overview of all the relevant European instruments within this field. (https://eudatasharing.eu/legal-aspects/report-eu-law-applicable-sharing-non-personal-data) | SCDS |
| Digitranscope: the governance of digitally transformed society | Full report of the Digitranscope research project, exploring the increasing awareness of the strategic importance of data and emerging governance models to distribute the value generated more equitably in society. (https://publications.jrc.ec.europa.eu/repository/handle/JRC123362) | EC JRC |
| EU regulation builds a fairer data economy | Working paper that summarises the European Data Strategy and the new legislative proposals for the data economy (Data Governance Act, Digital Markets Act, Digital Services Act, Artificial Intelligence Act and Data Act). It complements this overview with an exploration of the proposals' opportunities from the perspective of the public sector, SMEs, and individuals. (https://www.sitra.fi/app/uploads/2022/06/sitra-eu-regulation-builds-a-fairer-data-economy.pdf) | SITRA |
| IDSA Rule Book | This book provides a common governance framework that specifies the functional, technical, operational and legal agreements that structure roles and interactions within and across the various parts of the IDS ecosystem. (https://internationaldataspaces.org/wp-content/uploads/dlm_uploads/IDSA-White-Paper-IDSA-Rule-Book.pdf) | IDSA |

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| Principles for a Data Economy: Data Transactions and Data Rights | Set of transnational Principles that can facilitate the drafting of model agreements or provisions to be used voluntarily by parties in the data economy. (https://www.europeanlawinstitute.eu/fileadmin/user_upload/p_eli/Projects/Data_Economy/Principles_for_a_Data_Economy_Final_Council_Draft.pdf) | ALI-ELI |
| Rulebook for a fair data economy | Guide for creators of fair data economy networks, providing agreement templates and other tools to facilitate building and joining data networks. (https://www.sitra.fi/en/publications/rulebook-for-a-fair-data-economy/) | SITRA |
| White Paper on the Data Act | The data act white paper attempts to provide a first detailed analysis of the various provisions of the data act in light of the broader EU data economy policy and regulatory landscape. (https://www.law.kuleuven.be/citip/en/news/item/white-paper-data-act) | KU Leuven |
| White Paper on the Data Governance Act | The white paper offers an academic perspective to the discussion on the Data Governance Act proposal ("DGA proposal"), as adopted by the European Commission in November 2020. It contains a legal analysis of the DGA proposal and includes recommendations to amend its shortcomings. The White Paper aims to cover the full spectrum of the DGA proposal and therefore offers an in-depth analysis of its main provisions. (https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3872703) | KU Leuven |
| Functionality and Technology: Blueprints and Building Blocks | | |
| Data Sharing Coalition | The Data Sharing Coalition builds on existing data-sharing initiatives to enable data sharing across domains. By enabling multilateral interoperability between existing and future data-sharing initiatives with data sovereignty as a core principle, parties from different sectors and domains can easily share data, unlocking significant economic and societal value. (https://datasharingcoalition.eu/) | DSC |

| Data Connectors | This report captures 16 Data Connector variants and provides insights into their current development and usage status. Beyond the Data Connectors, this report provides insights into emerging technologies and concepts in data spaces and fundamental technologies that form a basis for data spaces. (https://dataconnectors.com/) | IDSA |
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| Data Usage Control in the IDS | This paper focuses on data usage control and data provenance, which are conceptual and technological solutions to cope with data sovereignty challenges. It presents three approaches researched and developed within Fraunhofer: The MYDATA control technologies, the logic-based usage control and degree. (https://internationaldataspaces.org/wp-content/uploads/dlm_uploads/IDSA-Position-Paper-Usage-Control-in-the-IDS-V3..pdf) | IDSA |
| FIWARE for Digital Twins | It describes how smart applications from multiple domains can be developed based on the Digital Twin paradigm using FIWARE software building blocks. Central in the vision, the NGSI-LD API is proposed as an open standard API for getting access to digital twin data and the use of standard data models is promoted to ensure the portability and replicability of solutions. (https://www.fiware.org/marketing-material/fiware-for-digital-twins/) | FIWARE |
| iSHARE | iSHARE is a coherent model ("Trust Scheme") of functional, technical, and legal agreements and standards used in the Dutch transport and logistics sector to exchange data. (https://ishare.eu/) | iSHARE |
| IDS Reference Architecture Model 4.0 | The IDS RAM contains the conceptual level, including technology-agnostic specifications. The general outline of the IDS RAM is based on the five layers and the three perspectives. Each layer should reflect the main components and aspects of the IDS. (https://www.fraunhofer.de/content/dam/zv/en/fields-of-research/industrial-data-space/IDS-Reference-Architecture-Model.pdf) | IDSA |

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| Minimum Viable Data Space (MVD) | A minimum viable data space (MVDS) is a combination of components to initiate a data space with just enough features to be usable for secure and sovereign data exchange, as specified by IDSA. (https://docs.internationaldataspaces.org/knowledge-base/mvds) | IDSA |
| OPEN DEI building blocks catalogue | Repository on GitHub to provide a state of the art of the various building blocks from projects and data-sharing initiatives participating in the OPEN DEI survey. (https://github.com/International-Data-Spaces-Association/Building-Blocks-Catalog) | OPEN DEI |
| Smart Data Models | Smart Data Models is a collaborative program to provide data models for digital twins and data spaces. The SDMs are free and open-licensed, multisector, based on real use cases and adopted open standards, collaborative, at market speed, customisable to local needs and compatible with linked data. (https://smartdatamodels.org/) | FIWARE |
| Technical Convergence Discussion Document | The discussion document is an agile paper that defines a common reference technology framework for creating data spaces. This framework is based on the technical convergence of existing architectures and models for data spaces defined by members of the Data Spaces Business Alliance. (https://data-spaces-business-alliance.eu/dsba-releases-technical-convergence-discussion-document/) | DSBA |
| **Use Cases** | | |
| Catena-X | Catena-X sees itself as a rapidly scalable ecosystem in which all participants in the automotive value chain participate equally. The goal: to provide an environment for the creation, operation and collaborative use of end-to-end data chains along the entire automotive value chain. (https://catena-x.net/en/) | Catena-X |
| Data Spaces Radar | The site gives an outlook on many data space initiatives and use cases, with an indication of maturity. (https://internationaldataspaces.org/adopt/data-space-radar) | IDSA |

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| Data Space Energy Transition | Supply chain management in the energy sector - Energy communities - optimisation of supply and demand/power grid stabilisation - data services and products for renewable energies. (https://gaia-x.eu/wp-content/uploads/files/2021-06/Gaia-X_Data-Space-Energy_Position-Paper.pdf) | Green Data Hub |
| European Health Data Space | The goal is to ensure that natural persons in the EU have increased control in practice over their electronic health data. It also aims to ensure a legal framework consisting of trusted EU and Member State governance mechanisms and a secure processing environment. (https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52022PC0197) | EC |
| Health Data Hub (HDH), France | The Health Data Hub (HDH) is a unique gateway to health data in France. The goal is to improve the quality of care and patient support. The HDH is a platform where pseudonymised health data from different sources is duplicated and made available. (https://www.health-data-hub.fr/) | Health Data Hub |
| I4Trust Data Space Experiments | i4Trust brings a framework that enables the creation of data spaces to exchange digital twin data. Thirty pioneer use cases will be experimented with in domains such as cities, mobility, energy, agrifood, logistics, ports or manufacturing. (https://www.health-data-hub.fr/) | FIWARE |
| Mobility Data Space | The Mobility Data Space is the data-sharing community for anyone who wants to make mobility more eco-, user-friendly, safer, and fair. (https://mobility-dataspace.eu/) | DRM |
| Resilience and Sustainability Data Space | The Resilience and Sustainability Data Space will allow for transparency of the supply chain by early identification of crisis and their effects on supply and production conditions for each individual participant. (https://www.resilience-sustainability-dataspace.eu/about/) | Advaneo RSDS |
| SCSN | Smart Connected Supplier Network (SCSN) is a data standard that makes exchanging information in the supply chain more efficient, allowing companies to share data more easily, quickly, and reliably. (https://smart-connected.nl/en) | TNO |

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| TEHDAS — European Health Data Space | The goal is for future European citizens, communities and companies to benefit from secure and seamless access to health data regardless of where it is stored. (https://www.sitra.fi/en/projects/joint-action-towards-the-european-health-data-space-tehdas/) | Sitra |
| **Organisations and Associations** | | |
| BDVA | With more than 230 members all over Europe, Big Data Value Association — BDVA focuses on enabling the digital transformation of the economy and society through Data and Artificial Intelligence by advancing in areas such as big data and AI technologies and services, data platforms and data spaces, Industrial AI, data-driven value creation, standardisation, and skills. (https://www.bdva.eu/) | BDVA |
| Data Space Business Alliance | Bringing together data providers, users and intermediaries, data spaces are key to driving businesses to extract value from data competitively. With its combined cross-industry expertise, resources and know-how, the Alliance drives awareness, evangelises technology, shapes standards and enables integration across industries. (https://data-spaces-business-alliance.eu/) | DSBA |
| DSC | The Data Sharing Coalition — DSC aims to drive (cross-sectoral) data sharing, under control of the entitled party, by realizing data sharing use cases, enabling interoperability between data spaces, and strengthening individual initiatives. It explores and defines agreements on topics such as technical standards, data semantics, legal agreements, and trustworthy and reusable digital identities. (https://datasharingcoalition.eu/) | DSC |
| FIWARE | Together with its members and partners, FIWARE Foundation drives the definition — and the Open Source implementation — of key open standards that enable the development of portable and interoperable smart solutions and the trusted and effective exchange of data among solutions. (https://www.fiware.org/) | FIWARE |

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| Gaia-X | With Gaia-X, representatives from business, science and politics on an international level create a proposal for the next generation of data infrastructure: an open, transparent, and secure digital ecosystem, where data and services can be made available, collated, and shared in an environment of trust. (https://www.data-infrastructure.eu/) | Gaia-X |
| IDSA | With 140 member companies, the International Data Spaces Association — IDSA aims to develop a reference architecture for international data spaces IDS, including a governance model and adoption strategy. Continue to evolve IDS-based on use cases. Establish IDS as the international standard for data exchange in the economy of the future. And support certifiable software solutions and business models. (https://internationaldataspaces.org/) | IDSA |
| MyData Global | The purpose of MyData Global is to empower individuals by improving their right to self-determination regarding their personal data. (https://mydata.org/) | MyData |
| SITRA | Sitra is a Finnish Fund that is influential nationally and internationally and acts as a think tank, promoter of experiments and operating models and a catalyst for co-operation. They collaborate with partners from different sectors to research, trial and implement bold new ideas that shape the future. (https://www.sitra.fi/) | SITRA |
| Team Data Space | Team Data Spaces brings together the leading European players in data spaces from European associations, industry, and research organisations with a common vision to deliver European data spaces. (https://dataspaces4.eu/) | Team Data Space |