



In-depth look at the data economy

Architecture, Players and Economic benefits of data spaces

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This paper contains the content of the free online course 'In-depth look at the data economy: Architecture, Players and Economic benefits of data spaces' organised by the Gaia-X Hub Germany. It provides interested parties with a basic understanding of the data economy and promotes discourse and the exchange of ideas.

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1. Understanding the architecture of a data space

1.1. From the European data dilemma to common data spaces

In the first three chapters of Course 1, we learned a lot about the data economy: It all started with Europe's big data dilemma. We saw that much of the data generated by companies and organisations remains unused. Legal concerns, technical hurdles, and worries about trade secrets often prevent genuine data exchange—a significant driver of innovation is running on empty. The land of poets, thinkers—and data silos!

The rest of Course 1 looked at the crucial consequences of this dilemma for value creation in the digital economy. We examined why platforms and digital ecosystems from the US and China are setting the pace, while European companies with individual IT systems and strict data protection regulations are often left behind. We asked ourselves: How can Europe regain sovereignty and competitiveness without individual companies losing control over their data?

Finally, in chapter 3, we took a first look at the concept of the data ecosystem. We learned that sustainable innovation and flexible cooperation arise when organisations do not just hoard their own data but share it with partners in a targeted and secure manner. However, one question remains: How can this exchange really succeed in a way that benefits *everyone* involved, ensures that no one loses control over their data, and organizes new value creation in a secure and legally sound manner?

1.2. Vision becomes reality – the need for new approaches

This is precisely the area that Course 2 covers. In the next step, we will focus establishing the foundations for a genuine European data economy. The vision of a sovereign, flexible, and fair data exchange is becoming a reality – with a new approach: decentralization.

What does that mean? While central platforms bundle all data in one place, decentralized data spaces create networks that leave data exactly where it originates: in smart companies, organisations, and public authorities. Control remains with the owner; data is only made accessible according to verifiable rules. Sounds abstract? Let's take a look at how this works in practice. At the centre is AITrainee, a fictional young company with big ambitions.

Imagine you are a decision-maker at AITrainee, a young company that wants to develop AI to analyse mobility data. However, every beginning is difficult: the necessary data is scattered across many organisations, each player speaks its own "data language," and before any data can flow, numerous contracts must be signed, interfaces programmed, and approvals obtained. It often takes more than a month just to onboard a new data partner. Many companies are familiar with this experience: access to data usually fails not due to a lack of willingness, but due to technical complexity, legal issues, and a seemingly endless coordination efforts.

What if all these hurdles could be overcome with the help of a trustworthy, flexible infrastructure?

This is precisely the concept behind a data space. The focus is on decentralization rather than the central platform as the new authority. But how does this work in practice and from a technical perspective?

The dilemma of individual networking and the move into the data space

Imagine that AITrainee had to negotiate separate data usage agreements with every city and every transport company. That would be like having to develop an individual ticket and a new ticket system for every new bus route in a large city – a huge obstacle to innovation.

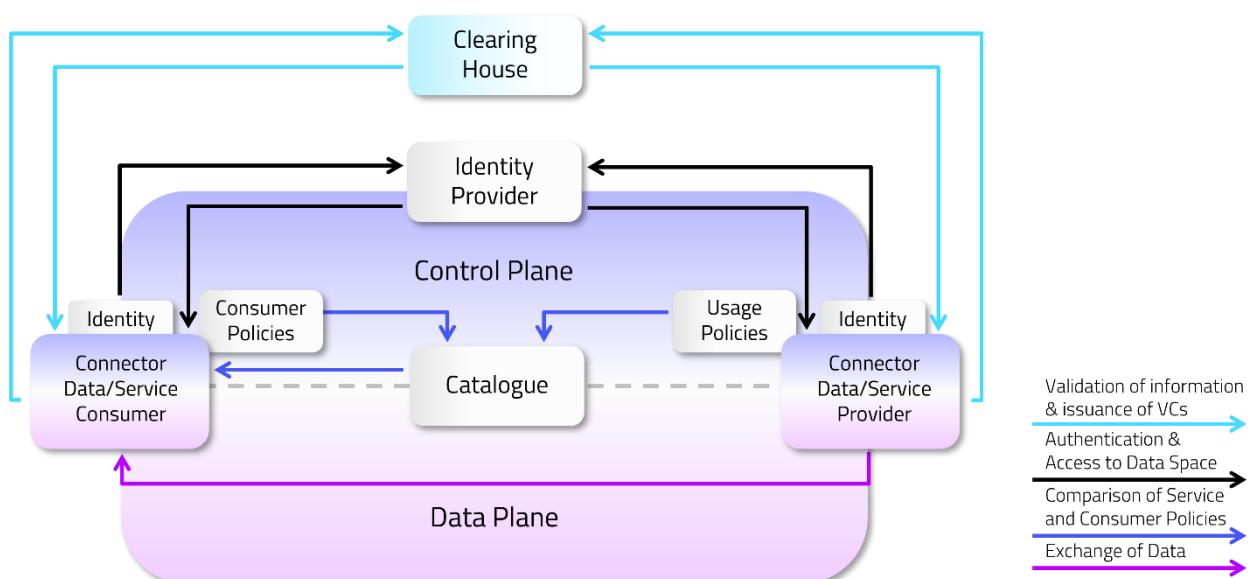
At this point, AITrainee makes a decision: instead of building individual solutions and silos, the company joins a decentralized data space. The goal is to make sharing and using data as easy as possible through common technical standards and automated rules.

1.3. Step by step: AITrainee on its way through the data space

When we look at AITrainee's journey to the data space, we follow a clearly structured process that reveals the central technical building blocks and processes step by step. Each of these steps is an indispensable piece of the puzzle that together forms the picture of a secure, controlled, yet flexible data exchange in a decentralized environment. From the initial connection to the actual data transfer, trust, security, and automation are at the forefront. These building blocks ensure that AITrainee not only gains access but also retains control over the data flow at all times.

Below, we accompany the company through five key stages: setting up the connector, digital identity verification, searching for and selecting suitable data in the catalogue, automated contract verification through policies, and finally, secure, logged data transfer.

Each step builds on the previous one and opens new doors in the world of sovereign data economy – without unnecessary effort or risk. This makes the complex process clear and understandable.



Source: Gaia-X Hub Germany, 2025

1. Getting started with the connector: The multifunctional entry point

Right from the start, AITrainee realizes that nothing works without a connector. The connector is a lean, highly secure piece of software that is installed on the company's own network. It acts as both a digital door opener and a firewall.

There is no universal connector, but rather a variety of different solutions and implementations. Depending on the data space and its requirements – such as security, data formats or governance – different connectors can be used to meet the respective technical and organisational standards.

AITrainee uses the connector not only to communicate with other data space users, but also to negotiate formats, check security requirements, and ensure compliance with defined rules – all automatically. In practice, this means that configuring a connector is much less time-consuming for AITrainee than developing individual interfaces for each partner, as current connectors are based on established and open standards, thus ensuring interoperability and security. This diversity enables the company to connect flexibly to different data spaces – each adapted to industry-specific or project-specific requirements.

The [Data Connector Report published by the International Data Spaces Association \(IDSA\)](#) provides an overview of the wide range of connectors available. This annual overview lists current data space connectors and provides detailed information on the respective data exchange standard, as well as application examples.

Although it may sound technical, it offers many advantages in everyday business life: Connectors are often designed to be easy to use, even for non-IT professionals, but offer all the security features that a modern company expects on the IT side.

2. The digital ID card: authentication & identity in the data space

However, the connector alone is not enough. The data space also requires a digital "business card presentation". This is exactly what identity providers do. AITrainee must prove that it is a trustworthy company and that it meets certain requirements, for example regarding data protection or industry-specific standards. We can find such a concrete list of requirements in the [Gaia-X compliance criteria for cloud services](#), for example. Proof of compliance must be provided for each of the various cybersecurity criteria.

This evidence is no longer emailed as PDF but provided digitally as *verifiable credentials* (VCs) – these are digital, machine-readable certificates that can be issued by trusted entities, known as Clearing Houses, and can get automatically verified. Digital Clearing Houses are usually operated by external service providers. You can read about their role and how they work in detail in our [blog series on Gaia-X Digital Clearing Houses](#).

Once identity has been successfully verified, AITrainee gains access to further services and offers in the data space. This step establishes the groundwork: only legitimate and verified actors are granted access to sensitive data and valuable services. This foundation also establishes trust between unknown actors, thereby encouraging exchange between them.

3. The catalogue – the marketplace for data and services

Once the first two steps have been completed, AITrainee can now browse the central data space catalogue, which functions like an intelligent industry directory. This shows which data sets and services are currently available: from real-time traffic data and environmental information to specialized processing services such as anonymization. Thanks to detailed filter functions, the company can search very precisely for the characteristics its AI needs for training – for example, "anonymized data, collected in Europe, updated within the last six months."

The same catalogue can also be used to book an anonymization service for a dataset that has not yet been anonymized, for example – everything is integrated and transparent.

4. Usage policies and contract conclusion: clear, digital, traceable

Now it's getting specific: AITrainee has decided to use the datasets in the data space and describes its own requirements in so-called *consumer policies*:

- The data must originate in Europe.
- AI training is permitted with the data.

Providers, in turn, are free to define their own usage rules – such as "data access only from the EU" or "processing exclusively in certified data centres." The system automatically checks whether supply and demand match and creates a digital contract ("smart contract") that is legally binding and machine-readable.

Key takeaway: The entire process, which would previously have taken weeks, is now automated, fast, and secure. With just a few clicks, AITrainee can compile multiple matching datasets for AI training without having to renegotiate with each provider individually.

5. Secure data transfer: When bits and bytes travel confidently

Once all checks and agreements have been completed quickly and automatically, the most important step follows: the actual data exchange. Here, the connector once again ensures transparent and secure data traffic. Every transfer is encrypted, and every access is logged, so the provider can always see when, where, how, and by whom the data was accessed.

AITrainee no longer need to worry about manual security checks or technical integration efforts. Time that used to be spent on maintaining dozens of individual solutions can now be devoted to actual innovation work.

1.4. Architecture with a principle: control plane and data plane

What appears to be a uniform process follows a sophisticated architectural principle behind the scenes: the separation into a control plane and a data plane.

Let's imagine a modern airport:

- In the control plane, all flights are registered, passengers and luggage are checked, and takeoff and landing times are coordinated. No one flies without everything being checked.
- In the data plane, the aircraft takes off from the runway and transports people and cargo exactly where they need to go.

Applied to the data space, this means:

- Control plane: All processes related to registration, identity verification, catalogue search, contract formation, and rule monitoring take place here. It ensures clarity, control, and transparency without storing any data itself.
- Data plane: This is where the actual data exchange takes place. Selected information and services are transferred in an encrypted and controlled manner between data owners, who retain full control at all times.

Looking beyond the horizon: Additional functions for special requirements

For most companies, the process described here is perfectly adequate. However, depending on the use case and regulatory requirements, additional modules may be useful – such as the integration of consent management for personal data or the creation of a participant register in very large data spaces. For AITrainee, the basic model is sufficient for working directly and securely with the relevant partners.

1.5. Reflection & outlook: what have we learned?

Thanks to the intelligent combination of connector, identity verification, catalogue, policy management, and secure data transfer, AITrainee not only gains access to urgently needed training data for its own AI—the company also retains control at all times and knows the rules, and who it is working with.

And what about you? How would your company benefit if all the formalities involved in data exchange were minimised? What data or services could you provide within such a framework?

In the next section, we will take a closer look at these questions: Who are the stakeholders in the data space? How do governance and collaborative rules emerge? And which models enable not only data but also value and responsibility to be shared?

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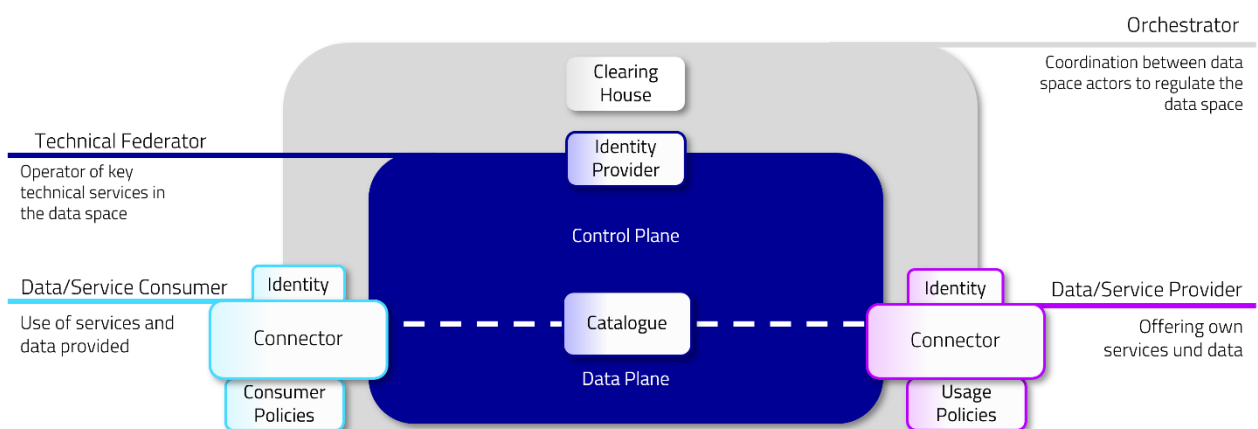
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2. Players and their roles in the data space

We have learned about the technical architecture of a data space – but technology alone does not make a functioning marketplace. A data space is more than the sum of its technical components; it is a living ecosystem comprising people, organisations and business relationships. Who are the players that bring this system to life? What roles do they play, and how do individual interests lead to shared success?

These questions lead us to the organisational level of a data space—the level that determines who can participate, what rules apply, and how all participants can fairly take part in value creation. This is where it becomes clear why data spaces are not just a technical innovation, but also a new model for economic cooperation.

2.1 Overview of the most important roles



Source: Gaia-X Hub Germany, 2025

A data space is an interactive network with different participants. Within this network, not only data but also services are consumed and provided. As a result, organisations participating in a data space often take on many different roles. This interaction gives rise to the following key roles in the data space:

- **Data provider:** Makes its own data available to others in the data space. For example, a sensor manufacturer that feeds in machine data.
- **Data consumer:** Uses external data, raw or structured data, or datasets from another actor to improve internal processes, enrich products, or gain new insights. Example: A logistics company imports traffic data to optimise routes.
- **Service provider:** Develops and offers data-based services, e.g., an AI provider that has built data analysis services.

- **Service consumer:** Accesses ready-made services that have often been developed based on shared data, e.g., an AI service for production optimization. The user receives insights, forecasts, or tools directly, but not the raw data itself.

Innovative business models often emerge at the service level. Those who consume data need precise quality and licensing rules. Additionally factors such as support, further development and integration often come on top.

Federators and orchestrators play a special role: they ensure that the data space functions as a whole. Unlike providers or consumers, they typically have no direct commercial interest in the exchanged data, instead focusing on operating and further developing the infrastructure.

- **Federator:** This actor ensures that central technical services in the data space function reliably. These include authentication, data catalogues, protocol translators, and interfaces. The federator enables and facilitates data exchange without becoming an exchange partner itself.
- **Orchestrator:** The orchestrator has a coordinating function. Its role is to ensure that all relevant actors in the data space jointly make and implement important decisions regarding the data space. For example, it convenes committees in which decisions are made about the rules of the data space. Its most important task is to balance interests and ensure that all actors participate fairly and that no individual players dominate. The orchestrator has a neutral role and acts as a mediator.

Why are neutral federators and orchestrators necessary at all? In a decentralized system where many equal players work together, a coordinating authority is needed to ensure order and fairness. Orchestrators prevent individual powerful players from dominating the data space to their advantage – a risk that quickly arises in the data economy. This is precisely why federal, community-based models are so central in Europe.

The reality of the universal role

In practice, most participants in a data space take on several roles at the same time. This is not only normal, but even desirable, as it creates a balance of interests and prevents one-sided dependencies.

Let's consider the participation of an automotive company in [the Mobility Data Space](#): As a provider, the company makes vehicle location data and battery status available. At the same time, it uses weather data, traffic information, and charging station availability as a consumer. In this dual role, the company acts as a partner in the ecosystem – it gives and takes in different forms.

The ability to take on different roles in the data space – even simultaneously – opens valuable opportunities for companies to gradually expand their own offerings. Those who act flexibly can, for example, initially provide their own data and thereby gain insights into the requirements of other participants. At the same time, they can supplement their own services or data in a targeted manner by using relevant offerings from other players. This creates a continuous learning process: Companies not only expand their network and product portfolio but also develop a deeper understanding of the dynamics of the data economy. With each step, new opportunities for cooperation and innovative business models emerge, enabling companies to actively shape and further develop their path into the data economy.

Dynamic role changes

Things get interesting when companies dynamically change their roles depending on the situation and their needs. For example, a logistics company is normally a consumer of traffic and weather data. However, during a natural disaster, it could become an important provider by sharing its real-time information on passable routes with emergency services.

This flexibility in roles is a characteristic of successful data spaces. It shows that data spaces are not static marketplaces but living ecosystems that can adapt to changing circumstances.

2.2 Governance – the organisational level

Who makes the rules?

The governance of a data space encompasses all mechanisms that determine how decisions are made, rules are established, and conflicts are resolved. This organisational level is just as important as the technical infrastructure, because it determines whether a data space remains successful and trustworthy in the long term.

Governance structures vary depending on the data space, but are always based on principles such as transparency, legitimacy, and efficiency. Important decisions are made jointly by the participants, often in specialized committees or working groups. Larger or strategically important partners may have more voting power, but no single actor can dominate the data space. A central organisation (orchestrator) is often established to play a special role in governance. This can be structured and organised in various ways. For example, it can be an association or a public-interest limited liability company. Various stakeholders can be involved in this organisation. These may include the key players in an industry, or a neutral organisation that mediates between them.



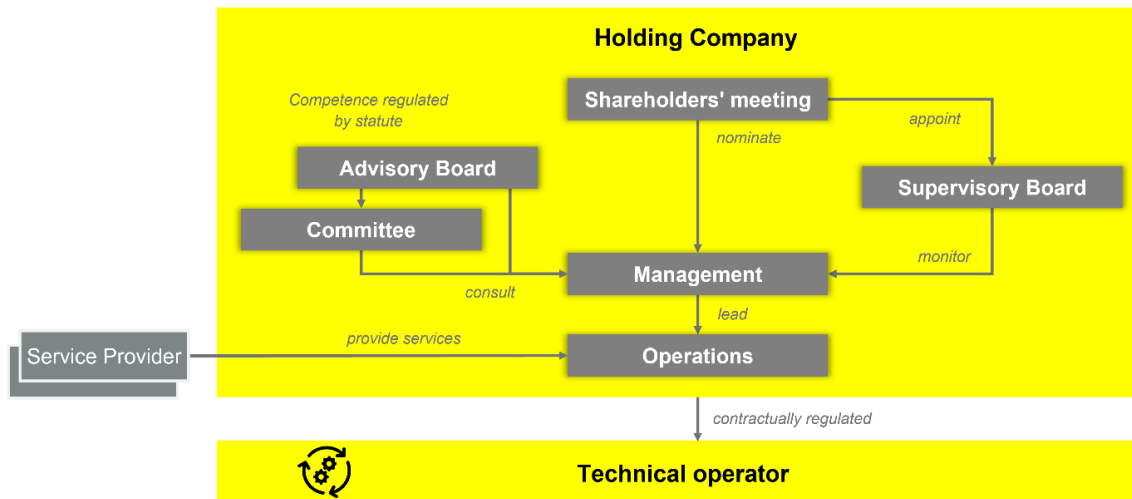
If you would like to learn more about governance, read our [white paper Governance of Data Spaces](#).

Governance example: the [Mobility Data Space](#)

The governance structure of the Mobility Data Space (MDS) ensures that strategic decisions are made transparently and in a balanced manner in the interests of all participants. At the centre is DRM Datenraum Mobilität GmbH as the operating company (orchestrator), whose majority shareholder is the German Academy of Science and Engineering (acatech). The neutral sponsorship by acatech as an independent and impartial institution is a key factor in its success. It ensures that the diverse interests of the participants – from automobile manufacturers and suppliers to research institutions and public institutions – are given equal consideration. This independent position enables acatech to make objective and long-term decisions that promote the development of a trusting ecosystem and ensure the sustainable operation of the data space.

The shareholders' meeting is the central body responsible for managing the organisation and, in addition to acatech, consists of a broad spectrum of companies from the mobility sector and related fields, including Deutsche Bahn AG, Volkswagen AG, Deutsche Post DHL Group, and public actors such as the federal states of Bavaria, Baden-Württemberg, and North Rhine-Westphalia. The distribution of votes in the meeting is based on the size of the company shares, which enables representative and balanced representation of interests. The meeting elects both the supervisory board and the advisory board, which perform advisory and monitoring functions. The supervisory board monitors the management and compliance with the company rules while the advisory board provides support.

The role of the technical operator (federator), who is responsible for the stable and secure operation of the data space infrastructure, is also clearly defined in the contract. The technical operator's tasks include both the operation and further development of the technical components and are essential for the scalability and reliability of the data space. The interaction between a neutral shareholder, structured committees, and a reliable technical operator creates a governance system that ensures transparency, fairness, and the avoidance of dominance by individual players. This lays the foundation for an open, trustworthy, and sustainable data economy in the mobility sector.



Source: Mobility Data Space, 2025

Development of common standards

Common standards are developed in an iterative process between technical working groups and practical use cases. This involves not only technical specifications, but also semantic standards: How are data formats defined? What metadata is required? How are quality levels measured and communicated?

This standardisation process is complex, but crucial for success. Only when all participants speak the same "language" they can work together efficiently. At the same time, the standards must be flexible enough to enable innovation and new use cases.

2.3 Business models in data spaces

Data spaces create the basis for new, sustainable business models in which companies can achieve economic added value not only through the ownership of data, but above all through its intelligent linking, use, and trading of data and services. It is important to emphasize that data spaces can be used to generate revenue not only from data itself, but also from data-based services – that is to say, digital services that create new benefits from data and offer these as added value on the market. These are based on the premise that value is not only created by owning data, but also by intelligently linking and using it.

Typical data-based service business models include, for example, AI-supported analysis or diagnostic services, automated decision-making aids, platforms for legally compliant data exchange, or marketplaces for data products and services. Data spaces thus open up a wide range of monetization opportunities: from directly marketing of raw data to developing and distributing highly specialized, data-driven services.



If you would like to learn more about business models, read our white papers [Gaia-X and Business Models: Types and Examples](#) or [Gaia-X and Business Models: EuProGigant as a Case Study for Industry 4.0](#).

From cost savings to new business areas

Participating in a data space is interesting for companies if they are aiming to save costs through more efficient processes, reduced waste, and optimized warehousing. This is a legitimate and important starting point, but the real potential lies in the development of completely new business areas.

For example, a mechanical engineering company might discover that its operating data, when combined with environmental data, provides valuable insights for sustainability consultancy. This means that the original machine manufacturer can also offer environmental consulting services – a business area that would not have been possible without access to data.

From closed chains to open networks

In traditional value chains, value is created linearly and often within a closed system. Data spaces break this pattern: they enable flexible, decentralized networking – value is no longer created at individual points, but continuously within the network of participants. Existing silos are broken down, and data and services from different providers can be brought together according to clearly defined, trustworthy rules. Companies can contribute to the value chain based on their core competencies – from data generation and analysis to the development of data-based services.

Monetization and revenue models

The central question is: How can value be created and monetized in the data space? There are many ways to generate income in data spaces. The range of potential business areas is so wide that it is almost impossible to provide a complete overview. However, one possible approach to illustrate this would be to structure examples based on different roles:

- 1. Data generation and provision:** Companies provide their own data as products or raw materials and receive direct, usage-based, or subscription-based revenue. The market value is determined by the quality, timeliness, or uniqueness of the data.
- 2. Data processing and data-based services:** The greatest added value often comes from the use and intelligent linking of data. Companies can develop data-based services – such as AI-supported diagnostics, forecasts or process optimizations – and sell these as a service (e.g., as a subscription or pay-per-use).

- 3. Operating and orchestrating:** Operators or orchestrators of data spaces provide the infrastructure and ensure security, standardisation, onboarding, and governance. They generate revenue through membership fees, platform fees, or additional services (e.g., certification, data quality services).

Important: According to the provisions of the [Data Governance Act](#), orchestrators are generally not allowed to operate on a for-profit basis but primarily generate revenue to cover their costs.

The special feature of the data space model is that value no longer arises solely from the ownership of data, but from its combined and context-related use. The business models are thus far more dynamic and open to innovation than in traditional platform structures.

Practical examples from the German Gaia-X funding competition

Four selected examples from the Gaia-X funded projects in Germany show how diverse and feasible these new business models are:

Car repair 4.0

- **What?** Medium-sized workshops provide diagnostic and fault data in the data space. On this basis, service providers develop AI-based services for more precise fault predictions and more efficient maintenance planning.
- **How?** The services are offered as a subscription or pay-per-use. The car repair shops benefit from better diagnostic options, save costs, and can monetize their data in a targeted and controlled manner. Service providers gain access to high-quality training data and can use it to develop innovative products.

EuroDaT

- **What?** EuroDaT acts as a neutral data trustee. Companies, public authorities, and research institutions can exchange and evaluate highly sensitive data in a legally compliant and anonymized manner.
- **How?** Funding is provided by usage fees that cover operating costs. Surpluses are used to expand the infrastructure and develop new use cases. EuroDaT thus serves as *an independent enabler* of complex, data-driven business models, especially for sensitive or legally protected data.

iECO

- **What?** The iECO data space offers numerous data-based services for the construction industry – from planning tools and construction progress monitoring to asset tracking. Various companies network, exchange data, and offer specialized services.

- **How?** Monetization is achieved through pay-per-use fees for special services, onboarding or transaction fees. The data space serves as a shared marketplace where data providers, service providers and consumers can jointly test and scale new digital business logic.

MERLOT

- **What?** The MERLOT educational data space brings schools, students, course providers, and companies together. They exchange quality-assured data via the data space and enable AI-supported education and career assistants.
- **How?** Funding comes from membership fees (e.g., for schools/institutions), various subscription models for companies, and technical integration services. AI providers book prominent placements on the marketplace, and companies pay fees for access to talent and educational data.



If you would like to learn more about the funded projects, read our report on the Gaia-X funding competition [Business Models with Data Spaces: Examples from the Gaia-X Funding Competition](#).

2.4 Conclusion

A data space is much more than its technical infrastructure – it is a living, dynamic ecosystem supported by the interaction of diverse roles and players. The ability to take on different roles flexibly and situationally promotes innovation and new business models. Organisational governance forms the backbone, ensuring long-term trust and sustainable success through transparency, fairness, and neutral orchestration. With clear rules, common standards, and an open, cooperative structure, a data space not only enables more efficient processes but also opens up completely new value creation potential – from data-based services to innovative operating models. The result is a future-proof data economy that enables companies to actively and confidently participate in digital transformation and develop new business areas.

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3. From data spaces to data ecosystems – The Gaia-X vision

We now know who the players are and what their roles are in data spaces. But what does this cooperation look like in practice?

In this lesson, you will learn how data spaces can become a coherent European data ecosystem that strengthens the competitiveness of the entire continent.

3.1 The interoperability problem

Why data spaces do not automatically work together

The need for data exchange is leading to the establishment and testing of data spaces in many industries. For example, the Mobility Data Space was developed for the mobility industry and Manufacturing-X for the manufacturing industry. A European Health Data Space is also currently being set up for the healthcare sector. Each data space should precisely meet the specific industry requirements in order to optimally support the respective use cases. For this reason, companies often develop their own standards, technical specifications, and governance structures that are specifically tailored to the needs of their industry.

For example, an automotive company in the Mobility Data Space needs real-time data on traffic conditions and charging infrastructure. A mechanical engineering company in Manufacturing-X, on the other hand, is interested in production capacities and quality data. These different focal points lead to specialized solutions that work optimally in their domain.

But as soon as companies start operating across industries, things get a little more complicated: A logistics company that wants to use both vehicle data and production data would have to register in different data spaces, implement different technical standards, and go through separate governance processes. This leads to the paradoxical situation that data spaces – although they are supposed to break down silos – could create new silos between industries.

That is why common standards for data spaces are needed. Without them, the various data spaces could develop so differently that they are no longer compatible. Imagine: The Mobility Data Space uses one identity system, Manufacturing-X uses another, and the European Health Data Space uses a third. A company that is active in all three areas would have to manage three different digital identities and go through three separate compliance processes.

3.2 Gaia-X as a European framework

The vision of an interoperable ecosystem

This is where Gaia-X comes in – as an overarching framework for a European data ecosystem. Gaia-X creates the common standards and rules that enable different data spaces to work

together seamlessly. The aim is to ensure basic interoperability between all data spaces without restricting their specific requirements.

The role of the Gaia-X Association

The Gaia-X European Association for Data and Cloud AISBL coordinates and regulates the Gaia-X initiative as a neutral body for the community: it defines and develops the technical and organisational rules and standards but does not itself act as an operator of data spaces. This role has been deliberately chosen: Gaia-X is not intended to become a "European hyperscaler" competing with American or Chinese platforms. Instead, Gaia-X promotes a network that optimally leverages the strengths of the European economy – diversity, specialization, and small and medium-sized enterprises.

Gaia-X AISBL brings together over 300 members from business and science to drive the strategic development of the European data ecosystem. Unlike traditional standardisation organisations, the impetus comes directly from the field: companies that are already setting up or using data spaces contribute their experience. This ensures that the standards remain applicable and realistic.

This bottom-up development is the key to success. Instead of theoretical standards developed in ivory towers, solutions are created that must prove themselves in practice.

The role of the Gaia-X hubs

The Gaia-X hubs play a central role in this: they serve as contact points for interested parties in each country, providing information, networking, and support for the implementation of data space projects. More than 25 Gaia-X hubs in various countries coordinate the user community in their respective regions—including outside the EU, for example in Japan and South Korea.

The Gaia-X Hubs



Source: Gaia-X European Association for Data and Cloud AISBL, 2025

The international dissemination and networking provided by the Gaia-X hubs is crucial, as European companies operate globally and need suitable data infrastructures. A German mechanical engineering company that operates plants in Asia must be able to exchange data between continents. Gaia-X is creating the standards that will enable such global data exchange to take place securely and efficiently.

The development of an international clearing house landscape is particularly exciting. Gaia-X Digital Clearing Houses serve as *clearing houses* for all Gaia-X data spaces. They check who is allowed to be part of Gaia-X. Various information and telecommunications technology (ITC) companies have already launched clearing houses, including Aruba in Italy, NTT Data in Japan, T-Systems and DeltaDAO in Germany, and Aire Networks and Arsys in Spain. Other providers intend to follow suit, thereby strengthening the decentralized and resilient infrastructure.

3.3 The trust framework as a common basis of trust

At the heart of Gaia-X is the trust framework – a system of standards and procedures that enables automated trust between different data spaces. It solves a fundamental problem of the digital economy: How can trust be established between members of organisations who may never meet in person? As a reminder from [Course 1](#), we have already learned how Gaia-X Digital Clearing Houses function as trusted entities and how participant credentials create trust. These mechanisms are now being taken to a new level: they enable trust not only within a data space, but also between different data spaces.

With the [Gaia-X Trust Framework](#), Gaia-X also provides open-source components and compliance mechanisms that can be used not only for Gaia-X data spaces, but also for other data space initiatives. They promote technical and organisational interoperability between different data ecosystems.

The trust framework is based on three pillars: uniform identity standards, standardized conformity testing, and interoperable data formats. This common basis allows companies to register once and then operate in different data spaces without having to go through new identity checks or compliance procedures each time.

Let's consider a medium-sized mechanical engineering company that wants to optimize its production processes while also verifying and reducing its carbon footprint. Thanks to Gaia-X interoperability, it can use data from different data spaces without having to register multiple times or implement different technical solutions.

From the Manufacturing Data Space, the company then receives, for example, anonymized production data from similar companies for benchmark analysis, quality data from suppliers for incoming quality control, and information about available production capacities in the region. The Energy Data Space also provides real-time electricity prices for the optimal planning of energy-intensive processes, forecasts on renewable energies for CO₂-optimized production, and information on available energy storage capacities. And the Mobility Data

Space provides optimized transport routes for logistics, availability of electric trucks and charging infrastructure, and real-time traffic data for delivery planning.

Automated integration through common standards

Without Gaia-X, the mechanical engineering company would have to negotiate individual contracts with dozens of data providers, implement various technical interfaces, carry out complex security checks for each partner, and manage different billing systems. With Gaia-X standards, the company registers once via a Gaia-X Digital Clearing House, receives participant credentials that are valid in all data spaces, uses standardized interfaces for data access, and relies on uniform security and quality standards.

Gaia-X is also strongly aligned with other existing, internationally recognized standards and certifications such as ISO, ETSI, and DIN. The aim is to ensure maximum interoperability, security, and compliance without creating separate, isolated standards. Instead, established standards are used as a basis and supplemented by Gaia-X-specific requirements where necessary.

One of the most important external standards and certifications that Gaia-X recognizes and uses as a basis for its compliance is, for example, ISO/IEC 27001, the international standard for information security management systems (ISMS). Another is DIN SPEC 2707, the specification for security gateways in an industrial context. It was developed in close coordination with the Gaia-X Association and is intended as a mandatory standard for secure data spaces and data sharing components. In addition, the Gaia-X Association has worked on the compatibility of the trust measures of CEN (Comité Européen de Normalisation) and CENELEC (Comité Européen de Normalisation Électrotechnique): since spring 2025, the Gaia-X design principles can be found in the CEN/CENELEC Trusted Data Transaction (TDT).

Gaia-X thus focuses specifically on established standards to ensure security, interoperability, and compliance in European data infrastructures. The standards mentioned above form the backbone for the technical and organisational design of Gaia-X services.

The added value of data linking

The decisive factor is the added value created by linking different data sources. Individual data points are often of limited value but combining them can provide completely new insights. The mechanical engineering company could, for example, discover that certain weather conditions affect the quality of its supplies, or that energy prices and traffic conditions together determine the best production and delivery times.

Such synergy effects only arise when data from different industries can be linked smoothly. Gaia-X's vision is to create the technical and organisational conditions for this without restricting the autonomy of individual data spaces.

3.4 Data space initiatives working together

The Gaia-X Association works closely with other European and international data space initiatives. It sees itself as *an enabler* for a connected, interoperable ecosystem of sovereign data spaces. The Gaia-X Association actively collaborates with other initiatives such as the International Data Spaces Association (IDSA), the Big Data Value Association (BDVA), the FIWARE Foundation, and the Data Space Support Center (DSSC). In addition, it has founded the Data Spaces Business Alliance (DSBA) together with IDSA, BDVA, and FIWARE to coordinate all activities of the initiatives. The aim is to develop common standards, technologies, and governance models that enable secure, interoperable, and sovereign data exchange between different data space solutions. The initiatives complement each other by focusing on different areas. The Gaia-X Association focuses on the development of trust rules and has created the Gaia-X trust framework for this purpose. In addition, the Gaia-X Association provides open-source components and compliance mechanisms that can be used not only for Gaia-X's own data spaces, but also for other data space initiatives. In this way, it promotes technical and organisational interoperability between different data ecosystems.

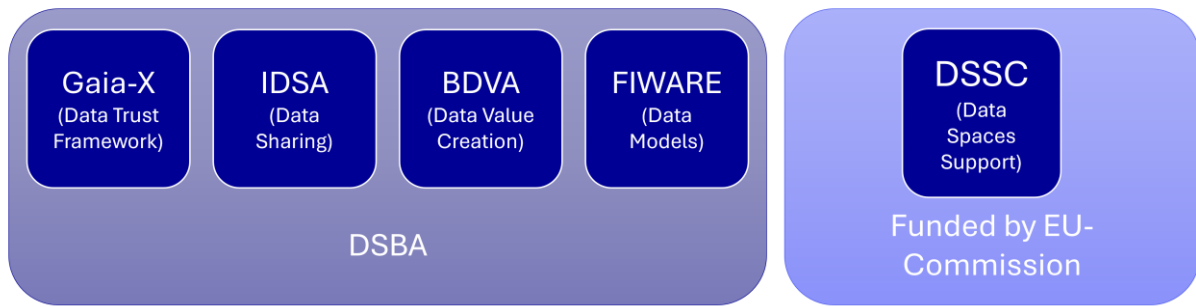
The development of general and common standards for the various data space initiatives is intended to ensure that a data space based on Gaia-X standards is also compatible with other data space standards, such as those of the IDSA. This will remove further barriers to interoperability between data spaces. Here is a brief overview of the most important data space initiatives:

The [International Data Space Association \(IDSA\)](#) is a non-profit association that promotes secure and sovereign data spaces. With over 160 member organisations from more than 30 countries, the IDSA is developing the technical foundations of data spaces. The IDSA defines reference architectures, functional requirements, and technical standards for the creation of data spaces, as well as a protocol for the effective management of data flows that are compatible with Gaia-X.

The [Big Data Value Association \(BDVA\)](#) is a key partner in defining requirements and use cases for cross-sector data spaces, particularly in the areas of big data and artificial intelligence (AI). The association focuses on the further development and promotion of areas such as big data technologies and services, data platforms and data spaces, industrial AI, data-driven value creation, standardisation, and skills.

The [FIWARE Foundation](#), a non-profit organisation, provides a framework of open-source software platform components. These components can be used together with others from third-party providers to build data spaces.

Data space initiatives in synergy



Source: Gaia-X Hub Germany, 2025

The [Data Spaces Business Alliance \(DSBA\)](#) brings together leading European organisations, including Gaia-X, the IDSA, the BDVA, and the FIWARE Foundation. The goal is to collaboratively develop data spaces. Together, they want to create a coordinated framework and international standards for sovereign and interoperable data sharing.

The [Data Spaces Support Centre \(DSSC\)](#), funded by the EU Commission, coordinates the harmonization and scaling of European data spaces. The initiative works closely with Gaia-X and other initiatives to develop reference architectures, minimum requirements, and governance models. These are intended to ensure the technical and organisational compatibility of data spaces. In addition, the DSSC has created a support platform that facilitates the establishment and operation of interoperable data spaces. The so-called [DSSC Building Blocks](#) break down data spaces into manageable components and can be used as a blueprint for setting up a data space. They serve as basic building blocks that can be implemented and combined with other building blocks to achieve the functionality of a data space.



If you would like to learn more about the various data space initiatives, please read our [fact sheet on data space initiatives](#).

Common European Data Spaces as a strategic initiative

The European Union has recognized the strategic importance of interoperable data spaces and, in addition to the Data Spaces Support Centre, is also promoting the establishment of *Common European Data Spaces* in various areas. This initiative aims to put the standards and technologies already developed for data spaces into practice and to create a European data infrastructure that can compete with non-European systems.

Common European Data Spaces are planned for the healthcare sector ([European Health Data Space](#)), mobility ([European Mobility Data Space](#)), industry ([!\[\]\(d415b5172fecdbaea44b7ff6524f4d79_img.jpg\) Campus: Course 2/2025](https://manufacturingdataspace-</p></div><div data-bbox=)

[csa.eu/](#)), energy (European Energy Data Space), finance ([European Financial Data Space](#)), and agriculture ([Agricultural Data Space](#)), to name a few.

The funding for European data spaces builds on Gaia-X and other data space initiatives. The aim is to anchor existing data space standards and initiatives in specific industry applications.

In the long term, the Common European Data Spaces will grow together to form a networked, interoperable data ecosystem. The aim is to strengthen innovation, artificial intelligence, and digital sovereignty in Europe.

Data Act promotes data space initiatives

The EU Data Act, which will come into full effect in September 2025, emphasises the importance of data spaces. Its purpose is to promote data exchange within the EU. Under certain conditions, the law obliges companies to share data. For example, manufacturers must make usage data of their devices accessible to users. For many manufacturers and service providers, this brings new obligations, but also opportunities. The act allows organisations to open to new technologies and fuels the development of data spaces, because data spaces offer the opportunity for organisations to fulfil the requirements of the Data Act in a structured and legally compliant manner. Data spaces thus not only ensure secure data exchange, but also compliance with EU legislation.



If you would like to learn more about the Data Act, read our [blog article on the Data Act: No more data silos: The EU Data Act enforces digital openness](#).

3.5 The path from strategy to practical implementation

The vision for the European data ecosystem is clearly defined, and the technical foundations have been laid. In addition to developing trust rules (Gaia-X trust framework), Gaia-X is also creating interoperability between data spaces, thereby enabling cross-industry innovation and value creation. Successful data space projects demonstrate how the technology works and what concrete benefits it brings. The European Commission supports this endeavour through initiatives such as the Common European Data Spaces and through regulations such as the Data Act.

So, how can your company become part of this European data ecosystem? What practical steps can you take immediately, and how can you prepare for the Data Act's requirements? In the next and final lesson of our course, you will learn how to turn this vision into reality, discovering specific recommendations to help you seize the opportunities offered by the European data economy.

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4. 4. Your path to the data space economy

4.1 Why a data space at all? – A differentiated approach

Many companies today are rightly asking themselves: Do we really need our own data space, or is the classic bilateral exchange sufficient? From discussions with executives, IT managers, and innovation managers, we know that true data economy is more than just a tool for sharing: It's about long-term competitiveness, flexibility, and the conscious use of resources and potential.

Traditionally, data exchange often takes place directly between two parties – for example, set up as an individual interface or a one-off project with a partner. But while this model has proven itself for individual use cases, it quickly reaches its limits: anyone who wants to cooperate with many partners or implement dynamic use cases – i.e., changing use cases – quickly loses track of the big picture with the bilateral approach. It is not uncommon for new isolated solutions to emerge that generate high IT costs in the long term, make data protection difficult to understand, and slow down innovation.

This is precisely where data spaces offer a decisive advantage: they structure the exchange and management of data in such a way that many parties can come together under clear, automated rules. This enables the transition from short-term individual projects to a sustainable – i.e., long-term viable and future-proof – position in the data economy. The move to the data space is usually not an end in itself, but rather a response to the actual requirements of a digitally networked market: realising new business models, securing international value creation, or scaling innovation processes.

4.2 The core reasons for data spaces: sovereignty, compliance, efficiency, innovation

Sovereignty – control and independence

Data spaces give a company the opportunity, for the first time, to handle data with real flexibility without having to relinquish control to third parties. Only then can we shape value creation ourselves and prevent it from flowing away to platform monopolies. We decide for ourselves who gets access and for what purposes the data is used – and can control the conditions both technically and organisationally. Open, interoperable standards (such as those developed by Gaia-X and the Data Spaces Community) put a stop to vendor lock-in and dependencies – and at the same time ensure that our technical investments remain usable in the future, no matter how our business develops.

Compliance – sovereignty meets legal certainty

Compliance with legal requirements is mandatory for data-based business models. European regulations in particular, such as the GDPR, the Data Act, and the Data Governance Act, set high hurdles and complex documentation requirements. The advantage of modern data

spaces: compliance is not an afterthought, but part of the technology itself. With Gaia-X, IDSA & Co., requirements and evidence (e.g., regarding data origin, use, security) are checked in a machine-readable and automated manner. Audits, documentation, and regulatory evidence can thus be mapped more efficiently and transparently than in traditional IT architectures. For us, this means less effort, greater security, and a [leap of faith](#) on the part of customers, partners, and authorities. [With the Data Act in particular, companies and data spaces benefit from](#) the fact that access logs, terms of use, and authorisation assignments are digitally recorded and verifiable.

Efficiency – scaling processes, reducing costs

With each additional partner and each new use case, increased efficiency becomes the decisive advantage of data spaces. Instead of creating separate structures for each new collaboration, we benefit from shared components: uniform interfaces, registered identities, common rules of use. Data spaces drastically simplify processes: from automated participant management to the rapid implementation of new use cases. In practice, this leads to accelerated project cycles, less redundancy, and greater flexibility in changing market conditions. [Examples from the Gaia-X funding competition](#) show how the combination of technical standards and [shared governance](#) not only accelerates and synchronises processes, but also systematically reduces sources of error. We can make better use of resources and develop and scale new solutions much quicker. The increased interoperability offered by Gaia-X enables better networking and the efficient use of existing data sets.

Innovation – Discovering and developing new business areas

[Data spaces are a catalyst for genuine innovation](#). Only by sharing data and services in data spaces, companies can develop new products, build data-based services, or access external data and use it to expand their own offerings. This enables products and services that were previously unthinkable from a technical or organisational perspective. The network effects grow with each participation, often resulting in [cross-industry ecosystems with entirely new value-added structures](#). For those responsible for innovation, this means that we do not have to invent everything ourselves, but can team up with partners, scale and test use cases, and respond flexibly to market trends.

4.3 Use existing knowledge and proven approaches

Before we start from scratch and rush into technical or operational implementation, it is worth taking a look at the network: Are there already existing data spaces or initiatives in our industry? It is often possible to dock onto existing structures, visit pilot projects, or benefit from the lessons learned by others instead of setting up our own complex structure.

Gaia-X Hub as a compass

The Gaia-X Hub Germany is a guide through the jungle of offers and should be the first port of call for anyone interested. Whether for an initial overview, guidance on suitable partners, technical questions, or funding programs, the hub offers regularly updated overviews of

ongoing projects, exchange formats, and [information materials](#). It is particularly worthwhile for [small and medium-sized enterprises](#) to start early and develop a feel for the industry, use cases, and possible collaborations. Especially helpful: the Hub provides [practical knowledge](#) from the front line—we benefit from the experience of the Gaia-X funding competition and the constant exchange with [various data space projects](#).

4.4. Skills: What we can do and need to know to get started

The Gaia-X Hub and [Data Spaces Radar](#) show that there already is a large number of projects and data space pioneers that you can join. However, if you do not want to join an existing project, you can also implement your own idea. However, there are a few aspects and areas to consider when implementing your own data space. Without the right know-how—not only in technology, but also in the areas of data management, governance, and communication—no data space is sustainable. It is important to understand how a data space really works and is managed. The insights from the [Gaia-X Hub's Dataspace Cheat Sheet](#) and [Gaia-X funding projects](#), as well as the DSSC's comprehensive [Knowledge Base](#) and [Co-Creation Method](#), help with this.

Industry knowledge and stakeholder analysis

This point is particularly relevant when we want to set up a completely new data space. Depending on the goal and size of your project, it may be advisable to form a "coalition of the willing" at an early stage, i.e., to identify potential data providers, users, and service partners and to bind them to the project. A consortium agreement helps to clarify motivation, objectives, and governance – turning a loose network into a resilient, long-term project. Initialising a consortium and defining use cases early on ensures focus and shared commitment. Even in the concept phase, it is advisable to develop use cases that solve real problems and create clearly measurable added value. For inspiration, the Gaia-X Hub offers [blog articles](#) and [white papers](#) that provide insight into existing projects and variations of data spaces. The [position papers of the Gaia-X Hub](#) domains are also helpful.

Carefully prepare the operating structure and governance

The choice of [organisational form](#), legal structure, governance rules, and the identification of roles (e.g., federators, trust service providers) influence the interaction of all parties involved. Clear administration, assignment of rights, and transparent processes help to make the data space project durable and resilient. The [governance building blocks](#) defined by the DSSC offer detailed guidance on dealing with the topic of governance.

Linking business model and use cases

The data space's [business model](#) must enable value creation from shared data and create incentives for all participants. Depending on the model, we can implement one or more use cases – the decisive factor is how well it fits the needs of the stakeholders and the specific industry requirements. However, this also raises questions: What does our data product look

like in concrete terms? Who has access? What intermediaries or additional services are needed? The [EUProGigant project](#) offers a case study for a business model. Analogous to the Governance Building Blocks, there are [Business Building Blocks](#), in which the DSSC provides support for business model and use case development.

Interoperability and technical standards

Uniform data models and open formats ensure cross-system exchange. Coordination via glossaries and metadata reduces misunderstandings and opens up many automation options. The [DSSC Technical Building Blocks](#) provide important theoretical guidance – especially for Dataspace Architecture Version 1.0 and the first working prototypes. For more practical relevance, we can look at the IDSA's [Reference Architecture Model](#) and [Connector Report](#), as well as the [DSSC Toolbox](#). The Toolbox combines the Co-Creation Method with the Data Space Building Blocks and shows suitable building blocks for setting up a data space.

Anchoring legal frameworks and compliance

Since various EU regulations impose legal requirements, particularly in the data economy, it is helpful to have an overview of the specific requirements at European, national, and industry level. Which laws apply, and which requirements must be observed and documented? Proactive preparation pays off, especially with regard to the [Data Act](#) and industry-specific regulations, and facilitates the implementation of compliance conditions for entering data spaces. More information on how [laws and regulations](#) are checked [in a machine-readable format](#) in a [Gaia-X data space](#) can be found in the Gaia-X Hub's tech blog series.

Plan technical implementation with foresight

The [open source landscape](#) is a real treasure trove for technical implementation. The [DSSC Toolbox](#) and the [co-creation method](#) make it easy to get started. The end result is an architecture that combines modularity, security, and scalability. Networks and forums offer help and inspiration in case of emergency.

4.5 Orientation and support: The most important networks and institutions

In addition to the Gaia-X Hub Germany as the first point of contact for interested parties in Germany, many [other players](#) also offer helpful connections. Industry-specific platforms and professional associations are also useful places for current developments, open calls, or initial use case ideas.

Gaia-X European Association for Data and Cloud AISBL provides us with uniform specifications and EU-compliant governance rules across Europe with the Gaia-X Trust Framework. Digital clearing houses are central anchors of trust that make certificates and compliance machine-readable, so that identity and conformity are not left to chance but enable trust.

Data Spaces Support Center (DSSC) offers a methodical toolkit for setting up and operating data spaces: from blueprints and standards to best practice methods, which prove to be a real asset, especially for small and medium-sized businesses and public institutions.

The International Data Spaces Association (IDSA) provides technological foundations and standards for interoperability and secure data space architectures. Particularly helpful is the [Data Spaces Radar](#), which provides a cross-industry overview of existing data spaces, use cases, and projects.

In addition to these players, there are also industry-specific hubs and networks that can be a good companion. It is worth taking a look at regularly held community events, onboarding offers, and templates for review processes and use case definitions.

4.6 Practice: Reach your goal quickly with Data Space as a Service and partners

Entering the world of data spaces for a long time has been a technical and organisational challenge, especially for SMEs. If your company lacks the resources and expertise to set up its own data space, various providers can help. Innovative providers enable quick access via "dataspace-as-a-service" by connecting to a data space infrastructure and guiding you through the onboarding process. Onboarding often takes place step by step, accompanied by best practices and sophisticated tools. This is an ideal way to get started for companies that do not want to (immediately) invest in their own data space team or want to explore the market first, allowing them to pilot their own use cases quickly and without risk. Nevertheless, it is important to acquire data space skills so that you can differentiate between the offerings of different service providers and take individual requirements into account.

4.7 Conclusion and next steps: Informed, connected, ready to act

We have seen how a modern data space creates concrete advantages: data sovereignty is no longer just lip service, but a reality that can be implemented. Compliance with European digital laws is not only achievable but is measurably easier thanks to technology and governance. Efficiency and innovative strength increase measurably, and thanks to guidance, networking, and service offerings, getting started is quicker than expected.

Now it's up to us: If you want to discover new value creation, operate in a legally compliant manner, and jointly shape the data economy of tomorrow, you should proceed in a structured manner and take advantage of the available opportunities. From stakeholder analysis to governance, technical standards, and compliance to concrete architecture—every building block deserves attention.

Whether as users, initiators, or cooperation partners, the next steps are clear:

- Sharpen your own goals and use cases.
- Research existing data spaces, standards, and offerings.
- Strengthen team expertise and initiate initial pilot projects.

- Make targeted use of support from the Gaia-X Hub, networks, and service providers.
- Work together to create genuine, sovereign data spaces.

In this way, we are not only participating in the transition to a digital data economy—we are taking an active, formative role from the very beginning.

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