



In-depth look at the data economy

Architecture, Players and Economic benefits of data spaces

Campus Course 2, Lesson 3
September 2025

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Gefördert durch:



aufgrund eines Beschlusses
des Deutschen Bundestages

About the series

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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Publisher

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Karolinenplatz 4

80333 Munich

Recommended citation

Reiberg, A. et al. (2025) In-depth look at the data economy: Architecture, Players and Economic benefits of data spaces.

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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 specialised 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, specialisation, 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 decentralised 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, standardised 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 optimise 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, anonymised 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-optimised production, and information on available energy storage capacities. And the Mobility Data

Space provides optimised 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 standardised interfaces for data access, and relies on uniform security and quality standards.

Gaia-X is also strongly aligned with other existing, internationally recognised 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 recognises 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.

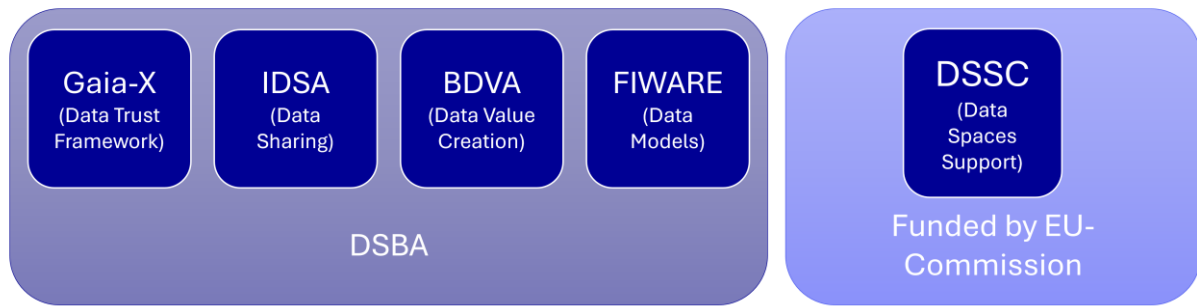
The development of general and common standards for the various data space initiatives is intended to ensure that a data space based on Gaia-X standards is also compatible with other data space standards, such as those of the IDSA. This will remove further barriers to interoperability between data spaces. 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 harmonisation 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 recognised 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 (<https://manufacturingdataspace->

[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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