

# Gaia-X magazine

May 2023 | Edition 2

Foreword by Gaia-X CEO  
Francesco Bonfiglio



Meet our  
**Market-X**  
Partners

Read the latest  
**Community**  
Updates

Learn about  
Upcoming  
**Gaia-X**  
Events

*"In today's digital age,  
data is king. From  
e-commerce to cloud  
computing, businesses  
rely on vast amounts  
of information to drive  
growth and solve  
societal challenges."*

Antonieta Mastroianni

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Summit 2022 - Lessons learned p

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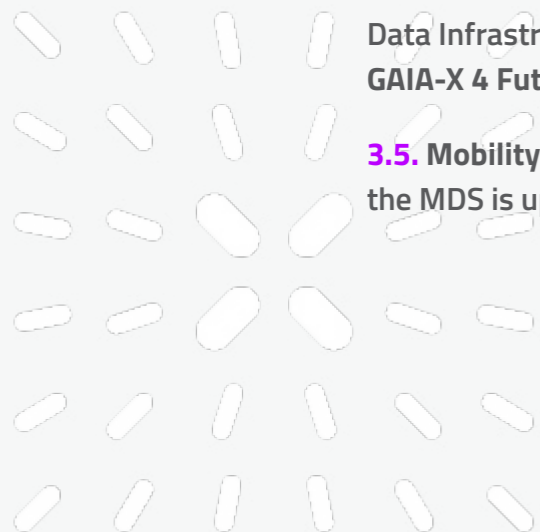
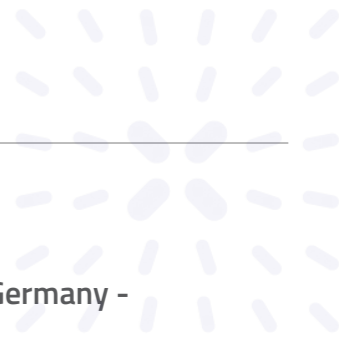
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# FOREWORD

## – WELCOME & OPENING



**“Through initiatives like Gaia-X, we build a better digital ecosystem for all”**

*Francesco Bonfiglio*



Dear Readers,

Welcome to our latest issue of the Gaia-X Magazine. In this issue, we explore as usual the hot topics and trends in the world of data and cloud computing. Our prestigious community and industry experts provide their insights, analysis, and practical advice on how to get the most out data through technology. Deep dive into topics such as data governance, hybrid cloud, security, and multi-cloud management are discussed for you as a business leader, an IT professional, or simply one interested in these cutting-edge themes. But most importantly we want to show how a better world, less dependent on non-controllable technologies, less constrained by political debates, more connected throughout country boundaries, more sustainable and respectful of human rights like transparency, human centricity and freedom, is

possible through projects like Gaia-X, aimed to build a new generation of trustworthy data infrastructures for the common good of all. Here we write for you, to share our ideas, vision, and to invite you to contribute to the fantastic endeavor of Gaia-X you're your participation. I hope you'll find here valuable information and ideas to help you stay ahead of the curve. So, sit back, relax, and enjoy reading this issue of the Gaia-X Magazine.

Francesco Bonfiglio

About  
**FRANCESCO BONFIGLIO**

CEO of Gaia-X, husband and father of three boys. He loves music and has played in several independent live and record productions since the 80s.

*Francesco Bonfiglio*



## 02 HIGHLIGHT

### Women in the technology sector

Women have played a significant role in the technology sector for well over a century. However, over the years, the industry has been male-dominated, and women have been underrepresented or overlooked for leadership positions, technical roles, and entrepreneurial opportunities. Despite this, women have made significant strides in the tech industry, contributing to critical advancements in computing, software engineering, electronics, and other technological fields. In recent times, the industry has witnessed more women in technology roles, and efforts have been intensified to address the gender gap and encourage greater diversity and inclusion. Today we speak with Antonietta Mastroianni, Chief Digital & IT Officer, Proximus Leadership Squad & BoD member of Gaia-X



02

# WOMEN IN TECH

## INTERVIEW WITH ANTONIETTA MASTROIANNI

**Antonietta Mastroianni**, Chief Digital & IT Officer, Proximus Leadership Squad & BoD member of Gaia-X

### Could you give us a quick synopsis of your career?

I'm Antonietta Mastroianni, currently Chief Digital and IT Officer and a member of Proximus Leadership Squad since April 2021. Before joining Proximus, I was the Group CIO and CDIO at the Danish TDC, Head of IT and Digital at Swiss Sunrise, and had several roles in Swisscom and H3G.

I am an influential IT leader with 23 years of international telecommunications experience leveraging technology to drive organisation growth, performance, and profitability in transformational environments. My expertise is focused on digital and agile transformation, the impact of cutting-edge technology on business, technology and product innovation, and IT and telecom transformation. I have had a passion for artificial intelligence and robotics since my teens, and I am very proud today to be the president of Proximus Ada, a subsidiary of Proximus dedicated to artificial intelligence and cybersecurity. My passion for Artificial Intelligence, technology, and robotics stems from my belief in their power to

shape and improve our world in countless ways. I worked in various countries of Europe (Italy, Switzerland, Denmark, and Belgium), and I'm an experienced board member (Board and Council member of Etis, Board Member and Finance Vice Chair of Gaia-X, Chairwoman of Proximus Ada and a Board Observer of Lumine Group). I have a master's degree in computer engineering and automation from the University of Siena, and I am a member of the Association of Engineers of the Province of Caserta. I have been nominated Danish CIO of the year 2000, I have been awarded 5G World CxO for the year 2021, Telco Woman of the Year 2022, Network X 50 2022 award winner | InspiringFifty 2022 award winner.

### What has contributed to your success so far?

I would say many different factors, allow me to start with the many people who trusted me, my wonderful colleagues and friends who shared my visions, helped me achieve ambition and performance and made my days fun and filled with joy. Also, some people who otherwise gave me a hard time, attacked me, criticised me, and sometimes used and sabotaged me, because it

taught me to have confidence and be strong and resilient. From a personal point of view, I would say dedication, passion, resilience, and a willingness to stand up for the good things and the right situation, including the ability to say no.

### What roles or responsibilities do you enjoy and feel good at? What sucks you dry?

As a CDIO and tech leader, I like to identify new growth opportunities by watching the development of the industry. I must always put the outside into perspective, stimulate myself and always inspire my team and me. I enjoy encouraging and fostering an environment where we can think creatively and generate ideas through a culture of innovation. I love fostering a diverse and inclusive workplace by valuing everyone's unique perspectives, experiences, and backgrounds. I love encouraging personal and professional growth through mentoring and leadership programs, but most of all, encouraging people to take on new responsibilities or challenges. High performance is my passion; I love creating a high-performance culture, winning personal limits and getting excited about high goals and ambitions. I enjoy nurturing passions and encouraging team members to pursue their passions and interests both on and off the job. The part of my work that I have a problem with is negative attitudes, limiting behaviour, and an emphasis on apology and cannot be done. Jealousy and gossip to discredit other people's high performance and strength are truly a No Go for me.

### Why did you decide to pursue this career?

As a teenager, I dreamed about changing the world and building a better and more intelligent world. I was already passionate at 18 years old

about creative innovation, intelligence, robotics, and intelligent ideas, but more importantly, I dreamed of a better world thanks to technological evolution. I have always believed that artificial intelligence and robotics have the potential to make a meaningful positive impact on society by helping solve complex problems. So, I decided to be an engineer, So I decided to be an engineer. When obtaining my degree, the AI technology was unfortunately not yet mature, so I went to Telco. Now 20 years later, I am glad to have a career that combines the power of state-of-the-art networks, data, digitalisation, and powerful AI-based services.

### What is your leadership style?

It isn't easy to describe it since it has very different aspects: a combination of clear vision, adaptability, empowerment, collaboration, technical knowledge, and customer focus. I am a visionary; I always like to have a clear strategy and a clear purpose. Of course, the actionable part is also essential to me. I must have a deep understanding of the industry and a clear sense of the future direction of technology. I'm also convinced that with a strong purpose, you can motivate teams to work towards a common goal, even in the face of challenges and insecurities. I would define myself as agile and empowering. I think it is important to be open to new ideas, flexible and able to pivot quickly, when necessary, while maintaining a clear direction and focus. I'm also communicative, have a deep understanding of the technology they are working with, and can communicate its potential to others effectively.

### How can the CIO and CDO play an innovative and influencing role?

The role of the CIO or the CDIO is essential today, not only for business, but for society. As disruptive science and technology drive business growth, it is expected that the CIO will catalyse new and innovative business capabilities. This emphasis on technology has shifted the conversation for CIOs, who are expected to drive business value and sustain innovation over the long term. Progressive technology innovation means new ways of working on implementing, managing, upgrading, and maintaining systems, processes and operations, including technological innovations such as cloud, AI and digital solutions. Workforce innovation, including mobile and social tools that can improve productivity, is critically important. Access to on-demand data that can enhance decision-making is essential.

Exploring new cooperation with historic competitors is a new trend, removing certain vertical barriers has created opportunities throughout the industry through data spaces and digital ecosystems. CIOs are responsible for helping businesses create value by driving business objectives for innovation, from digital breakthroughs and data to new technology driven products and services, such as those that create engaging customer experiences.

While the direction is clear, it is essential for the Chief Information Officer or Chief Digital Officers to position themselves as leaders in business transformation through technology.

### Key learning you would like to share?

I had a lot of learning during my carrier, but if I could summarise some, they would be:

- Be a problem solver in each situation
- Demonstrate that you can be a partner in every contest
- Show that you can engage on great things but also on small ones
- Share the rewards and the pain

### What do you like about your industry?

It has the power of connectedness, linking people and communities. It is fascinating and the most interesting industry now since it enables connectivity, high speed, and low latency with the most innovative digital services for consumers and businesses. It is fundamental to everybody's life and serves people and society for good.

It still plays a fundamental role in every crisis; if we look at the COVID-19 crisis and the role played by the industry, there is no need to explain it. The most important innovation comes from the combination of high-speed networks, digital services, IoT and AI; they can revolutionise the world. Therefore, as a lover of technology, it is a place to be.

### Could you give us three tips and tricks?

- Be passionate
- Have a faith
- Never hesitate

### Why is Gaia-X important in today's economy?

In today's digital age, data is king. From e-commerce to cloud computing, businesses rely on vast amounts of information to drive growth and solve societal challenges. However, this reliance often leads to a few dominant players who control the market.

Gaia-X addresses these challenges following European values such as sovereignty, transparency, and openness in an increasingly globalised and digitised world.

Moreover, Gaia-X provides an opportunity for businesses across different industries to collaborate on data-driven projects that can

address societal challenges and create business opportunities. By breaking down existing silos between sectors through interoperability standards and common rules for data sharing, Gaia-X enables cross-sectoral innovation at scale. By promoting sovereignty that complies with EU laws and regulations regarding privacy protection and security measures, Gaia-X purposefully seeks technological progress and ethical development within society. The importance of Gaia-X lies not only in its technical achievements but also in its potential impact on our societies' prosperity, sustainability, and social cohesion.

*Antonietta is a Member of the Board of Directors of Gaia-X and serves as the Vice Chair for Finance. She brings a wealth of knowledge and experience to the organisation, having previously served in leadership roles as Chief Information and Digital Officer at major Telecom operators in Europe, chairwoman of the board of Proximus Ada, and is part of the board of Etis and Lumine Group.*



03

## MARKET-X PARTNERS

### Market-X

Gaia-X held its Market-X Conference & Expo on 14 and 15 March in Vienna, Austria, in cooperation with the Gaia-X Hub Austria. The event gathered over 450 industry leaders, policymakers, and experts from Europe and beyond.

The Gaia-X Digital Clearing House (GXDCH) was launched at the event. The GXDCH offers a one-stop solution for verifying compliance with the Gaia-X rules in an automated way. In this section you will read about our Market-X partners who contributed to the success of Market-X.



03

# A REAL MOMENTUM PROPELLING DATA EXCHANGE

**Frédéric Bellaïche PhD**, Vice President of Technology and Research, Dawex

## Abstract:

Gaia-X published three essential documents that marked a significant breakthrough for data exchange. The Trust Framework, Reference Architecture, and Data Exchange Services Specification documents result from an extensive collaborative work and thorough continuous process with one objective in mind: Develop secure, trustworthy data ecosystems that promote a sovereign data economy. The Architecture Document is the centerpiece of Gaia-X as it describes the Gaia-X top-level Architecture mode, as well as the fundamental concepts and terms of the Gaia-X Architecture, including Data Exchange. The Trust Framework is essential as it defines the technical means to describe in a standardized manner participants and services, bringing transparency, control, and creating trust in a data ecosystem. The Data Exchange Services Specification specifies the vocabulary for data exchange and sets the definition of data exchange services, policies, and ontologies for data exchange. These documents illustrate the exceptional technical maturity of data exchange technology, and will provide guiding principles for organizations looking to create data ecosystems.

## Keywords:

Data Exchange, Trust Framework, Reference Architecture, Data Exchange Services Specification, Trust, Data Ecosystems, Data Transaction, Compliance.

## Main text:

Gaia-X relies on three major pillars which have been defined in essential publications: the Trust Framework, the Reference Architecture and the Data Exchange Services Specification. With these publications, data exchange is propelled to new heights.

Resulting from a highly collaborative and open work, these publications are a huge milestone for data exchange as they support the development of secure, trustworthy data ecosystems to foster a sovereign data economy. These comprehensive texts also demonstrate the maturity of the data exchange technology by structuring and defining what data exchange should be, and confirm the major opportunities generated through the creation of data ecosystems.

The Architecture Document is the centerpiece of Gaia-X as it describes the Gaia-X top-level Architecture model, the aim and means of

the association along with the fundamental concepts and terms of the Gaia-X Architecture, including the ones of data exchange.

The Trust Framework is of utmost importance as it presents the baseline in order to be part of the Gaia-X ecosystem. It defines the technical means to describe in a consistent way the participants and services, to bring transparency, control and create trust among the participants in a data ecosystem in order to give proof of who they are, what they do and how they do it.

The Data Exchange Services Specification

defines the vocabulary for data exchange, sets the definition of data exchange services as well as conceptual & operational models, data exchange policies and ontologies for data exchange to deliver trust, interoperability, discoverability and traceability to the data economy. The document delivers essential definitions such as what is a data product, how to put data products on a market, how to manage consent, or how to ensure traceability of the exchanges. Dawex has been invited by Gaia-X to lead the Data Exchange Services Specification Working Group, with IDSA as co-lead.

Each milestone produced by Gaia-X on the Reference Architecture, the Trust Framework, and the Data Exchange Services Specification demonstrate the strong technical maturity achieved to deliver secure, scalable and traceable data exchanges. This momentum marks a significant breakthrough for data exchange and for all organizations looking at implementing data exchange platforms or relying on either a data marketplace or a data hub. Public and private organizations engaging in building data ecosystems can now rely on guiding principles that will ensure they keep control over who accesses their data, for what purpose, and under which terms, all essential to building trust and retaining data sovereignty.

These significant steps forward for data exchange set guiding principles to what data exchange should be; create a common understanding and vocabulary around data exchange;





define the prerequisites for data spaces and data infrastructures; bring trust, data protection, transparency, security, portability and scalability; align data spaces towards a recognized trust framework; demonstrate the importance of creating data ecosystems; accelerate innovation through data circulation; and foster a strong and resilient data economy.

Dawex, a recognized expert in Data Exchange, actively contributes to the collaborative works of Gaia-X to structure and define the principles around data exchanges. Creating ecosystems around data exchange platforms that meet regulatory requirements and address traceability and security challenges have become a fundamental component of business competitiveness and economic sovereignty. The works conducted by the Gaia-X Association and its Members, representing more than 350+ organizations, demonstrate how open work and collaboration can create an impact and serve as a source of inspiration for those worldwide looking for a trustworthy data economy.

### Conclusion

The publication of the Gaia-X Trust Framework, Reference Architecture, and Data Exchange Services Specification is a major breakthrough for data exchange. The high level of technical expertise displayed in this collective effort is evidence of the remarkable progress made in establishing secure, trustworthy, and traceable data exchanges. By creating a shared understanding and common terminology on data exchange, as well as defining the prerequisites for data ecosystems and infrastructures, this initiative will promote the growth of a sovereign data economy. The efforts undertaken by the Gaia-X Association

and its members underscore the value of open collaboration in fostering change and inspiring those around the globe seeking a dependable data economy.

### Bibliography

Selection of Dawex publications and contributions

- [Exchanging data or not exchanging data - It is a survival issue](#) - July 2022 - MIT CDOIQ
- [Designing Data Spaces, The Ecosystem to Competitive Advantage](#) - Mars 2022 - Editors : Boris Otto, Michael ten Hompel and Stefan Wrobel.
- [Harnessing the power of agriculture data](#) - Mars 2022
- [Deep Dive in Data Exchange](#) - Mars 2022 - Eckerson Research
- [Transformation Map - Data Policy](#) - Septembre 2021 - World Economic Forum
- [Towards a Data Economy: An Enabling Framework](#) - August 2021 - World Economic Forum

### Author biography:

*Frédéric Bellaïche is a PhD and Vice President of Technology and Research at Dawex. He is responsible for the strategic development and integration of most advanced technologies within the Dawex organization and product architecture. Prior to joining Dawex, Frédéric served for 14 years as Technical Expert for a leading digital services company where he led innovation in the areas of Data Science, Artificial Intelligence, Edge Computing, Blockchain, Security and Quantum Computing. Prior to that, Frédéric also served as CTO and co-founder of a start-up specialized in securing financial flows for 7 years. During his career, Frédéric has conducted research at Brookhaven National Laboratory in the field of high energy physics, at CERN and at the Université Claude Bernard. Holding a PhD. in particle physics and a DEA in nuclear and particle physics, Frédéric is a member of the Blockchain working group at Numeum and contributes to the OWASP project.*



# ARUBA, THE LARGEST ITALIAN CLOUD PROVIDER, AND ITS COMMITMENT IN THE GAIA-X ENVIRONMENT

## AFTER ITS ENTRY AS “DAY-1 MEMBER” IN GAIA-X AND THE COLLABORATION IN STRUCTURA-X, ARUBA CONTINUES TO DEVELOP CLOUD INFRASTRUCTURE FOR SECURE DATA SHARING

Gaia-X was founded with the intention of creating an interoperable and secure cloud, based on compliance with European standards in order to have a free and transparent circulation of data, to avoid the risk of lock-in for companies and at the same time to foster the widest participation and competition among cloud solution providers, with a certification system at compliance level that guarantees the exercise of rights and data protection. It is a project open to all countries that wish to contribute to its growth and join as members: as a goal, it aims to provide European companies with a cloud that has security standards guaranteed by the European institutional system.

The agreement has become official during

the Market-X Conference & Expo in Wien, a networking event organised by Gaia-X to raise the awareness of the association's standards and ensure the integration of the GaiaX community into an ecosystem. Aruba is a “Day-1 member” of Gaia-X and will play a pivotal role in the development of a secure infrastructure for the sharing and accessing of data between organisations, laying the foundations for a cloud offering based on core European values.

The Gaia-X Digital Clearing House constitutes the necessary building blocks to make Gaia-X operational in the market. It will become an external structure composed of geographically distributed and decentralised nodes that can support companies interested in benefitting



from Gaia-X's federated digital ecosystem by helping them achieve compliance with its standards.

“Becoming one of Gaia-X's nodes is an essential milestone; the next step in the process that will enable us to deliver compliance component services. We will operate as a distributed and decentralised node, not directly managed by the association, helping anyone who wants to achieve compliance with the Gaia-X standards. Meanwhile our customers will be able to directly access Gaia-X as participants through Aruba's GXDCH node.” – commented Fabrizio Garrone, Enterprise Solution Director of Aruba.

To sum up, Aruba is a **Day-1 member** of Gaia-X and part of the **Lighthouse project Structura-X** and now one of the GXDCH node.

Aruba's commitment reflects his customers' commitment and need. In order to simplify the approach to the cloud infrastructure services and to the Gaia-X compliance, Aruba can be considered as a **single service provider** in order to:

- benefit of the compliance of Aruba's cloud infrastructure for their projects;
- directly access to Gaia-X as a participant through the Aruba's GXDCH node;
- have the guarantee of the interoperability, portability and data sovereignty.

# FEDERATED TRUST ANCHOR

## ATTEST SERVICE IDENTITIES WITHOUT A CENTRAL AUTHENTICATION AUTHORITY

Florian Bühr, Architect, Hewlett Packard Enterprise

The open source identity framework SPIFFE and its reference implementation SPIRE enable trust relationships across trust domains without intermediaries. This is a crucial foundation for open and dynamic cloud and data networks.

SPIFFE and SPIRE have reached the highest maturity level („graduated“) within the Cloud Native Computing Foundation. The SPIRE server supports trust federation with SPIRE servers of other domains and acts as the enforcement point for continuous multi-factor attestation of service identities. This creates new possibilities for interoperability between multiple trust domains. As an example, SPIFFE/SPIRE can be used to enhance trust, privacy and security of the verification process of Gaia-X services.

These N:N federation capabilities not only apply to cloud-native workloads, but also to legacy or bare-metal applications, for example. One could also integrate small engineering offices that do not have servers but only work with notebooks – as well as connected intelligent devices, such as production machines or robots in a factory.

This paves the way for open, distributed and dynamic systems where trust relationships can be established and adapted depending on the use case – be it management of pandemics, distributed engineering, or multimodal mobility.

### About the author:

*As Solution Architect at Hewlett Packard Enterprise, Florian Bühr is focused on developing IT architectures for data value creation in multilateral use cases.*



# GAIA-X 4 FUTURE MOBILITY: DRIVING INNOVATION IN EUROPE'S SECURE DATA INFRASTRUCTURE

By DLR Institute for AI Safety & Security

## Abstract:

GAIA-X 4 Future Mobility is a European initiative focused on creating a secure and interconnected data infrastructure that prioritizes digital sovereignty and innovation. Within an open and transparent digital ecosystem, data and services can be made available, merged, shared, and utilized in a trusted manner. The six projects within GAIA-X 4 Future Mobility, located within the German GAIA-X Hub's mobility domain, are dedicated to implementing future mobility applications based on GAIA-X. With approximately 80 stakeholders involved, the projects address questions related to distributed data and service infrastructures, which are crucial for the data-driven networking of manufacturers, suppliers, service providers, and users.

All projects in the project family are funded by the Federal Ministry of Economics and Climate Protection of the Federal Republic of Germany.

Keywords: GAIA-X, Future Mobility, Data Infrastructure, Digital Sovereignty, Innovation

## Introduction:

As digital technologies continue to transform the mobility sector, data has emerged as a crucial resource for driving innovation and improving services. However, concerns over data privacy, security, and sovereignty have highlighted the need for a European initiative that can establish a secure and interconnected data infrastructure, meet the highest standards of digital sovereignty, and promote innovation. GAIA-X 4 Future Mobility is a project family within GAIA-X that aims to address this need, with a focus on developing future mobility applications based on GAIA-X. This article provides an overview of GAIA-X 4 Future Mobility, its projects, and its potential impact on the transformation of the mobility sector.

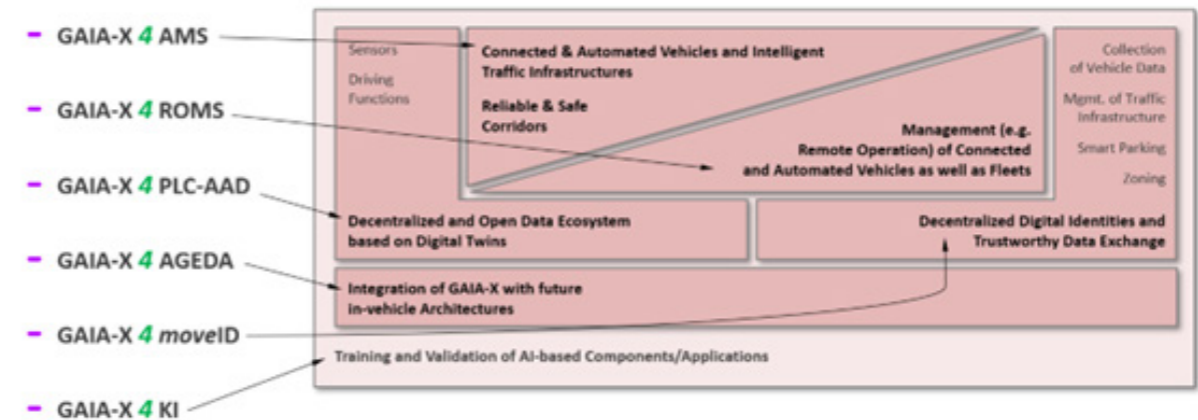
## Family of Projects

### Overview – currently established projects (Q1/2023)

- GAIA-X 4 AMS	Connected & Automated Vehicles and Intelligent Traffic Infrastructures as well as Reliable & Safe Corridors – e.g. Rescue Corridors
- GAIA-X 4 ROMS	Management (e.g. Remote Operation) of Connected & Automated Vehicles and Fleets with respect to the status of the Traffic System
- GAIA-X 4 PLC-AAD	Decentralized and open Data Ecosystem based on Digital Twins intended to support Product Development, Manufacturing and After Sales – with a focus on automated driving
- GAIA-X 4 AGEDA	Integration of GAIA-X with future In-vehicle Architectures for safety-critical Applications in connected and automated Vehicles
- GAIA-X 4 moveID	Decentralized Digital Identities and Trustworthy Data Exchange for various Use-Cases (e.g. Zoning, Traffic Infrastructure Management, Smart Parking and Collection of Vehicle Data)
- GAIA-X 4 KI	Data and Service Ecosystem for Training and Validation of AI-based Components/Applications with a focus on the Automotive Sector.

## Family of Projects – Synergies by Design

### Overview – currently established projects (Q1/2023)



## GAIA-X 4 Future Mobility - Projects and Focus Areas:

GAIA-X 4 Future Mobility is a project family within GAIA-X that focuses on developing future mobility applications based on GAIA-X. The six projects within GAIA-X 4 Future Mobility are GAIA-X 4 KI, GAIA-X 4 AMS, GAIA-X 4 ROMS, GAIA-X 4 PLC-AAD, GAIA-X 4 moveID,

and GAIA-X 4 AGEDA. These projects address questions related to distributed data and service infrastructures on the basis of GAIA-X. They are crucial for the data-driven networking of manufacturers, suppliers, service providers, and users.

GAIA-X 4 KI focuses on the development of artificial intelligence (AI) algorithms for data

processing and management in the mobility sector. GAIA-X 4 AMS aims to implement the GAIA-X architecture for the data-driven networking of automated mobility services. GAIA-X 4 ROMS focuses on the development of remote operation and maintenance systems for automated vehicles and fleets. GAIA-X 4 PLC-AAD aims to develop a platform for secure and decentralized digital identities in the mobility sector. GAIA-X 4 moveID focuses on the development of product lifecycle and digital twin technologies for automated driving. GAIA-X 4 AGEDA aims to develop a platform for the data-driven networking of smart cities and regions.

### Potential Impact of GAIA-X 4 Future Mobility:

The projects within GAIA-X 4 Future Mobility have the potential to drive innovation and transform the mobility sector. They provide important product-related impulses for the development of digital assets and products, as well as innovative business models. The data-driven networking of manufacturers, suppliers, service providers, and users is crucial for the development of future mobility applications that meet the highest standards of data privacy, security, and sovereignty. By promoting the development of distributed data and service infrastructures, GAIA-X 4 Future Mobility can help to create a more sustainable, efficient, and user-centered mobility ecosystem.

Conclusion:

GAIA-X 4 Future Mobility is a European initiative that aims to establish a secure and interconnected data infrastructure, meet the highest standards of digital sovereignty, and promote innovation. The six projects within GAIA-X 4 Future Mobility are focused on developing future mobility applications based on GAIA-X, with a particular focus on distributed data and service infrastructures. These projects have the potential to drive innovation and transform the mobility sector, by providing important product-related impulses and promoting the development of sustainable, efficient, and user-centered mobility ecosystems.

Gefördert durch:



Bundesministerium  
für Wirtschaft  
und Klimaschutz

aufgrund eines Beschlusses  
des Deutschen Bundestages

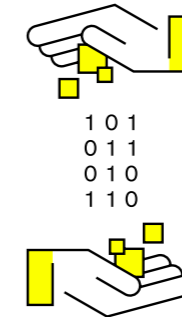


# MOBILITY DATA SPACE (MDS): THE FIRST OPERATIONAL DATA SPACE – THE MDS IS UP & RUNNING

## Your membership in the MDS is free of charge

- The MDS is 50% funded by the German government and
- 50 % by the private sector
- Therefore, the MDS offers its services to new participants free of charge!

Funded by:

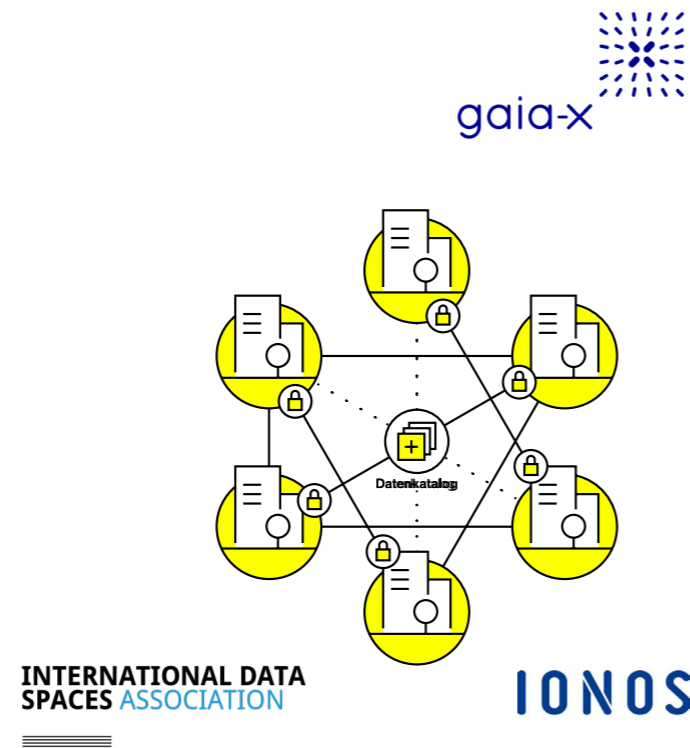


on the basis of a decision by the German Bundestag

## JOIN THE DATA SHARING COMMUNITY!

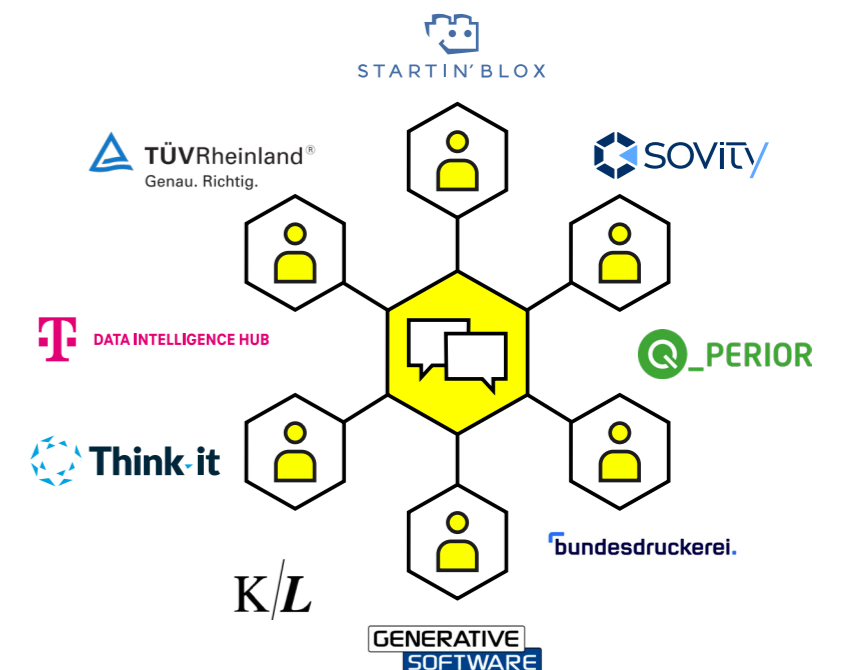
### Technical Highlights

- The MDS architecture is based on the International Dataspace Association's (IDSA) framework.
- The MDS is **productive and ready to use**. Our technical operator IONOS ensures maintains the underlying IT infrastructure.
- The MDS is as of now Eclipse Data Component (EDC) Connector compatible!




### Strong Community & Strong Partners

- Today, in Q1 2023, the MDS has **more than 70 members** from the industry and we are constantly growing.
- The MDS is engaged in the **Gaia-X community** to promote interoperability between dataspaces, intra- and cross domains.
- The MDS is currently connecting to the first dataspace and is eager to increase its network of data spaces.
- Our **Trusted Partners (right)** are supporting our community with data related expertise and services.



### Lighthouse<sup>2</sup>



- The MDS is lighthouse project of GAIA-X
- And in the digitalization strategy of the German government

# 04 COMMUNITY

## The Gaia-X Community

The open-source Gaia-X Community comprises the overall Gaia-X network. On the basis of working groups, users and providers work hand in hand to deliver the milestones of Gaia-X: the architecture, the labelling, the policy rules and the trust framework. Everyone is welcome to join the Community to share their knowledge, expertise and advice through a series of meetings, hackathons, tech dives, conferences, articles, magazines, and podcasts to name a few – all of which present the means to drive the community forward. In this section you will read about Gaia-X community members sharing their stories and perspectives.



04

# DATA-DRIVEN BUSINESS MODELS IN THE GAIA-X HUB GERMANY

**Peter Kraemer**, Head of Gaia-X Hub Germany

In the Gaia-X Hub Germany, 12 working groups from different sectors are currently working on the development and implementation of data-based business models and new data spaces. Peter Kraemer, Head of the Hub, answers questions regarding the.

## What is the focus of the Gaia-X Hub Germany?

The focus of the Gaia-X Hub Germany has changed considerably since its launch at the Gaia-X Summit in 2020. Due to the progress of the project, and especially since the founding of the Gaia-X Association, our focus has shifted. We initially only dealt with the issue of data sovereignty. We have since realised that we need to expand the narrative of Gaia-X. We have started to combine, in our domain working groups, goal-oriented and efficient information sharing, regional requirements evaluation and an open discussion on enabling data-driven business models in sovereign data ecosystems (e.g. data spaces) with Gaia-X.

## How can we imagine your work in concrete terms?

In principle, our work consists of three overarching tasks. Firstly, the dissemination of information about developments and news within the Gaia-X Association, its committees and working groups. Secondly, the analysis of the effects of European, national and regional regulatory and legal requirements activities relevant to Gaia-X. Thirdly, community and stakeholder management of all those interested in Gaia-X in Germany.

Within 12 different sector-related working groups with more than 1400 contributors, we are offering a platform to the community to discuss possible business models that are made possible by Gaia-X. We are substantiating this by the lessons learned by implementation projects that we are incubating in Germany, such as Catena-X, the Mobility Data Space and EUProGigant. Additionally, we have the privilege of working closely with 11 projects funded through the Gaia-X Funding Competition



to help us understand what synergies can be leveraged, what the common challenges are and what shortcuts we can take.

## What is most characteristic about the German hub?

The German economy is characterised by a large number of small and medium-sized industrial and technology clusters as well as a myriad of Small and Medium-sized Enterprises (SMEs). Gaia-X offers enormous potential for implementation for this economic structure in particular, as there are many different data silos, whose value creation potential can only be realised if the data can be shared in a fair, responsible and sovereign manner. The idea of decentralised federations is perfectly suited to these requirements.

## What lessons have you learned from the process so far and where do you see the Gaia-X Hub Germany in a year's time?

First and foremost, we can definitely state that there is still a misconception in many people's minds about Gaia-X. It is quite clear to us that we need to communicate the ideas behind Gaia-X more clearly and with a target audience

in mind. We are trying to clarify this through concrete examples and thus make it more tangible. In order to bring about agreement and harmonisation, we also try to communicate at eye level, because, in the end, we all want the same thing: sovereign, open and transparent data infrastructures that leverage the potential of data-based value creation.

I am very happy with the current situation and very proud of the progress we have made so far. Now we have to succeed in presenting Gaia-X implementations that have a clearly defined added value whether for the economy or society, in order to convince the industrial sector but also the public sector of the value of Gaia-X.





## About the interviewee **PETER KRAEMER**

Peter Kraemer has been serving as Head of the Gaia-X Hub Germany since its inception in 2020 and chairs the

Working Group Hubs in the Data Space and Business Committee of the Gaia-X Association.

He works at acatech, the German Academy of Science and Engineering, a Munich-based think tank for innovation and technology, where he is the Head of the Department 'Technological Sovereignty & Industrial Value Added'.

### Box Gaia-X Hub Germany

#### 12 Domänen (Working Groups)

1. Agriculture
2. Energy
3. Finance
4. Geoinformation
5. Health
6. Industry 4.0/ SME
7. Mobility
8. Public Sector
9. Smart City/ Smart Region
10. Smart Living
11. Planning & Construction
12. Education & Skills

## Box Funding Projects:

The 11 Gaia-X funding projects and their use cases

### **AW 4.0 (Mobility)**

The Autowerkstatt 4.0 project is building a data platform that will help in particular independent car repair shops to make more precise fault diagnoses and thus minimise troubleshooting costs. Through the use of artificial intelligence, data from measurements by special automotive oscilloscopes, observations of vehicle users and classic control unit diagnoses are combined. The result is an easy-to-use system that provides diagnostic suggestions in real-time.

<https://www.autowerkstatt40.org/>

### **COOPERANTS (Industry)**

COOPERANTS is working on the digitalisation process in the aerospace industry to implement more efficient working methods and production processes in the aerospace sector. Using a newly developed secure collaboration platform, digital building twins and so-called smart services are being created. They facilitate (international) cooperation in planning, production and maintenance. This largely eliminates time-

consuming travel by those involved, and all work processes are simplified and accelerated.

<https://cooperants.de>

### **EuroDaT (Finance)**

The aim of EuroDaT is to establish a neutral data trustee in alignment with the EU's Data Governance Act, which makes it possible to bring together and evaluate the highly sensitive data of the financial industry. This is done by means of a black box that prevents the encrypted financial data from being attributed or viewed by any party. Only the original data owner can do this. This makes it possible to use this data for anti-money laundering, more precise ESG ratings or research purposes, for example.

<https://www.eurodat.org>

### **HEALTH-X dataLOFT (Health)**

With the HEALTH-X dataLOFT platform, even previously unusable health data of citizens distributed among various institutions can be utilised in a data protection-compliant manner. With a so-called data wallet app, the data owner has the option of accessing their personal data and releasing it transparently for use for certain purposes and periods of time. This allows, for example, services for personal health prevention or home monitoring for cancer patients to be created and data to be released for research purposes.

<https://www.health-x.org/home>

### **iECO (Planning & Construction)**

In iECO, the consortium partners are creating a common data space for the construction industry in which the entire life cycle of a building - from planning to demolition - is mapped as a

digital twin, a virtual image of a building. In this way, all persons and companies involved in the construction process can exchange their data in this data space in a secure and uncomplicated manner. This minimises costs, prevents waiting times and speeds up work processes considerably.

<https://ieco-gaiax.de>

### **MARISPACE-X (Geoinformation)**

The data space created by MARISPACE-X will enable stakeholders from industry, science, authorities and NGOs to share, analyse and use their marine data. For this purpose, the decentrally distributed maritime data of different file formats will be standardised. The processing of the geodata measured in the sea is carried out via interlinked and intelligently networked measuring objects, creating a three-dimensional "digital twin" of the underwater world in real-time. This makes it much easier to carry out projects such as the removal of old war munitions from the sea. Further Use Cases: Windpark, Climate protection.

<https://de.marispacex.com/>

### **MERLOT (Education & Skills)**

The MERLOT funding project is building a digital marketplace for the education sector. Each data owner holds their data identity in a so-called SSI wallet. This makes it possible to access and share one's own education data, which is stored in a wide range of institutions, quickly and easily. In the digital education marketplace, everyone can also use various smart services - for example, a continuing education assistant that uses artificial intelligence to help employees and job seekers find their individual learning paths.

<https://merlot-education.eu/>

### **OpenGPT-X (Cultural & Creative Industries)**

OpenGPT-X is developing large-scale AI language models and innovative language application services that can be cost-effectively adapted to Europe's multicultural and multilingual population, as well as the diverse needs of industry and government. Unlike the current licensed models from the US and China, the data generated by their use can be easily processed within Europe and in compliance with European data protection standards. This can create new types of smart services with AI language models - for example, a digital assistant for reading, processing and analysing claim forms for the car insurance industry.

<https://opengpt-x.de/>

### **POSSIBLE (Public Sector)**

For the areas of education, SMEs and public administration, the POSSIBLE project is developing a Gaia-X-compliant data space in which individuals, authorities or companies can exchange their data securely, transparently and in an interoperable manner through the POSSIBLE collaboration software. The special feature of the POSSIBLE open-source software is that it can be easily and flexibly adapted to many different requirement profiles. It thus enables the use and exchange of previously unused data pools - for example in administrations. Use cases: Continuing education and training in public institutions; Optimisation of communication in disaster control centres; Accessible communication between administrations etc.

<https://www.possible-gaia-x.eu/>

### **TEAM-X (Health)**

TEAM-X is building a data ecosystem in which patients can access their own health and (elderly) care data transparently at all times, regardless of the origin of the data, and have full control over the sharing of their data. For this purpose, IoT (edge) devices such as smartwatches or fitness trackers are connected to the cloud, and the resulting data is analysed decentrally and automatically. In addition, the resulting data - if released by the data owner - can be used to improve prevention, prediction and personalisation in care. Use cases: Women's Health Breast Cancer Care, Digital care platform (outpatient and inpatient).

<https://project-team-x.eu/>

### **TELLUS (Public Sector)**

TELLUS works to provide all Gaia-X users with high-performance connectivity and integration of heterogeneous network infrastructures by technically integrating all connection elements. The aim is to achieve optimal performance in terms of latency, bandwidth, security, resilience, dynamics and monitoring. The result is a Network-as-a-Service service where, for example, companies can order transmission services for critical business processes according to individually defined requirements instead of building their own network infrastructure. Use Cases: Intelligent glove (mimetics), Equipment as a Service (EaaS), Digital twin.

<https://www.tellus-project.de/>



# MANAGEMENT OF THE COMPLEXITY FOR MULTI-PROVIDER SERVICE OFFERINGS THROUGH ARTIFICIAL INTELLIGENCE

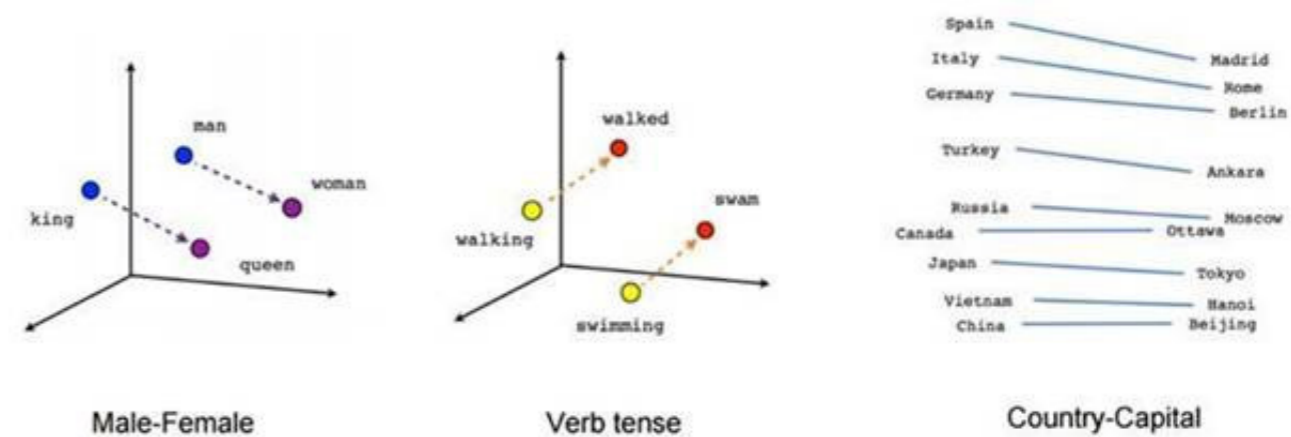
Thierry Caminel & Klaus Ottaradovetz, Atos

With the ever-expanding number of services for a catalogue of Gaia-X self-descriptions, it will be more and more difficult to find the best one to fit a given use case. Of course, we can leverage the existing mechanisms (like the Self-Description Tool) provided by GXFS to classify a service, but that requires an action from the service provider, and it's not easy to find the right place in the Gaia-X service ontology, especially if this one evolves with new categories. We could also use a search engine indexing keyword, but it's usually not well adapted to deal with a combination of structured information (normalized fields in the Self-Description Files) and unstructured one.

Recent development in AI and Machine Learning can help to tackle this issue through an emerging technique called "embeddings". The basic idea is to encode a concept (a word, a technology, a service, etc.) in a numeric vector,

typically of 512 dimensions. The vectors are constructed by unsupervised learning from a set of texts, and form points in a space, such that a distance between points (vectors) reflects the proximity of concepts in the corpus, and parallelism between segments, the similarity of relationships between concepts. Here are some examples:

Vectors can capture contextual information about entities, which could contribute to better approaches to searching information based on similarities. The principle can be extended with sentences (sentence embedding) or with graphs (graph embeddings). With this kind of technique, it is possible to create language models in spaces of billions of dimensions, which can be used for all kinds of purposes, e.g., to classify documents, extract entities and relations from text, generate texts, translate them, etc.



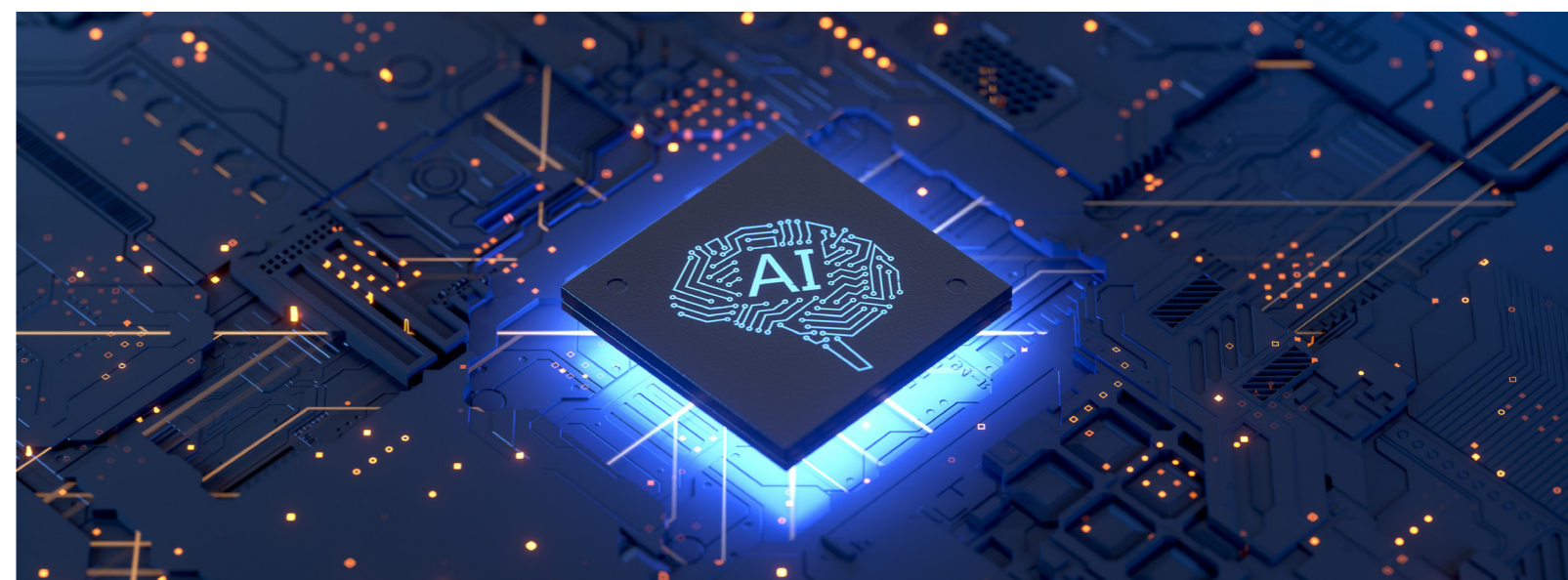
Source: John, Vineet. (2016). Rapid-Rate: A Framework for Semi-supervised Real-time Sentiment Trend Detection in Unstructured Big Data. 10.13140/RG.2.2.32385.04966.

This technique can be very useful in tackling our problem. Instead of having to provide keywords to describe services or classify them into an ontology, we could use some form of "Gaia-X service" embedding models to automatically encode a service description file into a vector. Such a model could be created by fine-tuning an existing large model with actual files, classifications, and ontologies.

That way, we could embed some domain knowledge with the search. The system, for example, could "know" that "RDMS", "Database", or "MySQL" are similar concepts without having to explicitly provide it with that information and thus find more relevant information when searching for such service.

We could also embed in the same vector textual information of the service and, leveraging graph embeddings, its connection with other services and other aspects of the Gaia-X Knowledge Graph, such as the Trust Framework.

Supporting providers in the creation of Gaia-X self-descriptions will also provide the opportunity to understand similarities, dependencies, and trends between all the service offerings and thus help to increase the alignment of the service offering toward a higher level of commonality and, with that, interoperability.



# EUPROGIGANT – DATA-DRIVEN BUSINESS MODELS FOR EUROPE’S MANUFACTURING INDUSTRY

**Prof. Dr.-Ing. Matthias Weigold**, Head of Institute  
Institute for Production Management, Technology and Machine Tools (PTW) at TU Darmstadt

Industry 4.0 stands for a smart manufacturing industry and is accompanied by a continuously increasing amount of generated data. To meet the challenges of a globalised manufacturing world (e.g., carbon footprint reduction, resilient supply chains, etc.), more and more data needs to be shared across companies in a secure way. Gaia-X will build the bridge between companies in a trustworthy environment under European law and will enable a secure and sovereign data exchange. This also opens up the opportunity for data-based business models.

These evolving business models are part of EuProGigant-’s industry-related use cases. The Austrian-German research project stands for the vision of a smart, resilient and sustainable European manufacturing industry and will set up a multi-location, digitally networked production ecosystem by March 2025. Created for the industry and its needs, EuProGigant showcases how data can support the industrial value creation process and describes at the

same time the utility of **data-driven business models** – which are part of all four thematic working groups. They focus on

- The product carbon footprint in production engineering and manufacturing by providing CO2 equivalent data in the product design phase to influence the carbon footprint in product manufacturing.
- the cross-company cooperation to create a database from test stands for condition monitoring via the validation platform.
- optimised, data-based combinations of assembly components
- processing and usage of large data amounts in the mobile use of machines

The recently published **paper “Developing Gaia-X Business Models For Production”** by the project partners Felix Hoffmann, Prof. Dr.-Ing. Matthias Weigold, Markus Weber, and

Joachim Metternich (Institute of Production Management, Technology and Machine Tools at TU Darmstadt) focuses on opportunities for the development of platform-based business models for the manufacturing industry in the context of Gaia-X and EuProGigant. In addition to a discussion of the basic characteristics of data-driven, platform-based business models, a process model was derived. This is based on the Artificial Intelligence Management Model for the Manufacturing Industry (AIMM) by Biegel, which has been adapted in broad areas to the already known framework conditions of Gaia-X. The newly studied characteristics of business models in the context of Gaia-X federated data and infrastructure ecosystem will be:

- sustainable value proposition formulation for all participating stakeholders from the cloud service providers, data providers, and service developers to end consumers
- dynamically changing interconnections with the stakeholder’s infrastructure during business operations
- dynamical, autonomous data and service exchange logging for generating a business revenue stream
- electronic, verifiable contracting
- multilateral, bidirectional data and service exchange using harmonised vocabularies and connectors (token-based access authorisation based on policy rules, IDS connector, EDC connector, EuProGigant edge-system data switch)

Furthermore, the approach also integrates tools from business model innovation – these are applied especially in the solution design phase. One of the tools used in this phase of the process model is the Business Model Canvas (BMC) by Osterwalder and Pigneur, which is a framework for visualising and structuring business models. This developed process model has been applied to the two EuProGigant use cases, “validation platform” and “ideal component matching”. Near future topics will be the interoperability of various Gaia-X ecosystems or data spaces in terms of interoperable business models, legal frameworks, and technical implementation.

The paper “Developing GAIA-X Business Models for Production” provides valuable insights into the business modelling process of EuProGigant and can be downloaded [here](#).

About EuProGigant:



The Austrian-German Gaia-X lighthouse project EuProGigant demonstrates how secure and sovereign data exchange can be implemented across companies using Gaia-X, and how new, data-driven business models can be created. The European Production Giganet stands for the vision of a smart, resilient and sustainable European manufacturing industry. By March 2025, the project team will set up a multi-location, digitally networked production ecosystem. In interaction with Gaia-X, EuProGigant not only enables sovereign data management but also offers a new dimension in the analysis of the companies' own production processes by making cross-company data value chains in a multi-platform ecosystem describable.

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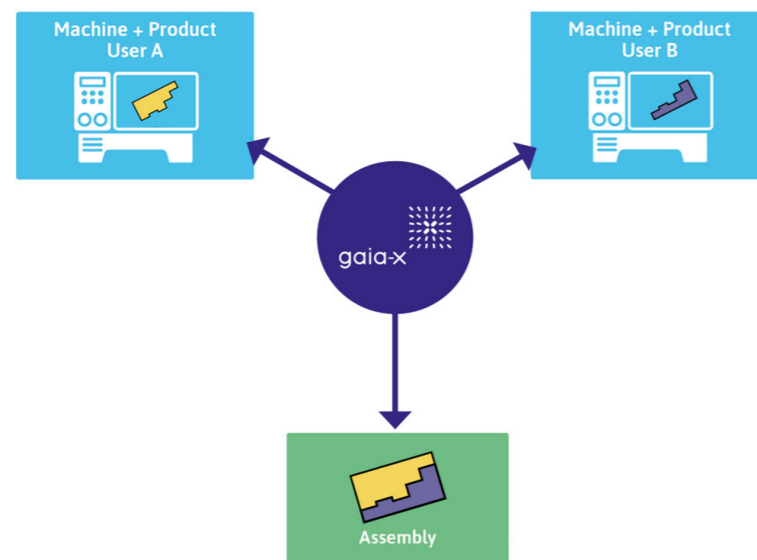
Prof. Dr.-Ing. Matthias Weigold studied mechanical engineering at the TU Darmstadt and earned his doctorate at the Institute for Production Management, Technology and Machine Tools (PTW) at the TU Darmstadt. During his eleven years in the industry, he gained international experience in a management role in the manufacturing and as a product owner in digital manufacturing. Prof. Weigold was appointed to the TU Darmstadt in 2019 and has managed the institute since then.



# EUPROGIGANT THEMATIC WORKING GROUP SERIES: IDEAL COMPONENT MATCHING

## THE MISSING PART OF RESOURCE-SAVING

Clemens Neuwirth, IT consultant Concircle Österreich GmbH



### Mismatched components cause waste through overproduction

Components are usually manufactured by different companies. After ordering and delivery, these components are assembled into the actual part. The components must fit

perfectly together so that the final product can be assembled smoothly. In this context, clients determine the acceptable tolerances that other companies must observe when they are manufacturing the matching components. In most cases, there is not much leeway in manufacturing.

Depending on the company's digital equipment and production management, these margins are communicated to the machine-operating personnel (e.g., via component drawings), who then carry out process planning based on these margins. This can also be done with computer assistance.

Sometimes components manufactured by different companies deviate from the tight tolerances to different degrees. In these cases, rework must be carried out to achieve the required accuracy. In other cases, incongruous components have to be stored so that they can perhaps be used later.

In other words, there is waste due to overproduction. Other processes are needed to save resources and to produce more efficiently and in a more environmentally friendly way.

### Tight tolerances for supplied parts

To produce a precisely fitting component pairing, very high demands (in the form of tight tolerances) are placed on the pairing components to be joined. Tolerances are often intentionally tight to ensure that variations in quality can be compensated. In some cases, manufactured and supplied components must fit and be matched to within a thousandth of a millimetre.

### Increasing efficiency and saving resources thanks to digital technologies

With the thematic working group 'Ideal component matching', the EuProGigant project team is working on a demonstrator that highlights the potential of using measurement data in product creation.

Components that are better-matched thanks to the use and analysis of measurement data are manufactured more efficiently and save

resources. Overproduction and warehousing of non-matching components decrease. This approach can also reduce rework costs: if components fit perfectly, one major assembly step is eliminated – namely, the reworking of the components.

Currently, however, many companies are reluctant to share their measurement data. Data is often uploaded to the cloud completely and unedited. Companies, especially SMEs, lack the resources to clean and analyse their measurement data. Sharing this raw data also means that all data is transferred to other companies and stored there.

### Efficiency and fair service thanks to transparent data exchange

Transparent data exchange can be a solution here. Specifically, this working group is building a demonstrator of a 'component matching service' that will achieve data sovereignty as defined in Gaia-X. A data set will only be uploaded after it has been requested and it will always be transmitted in a secure, sovereign manner. This transaction is also transparent: it is logged each time a set is requested and transferred.

In the application, the outer bushing and inner bushing of a multifunction spindle are manufactured at two locations. Together with parts from other parts suppliers, the spindle is assembled in Germany. During this process, all relevant data, such as serial numbers and measured values, are entered into the component matching service. The data ensure not only a precision fit but also traceability and transparency. Thanks to working with the measurement data, tuning rings no longer have to be constantly assembled, measured and machined. This rework can be avoided.

The concept opens opportunities for providing matching services that can also be applied to many other processing industries.

Stay tuned for more info on the other EuProGigant thematic working groups in the next editions!

About EuProGigant:

The Austrian-German Gaia-X lighthouse project EuProGigant demonstrates how secure and sovereign data exchange can be implemented across companies using Gaia-X, and how new, data-driven business models can be created. The European Production Gigant stands for the vision of a smart, resilient and sustainable European manufacturing industry. By March 2025, the project team will set up a multi-location, digitally networked production ecosystem. In interaction with Gaia-X, EuProGigant not only enables sovereign data management but also offers a new dimension in the analysis of the companies' own production processes by making cross-company data value chains in a multi-platform ecosystem describable.

About the editor:

**Clemens Neuwirth**, IT consultant, Concircle Österreich GmbH

Clemens Neuwirth supports EuProGigant in the course of his activities as an IT consultant at Concircle Österreich GmbH and focuses on the implementation of demonstrators. Concircle is a consulting company for digitalisation solutions especially in the areas of supply chain management and manufacturing, and is involved as a project partner. Through his studies and years of experience in the field of digitalisation as a consultant in manufacturing, he brings in practical as well as theoretical knowledge from a wide range of industries.



# SUSTAINABLE DATA ECONOMY FOR GAIA-X

**Claire Jean-Quartier PhD \*** and **Sarah Stryeck PhD #+**

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## Abstract

In the last few years, data and data-driven developments have gained more and more importance. In all institutions, a variety of different data is generated or collected. Information extracted therefrom can be used directly, or the data can be processed and analysed to obtain the desired information. Due to the increasing use and conversion of data and the development of numerous data-driven companies, it is essential to consider sustainability aspects. Hereby, it is important to think about sustainable data generation, used sensor technologies, storage needs and many other aspects. The aim of this publication is to present the relevant aspects of green data along the entire data life cycle to guide Gaia-X participants to ensure a sustainable data economy.

## Keywords

sustainability, data lifecycle, green data, technology, resource-efficiency

## Introduction

Data is a crucial raw material of our time. Raw materials are usually collected and used directly in their original form or consumed in processed form. The same approach applies to data. Data is generated or collected, and information extracted from data can be used directly, or the data can be processed to obtain the desired information. Approaches for mining, processing and further alteration of raw materials are resource intensive in many cases - the same is true for processing data. Many European or international organisations strive to act more sustainably and set goals for resource efficiency. For example, the United Nations defined 17 Sustainable Development Goals (<https://sdgs.un.org/goals>). These goals should ensure sustainable development on economic, social, and ecological levels. The European Green Deal ([https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal\\_de](https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_de)) was launched by the European Union to address climate and environmental challenges. The action plan aims to make the EU economy more sustainable, cleaner and resource-efficient. The goal is to reduce net greenhouse gas emissions to 0 by 2050, with a reduction of at least 55% by 2030 compared to 1990.

In addition to the major initiatives, concrete processes and standards for sustainable raw material use are already being defined. For example, the Renewable Energy Certificate System (RECS - <https://www.e-control.at>) provides a standardised certificate as proof of renewable energy production in Europe. For Smart Buildings, ecologically safe and low-emission building materials are used. These are labelled with the Environmental Product Declarations (EPD - <https://ibu-epd.com/epd-programm/>). Responsible forest management is certified with the Forest Stewardship Council (FSC - <https://www.fsc-deutschland.de/de-de/zertifizierung>) standard or the Programme for the Endorsement of Forest Certification Schemes (PEFC - <https://www.pefc.at/pefc-austria/>) standard. There are many more examples of certification of sustainable processes or products in the food industry, construction industry and other sectors.

Sustainability is also important on a data level. In the area of data economy, the main focus of initiatives is currently on data sharing and the creation of the necessary infrastructures (e.g. Gaia-X - <https://www.data-infrastructure.eu/>, European Open Science Cloud - <https://eosc.eu/>).

Gaia-X, which emerged from a Franco-German lead project (Position franco-allemande sur Gaia-X, 2020), aims to pave the way for a European digital ecosystem. Stakeholders in the data economy are working together on proposals, framework conditions, definitions, etc., to create a secure and networked data infrastructure. On the one hand, this should promote innovation and, on the other hand, strengthen Europe in the international context while at the same time meeting the highest standards of digital sovereignty.

In order to ensure that data is treated in a sustainable manner, we propose that stakeholders in the Gaia-X ecosystem should ensure that they adhere to sustainable data economy practices as described in this work.

However, currently, there are no certificates or standards for data that has been sustainably collected, processed and/or reused. Blauer Engel developed a first approach for resource- and energy-efficient software products (<https://www.blauer-engel.de/de/produktwelt/ressourcen-und-energieeffiziente-softwareprodukte>). Due to the increasing use of data and the rise of numerous data-driven companies, it is essential to consider underlying sustainability aspects. This includes the following questions:

- Where does the data we work with come from?
- To which extent has the collection of data affected climate change?
- Is the sensor technology used to collect the data made of environmentally friendly or non-harmful materials?
- To what degree does storing or processing of the data influence climate change?
- Which processes should be made more sustainable?

The aim of this publication is to present the relevant aspects of "green data" along the entire data life cycle. We define questions that need to be answered for a data set to specify and ensure sustainability. This collection of relevant questions forms a basis for the development of metrics and standards to design a certificate for green data.



## Sustainability throughout the data lifecycle.

Data is generated, collected, processed, analysed, stored, and ultimately (re)used or destroyed. In all the phases of the data life cycle, resource-consuming technologies and infrastructures are used to collect, modify, or process data. It is estimated that data centres consume over 200 terawatt hours (TWh) per year; this is more than the total energy consumption of some countries (Nicola Jones, 2018, p. 163-166). Additionally, cryptocurrencies continue to increase energy consumption. Their power amounts to over 50 gigawatts (G.W.) per day (<https://ccaf.io/cbeci/index>), which is equivalent to the power needed per year in Poland. The forecast of the future energy demand of data processing systems comes from Anders Andrae (Huawei Technologies Sweden), who predicts that data centre's power consumption is expected to increase to 8% of the projected global demand by 2030 (Anders S.G. Andrae, Tomas Edler, 2015, p. 117-157). In the following, these

resource-consuming aspects are explained in the respective phases along the data lifecycle; in addition, relevant issues for assessing the sustainability of data are defined.

### Data generation / collection

In the first step, data is generated or collected by measurement instruments, sensor technologies, but also by manual collection (e.g., manual entry into a database, transcription of interviews). Here, especially the use of resource-efficient sensors can play a supporting role in the environment. There are already many approaches to developing more environmentally friendly sensors, such as those made from natural fibre-reinforced biopolymers (<https://science.apa.at/power-search/3792601395331514951>).

Most of the data generated can be summarised into three main classes: social media data, machine data (including 5G), and transactional data. Data from social media is produced through the creation of likes, tweets & retweets,

comments, video uploads, and general media uploads. This type of data provides invaluable insights into customer behaviour and is essential for marketing analytics. Machine data is information that comes from industrial equipment and various types of sensors (e.g., pressure or sound sensors, medical devices, and satellites). This type of data is expected to grow exponentially as the Internet of Things (IoT) becomes more ubiquitous. In addition, global data growth will be further fueled in the near future as many countries push forward with the rollout of 5G networks. For example, China deployed an extensive 5G network for its telecom operators in early November 2019 ([https://www.nikkoam.de/articles/2020/whats\\_causing\\_the\\_exponential](https://www.nikkoam.de/articles/2020/whats_causing_the_exponential)).

Transaction data is generated from all daily transactions that take place both online and offline. Invoices, payment orders, stock records, delivery bills - all data is referred to as transaction data. Irrelevant data can also be removed during the collection or generation of data.

Relevant questions:

- How is the data generated?
- In the case of measurement data, are energy-efficient sensors used?
- What storage resources are used for the data?
- How is irrelevant data handled when collecting or generating data?

### Data processing

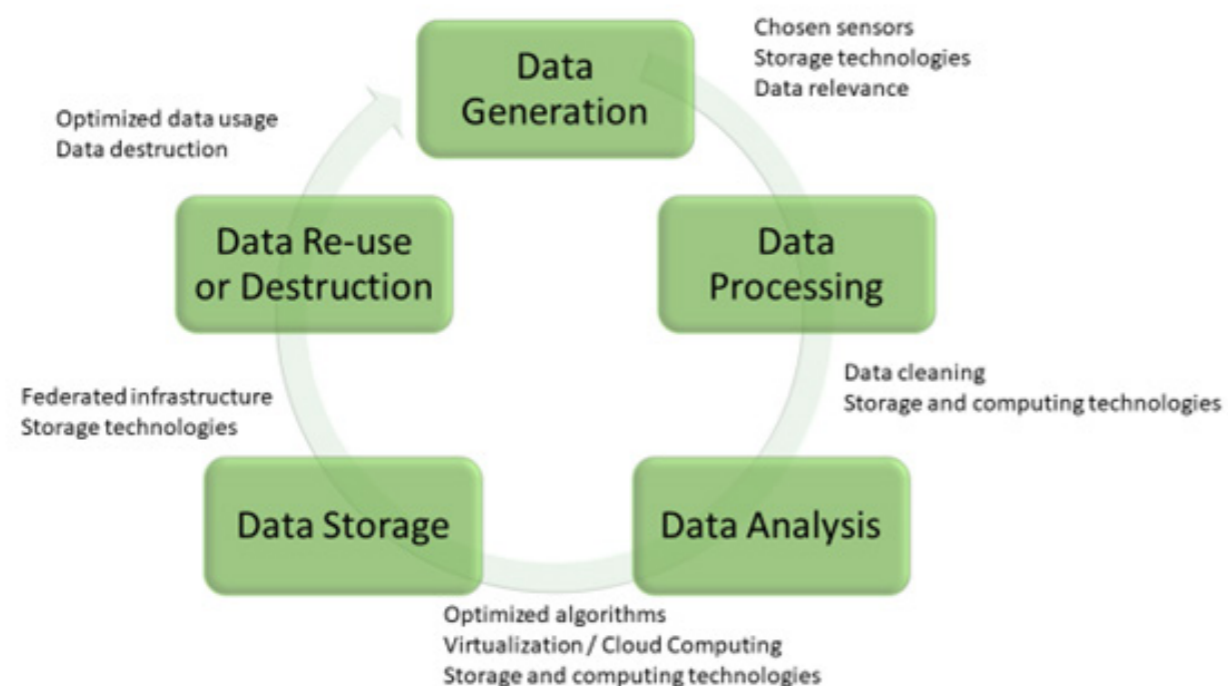
Data processing is the step where data is cleaned and prepared for analysis, or raw data is converted into higher quality data products. Here, data cleansing can reduce the amount of data stored by removing unnecessary

replicas (e.g., through deduplication software). In addition, using storage and computing resources, which consume only renewable energy, can improve the environmental footprint.

For big data processing, there are also approaches that seek to prioritise green energy. Green Hadoop, for example, balances energy demand and availability and relies on green energy when possible to minimise the use of brown energy (<https://cloudtimes.org/2012/05/30/green-hadoop-solar/>).

The average server load during data processing can be averaged to 20-30 per cent only. Power management, i.e., the use of sleep mode, helps to reduce energy consumption. Policies are required to promote the efficient use of computational resources (Giuseppe Iazeolla, Alessandra Pieroni, 2014, p. 29-39). In addition to power management, there are a variety of organisational measures (Aryan Azimzadeh, Nasseh Tabrizi, 2015, p. 128-131) to increase energy efficiencies such as equipment utilisation optimisation, process harmonisation and homogenised server landscape, acceleration of digital service creation, redundancy avoidance, energy monitoring, and metrics (Jumie Yuventi, Roshan Mehdizadeh, 2013, p. 90-94) to evaluate the efficiency of environmental efforts.

It is worth noting that servers account for only a portion of server room energy consumption. Cooling of server rooms can account for a quarter of electricity costs (<https://www.ingenieur.de/fachmedien/hlh/raumlufttechnik/kuehlung-von-rechenzentren/>). Here, the use of thermally driven cooling systems (absorption chiller) can significantly reduce energy consumption (solar cooling; Timm Rössel, et al., 2009, p. 37-41). Using waste heat to heat other areas of the building is another way to save resources



(<https://www.heizung.de/ratgeber/diverses/sauberes-heizen-mit-serverabwaerme-vor-und-nachteile.html>). In addition, the energy consumption of storage technologies should also be taken into account.

Relevant questions:

- Are unnecessary datasets removed through data cleansing processes?
- Which storage and computing technologies are used for processing?
- Are aspects of energy efficiency considered in all available areas (incl. waste heat utilisation)?
- In which way do these technologies affect climate?

### Data analysis

Data analysis involves extraction of information from existing data. Sophisticated evaluation routines can help to increase resource efficiency. For example, the use of hybrid models is helpful: the reduced number of simulations needed helps minimise energy requirements. In future, new approaches such as quantum computing may also lead to a strong reduction of computation times and thus save energy (Ikonen, J., Salmilehto, J. & Möttönen, M. Energy-efficient quantum computing. *npj Quantum Inf* 3, 17 (2017). <https://doi.org/10.1038/s41534-017-0015-5>). In addition, the promotion of open-source projects, i.e., joint optimisation of algorithms, can lead to increased energy efficiency.

Energy-efficient hardware systems should be preferably chosen for the sake of sustainability (e.g., LUMI supercomputer in Kajaani, Finland; <https://www.lumi-supercomputer.eu/sustainable-future/>). Companies such as Intel and Microsoft are developing special, energy-efficient hardware for privacy-preserving

technologies. Virtualisation or the use of cloud resources instead of operating a single data centre are further energy-saving alternatives.

The computing power available today is the driving force for efficient AI (artificial intelligence) algorithms. Computer vision is the prime example of a field that has benefited greatly. In these areas, there is also a specialised need for processors. More and more Graphics Processing Units (GPU) are needed instead of Central Processing Units (CPU).

*This example is a simplified illustration of the energy costs when using GPU resources. Here, we assume a 1:1 ratio of a graphics card to a processor. How high are the energy costs when operating (under idle/average/full load) a common graphics card like the Nvidia Tesla series? On the Nvidia homepage, it says that the maximum power is 250 W. That is about 2 times greater than the power of a current average Intel Xeon CPU (Xeon Gold 16-core, for example, up to 165 W). The power per day is then  $24 \times 250 = 6 \text{ kWh}$  for GPU and  $24 \times 165 = 3.9 \text{ kWh}$  for CPU. This means for a data centre with 5k GPUs at full load: How much energy does such a data centre cost per day according to our previous figures, assuming 4 GPUs are installed per system?  $5k \times 6 \text{ kWh}$  for GPU and  $5k/4 \times 3.9 \text{ kWh}$  for CPU. So, in total, around 35 MWh per day. This calculation does not yet include any power dissipation or further, albeit minor, energy consumption that is caused by other system components.*

In addition to the hardware, other aspects like cooling also contribute significantly to energy consumption. However, actual energy consumption can vary greatly depending on the operation and must be measured on a system- or room-specific basis.

Relevant questions:

- Which storage and computing resources are used for the analyses?
- In which cases is virtualisation and cloud computing used?
- What form of energy is used to power the cloud (renewables)?
- Which algorithms are used for the analyses?

### Data storage

After the data has been analysed and information has been generated, the data is stored. In many cases, internal storage resources or cloud resources are used for this purpose. Here it is recommended to calculate which form of storage has higher energy efficiency.

The power of the hard disk drive (HDD) was estimated at 14 W/hard disks in 2006, which is decreasing by about 5 per cent every year (8.6 W/hard disks in 2015). Solid state disk (SSD) performance has remained constant at 6 W/drive since 2010, but performance per terabyte (TB) has improved. Total power consumption for HDDs in the US in 2020 is estimated at just over 8,000 GWh/year for a total of 1,000 million TB of storage. With an estimated lifespan of 4.4 years, the number of hard drives in use is stable, but total capacity is increasing (<https://eta.lbl.gov/publications/united-states-data-center-energy>).

Emissions calculations of physical infrastructure are described in the Greenhouse Gas Protocol (The Greenhouse Gas Protocol, 2004). These types of emissions fall under Scope 1 and Scope 2 reporting guidelines, which many organisations are required to publish (<https://www.gov.uk/government/consultations/streamlined-energy-and-carbon-reporting>).

Additionally, standards exist for building energy-efficient data centres (Conference Proceedings, 2012, p. 54-104; Michael Pawlish et al, 2014, p. 1-6).

Corresponding emissions from cloud resources can be reported on a voluntary basis in Scope 3 reporting as "indirect" or outsourced emissions. Calculating actual emissions is more difficult because cloud providers such as Amazon Web Services, Google Cloud, and Microsoft Azure mainly publish aggregated global data with varying degrees of transparency (<https://nachhaltigkeit.aboutamazon.de/umwelt/nachhaltige-betriebsablaufe/CO2-Bilanz>; David Mytton, 2020). This lack of transparency also led to Amazon being criticised in a Greenpeace report (<https://www.greenpeace.org/usa/reports/click-clean-virginia/>).

In parallel, scalable infrastructures are also actively working on energy efficiencies, such as Google building its own servers ([https://cloud.google.com/docs/security/infrastructure/design#hardware\\_design\\_and\\_provenance](https://cloud.google.com/docs/security/infrastructure/design#hardware_design_and_provenance); <https://www.wired.com/2016/05/googles-making-chips-now-time-intel-freak/>) and building of the first gas data centre by Microsoft (<https://blogs.microsoft.com/green/2017/09/24/redesigning-datacenters-advanced-energy-future/>). The technology sector is also the largest consumer of renewable energy (<https://www.iea.org/commentaries/data-centres-and-energy-from-global-headlines-to-local-headaches>; <https://blogs.microsoft.com/blog/2020/01/16/microsoft-will-be-carbon-negative-by-2030/>).

In the storage phase of the data lifecycle, data is also shared with collaborative partners. Additional data flow due to increased data exchange also result in increased energy consumption. It is therefore important to use strategic approaches to make data exchange

sustainable (e.g., optimised use of resources through federation). Companies should also focus on efficient data management in this area (e.g., information lifecycle management), delete unnecessary cloud data and use data profiles.

Relevant questions:

- What storage resources are used to keep data?
- In which cases are virtualisation and cloud storage resources used?
- In which cases is federated infrastructure relied upon?

### Data (re-)use and data destruction.

The final phase of the data lifecycle does not mean that data is no longer usable. Preferably, data is used for other purposes or questions. In some companies, however, there are large amounts of data that remain on storage resources and are no longer used (dark data). In many cases, this is the less expensive option because assessing the usability of the data is a new process that requires dedicated human resources.

A variety of initiatives have been launched to maximise data sharing. At the European level, Gaia-X and International Data Spaces (<https://internationaldataspaces.org/>) play an important role. Here, data ecosystems are established in different domains to drive data sharing. Through Gaia-X and International Data Spaces, resources can be saved, and data-driven collaborations lead to added value.

Domain-specific initiatives such as the Green Data Hub (<https://www.greendatahub.at>), launched by the Data Intelligence Initiative (<https://www.dataintelligence.at>) together with the Federal Ministry for Climate Protection, Environment, Energy, Mobility, Innovation and

Technology, foster the sustainable use of data in the areas of the energy transition, mobility transition, circular economy and climate change mitigation.

Relevant questions:

- What is the visibility of data to maximise possible post-use?
- Which processes are in place for efficient data (re)use?
- Which processes are used to destroy data?

### Other sustainability aspects for data

In addition to the aspects around the data lifecycle, other approaches can be used to increase sustainable data economy.

The use of energy-efficient equipment (e.g., server sizing, blade servers, passive instead of active coolers, thermal design power CPUs, OLED displays, SSD instead of HDD), long service life, ecological balance in manufacturing as well as recycling of IT equipment is another environmentally friendly approach.

Billions of electronic devices are produced, sold, and disposed of every year. This brings a large profit for the electronics manufacturers but also harms the environment.

The use of sensor technologies is also accompanied by a great burden for our planet. The main focus here should be on the use of renewable raw materials. The origin of raw materials has also to be taken into account - rare earth, lithium, gold, copper, etc. - and the renunciation of the use of environmentally hazardous chemicals such as PVC or brominated hydrocarbons. In addition, planned obsolescence of products has a major impact on the environment (Gary Cook, Elizabeth Jardim, 2017).

In the area of human resources, the reduction of business travel through efficient online collaboration options can contribute to resource conservation. In addition, mobile workstations as well as, for example, solar-powered small backpacks and training on energy efficiency, enable remedial action and raise awareness of sustainable data economy.

Additionally, data can also be collected for a sustainable application purpose (e.g., data-driven optimisation of waste recycling processes, data-driven optimisation of energy use).

### Conclusion

This publication describes those processes in the lifecycle of data that play a central role in a sustainable data economy. A great deal of attention has been paid to energy efficiency: What form of energy is used? Are sustainable forms of energy used? Is waste heat used in energy generation and use? Are energy-efficient technologies used? We encourage Gaia-X and data space participants to think about these questions and to plan and choose data handling practices accordingly to ensure that the Gaia-X effort is realised to best serve the SDGs.

The next step is to define metrics for these aspects to enable measurability. These metrics can then provide a measurement basis for standardisation. Labels help consumers to evaluate products. Products from organic farming are labelled with a BIO seal, and food that has been produced under certain social and ecological criteria is marked with the Fairtrade seal. Such a seal of approval would also be conceivable in the field of data management. This is the first step towards a green data economy. To integrate these

processes sustainably into companies, these metrics should be integrated into internal company systems and recommendations for the greening of data should be made using recommender systems.

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# 05 EVENTS

## Gaia-X events

Every year Gaia-X hosts and participats in a wide range of events where its community can share their knowledge, expertise and advice. In 2023 Gaia-X hosts multiple large and small scrale events – Data Spaces series (online), Market-X, Tech-X, Hackathon, Hub workshops, Summit 2023 to name a few. In this section you will read about past and upcomming events and how they impact the industry.



05

# The Gaia-X initiative is hosting a series of exciting events to promote secure and trustworthy data infrastructure in Europe that upholds European values and regulations.



A special thanks to our partners

## Gaia-X Summit 2022

The 3rd Gaia-X Summit in Paris, which took place on 17-18 November 2022, featured platinum partner Dawex, gold partner IONOS, and silver partners DECIX, aruba.it, and deltaDao. At the Summit, we showcased a demo of 170+ service descriptions, ready in the take queue to get compliance through the upcoming Gaia-X Digital Clearing House. Moreover, eight Gaia-X Lighthouse projects have displayed their Gaia-X Framework-based innovations in the areas of mobility data spaces, tourism, agriculture, and manufacturing to further highlight the demonstration.

*“The Gaia-X Framework – the engine of Gaia-X – is up and running, and eight lighthouse projects have already started adopting it. We announced the launch by March 2023 of the services for a GXDCH (Gaia-X Digital Clearing House) – the one stop place to go and get verified against the Gaia-X rules to obtain compliance, in an automated way. We showed a demo of 170+ service descriptions from our members, ready in the take off queue to get the compliance through the Clearing House.”* – Francesco Bonfiglio, Gaia-X CEO

*“The Gaia-X framework is defined by the core pillars of compliance, federation and data exchange, in fact resulting in bringing further user control, openness and transparency on the*

*basis of a common governance documented and defined by specifications that can be used by Providers to design their own products and Users to control their choices.”* – Pierre Gronlier, Gaia-X CTO

*“Based on Gaia-X principles, we showcased how Gaia-X can turn a standard provider/user relationship into a new ecosystem in which both parties can materialise and monetise. To highlight the demonstration, eight Gaia-X Lighthouses projects impressively demonstrated the power of Gaia-X to build industry grade solutions for data driven value chains.”* – Roland Fadrany, Gaia-X COO



PLATINUM



GOLD



SILVER



SILVER



SILVER



# Market-X Conference & Expo

The **Market-X Conference & Expo** in Vienna on 14-15 March 2023 launched the Gaia-X Digital Clearing House (GXDCH), offering a one-stop solution for verifying compliance with Gaia-X rules in an automated way, with Aruba and T-systems as the first two GXDCH nodes.

Two more lighthouses also joined forces with Gaia-X, including **Gaia-X 4 Future Mobility**, which focuses on smart city mobility, and **Omega-X** for energy dataspace.



**Francesco Bonfiglio**, the CEO of Gaia-X, commented on the announcements: *"To become a de-facto standard, Gaia-X must be adopted by the market, and by the largest number of users and providers. As we promised, Gaia-X is now a reality, and the availability of the first Gaia-X Digital Clearing House proves this. The first nodes of verification of Gaia-X compliance, together with catalogues populated by thousands of Gaia-X compliant service descriptions, dozens of projects can now implement real common dataspaces in multiple business segments."*

**Roland Fadrany**, the COO of Gaia-X, stated: *"As the Gaia-X Digital Clearing House is becoming available, we can present it to all the projects that are invested or interested in the Gaia-X Framework. Hence, the Market-X event was crucial for developing the Gaia-X of the future: It brought together the best project examples from the +370 members businesses and start-ups, dozens of projects, hundreds of federation participants from all countries, and thousands of Gaia-X compliant services deployed in all industry verticals."*

**Pierre Gronlier**, the CTO of Gaia-X, exemplified that *"the Gaia-X Framework shows how specifications and software components, as well as their operationalisation, fit together to create technological trust and provide market transparency."*

**Fabrizio Garrone**, Enterprise Solution Director, Aruba Enterprise: *"Becoming one of the nodes is an essential milestone. It's a big second step in the main process that will enable us to support the execution of compliance component services. This safeguards the distributed and decentralised node, not managed by the Association, where anyone can refer to achieve compliance with the Gaia-X standards. And this could be direct access to Gaia-X for our customers as a participant through Aruba's GXDCH node."*

*"T-Systems has become one of Europe's first Gaia-X Digital Clearing House node providers. By providing this infrastructure, T-Systems aims to support the development of innovative digital solutions that can drive economic growth and competitiveness in Europe while maintaining strong data protection standards and transparency on sovereignty standards,"* declared **Maximilian Ahrens**, Chairman BoD Gaia-X and SVP T-Digital, Telekom Deutschland.

# Tech-X Conference & Hackathon

The **Tech-X Conference & Hackathon**, took place in Bilbao, Spain, on 3 & 4 May 2023, organised by Gaia-X and the OSS Community, explored a range of exciting topics, including the GXDCH, confidential computing, ODRL, data exchange, data traceability, trust anchors and open-source technologies.

Gaia-X's Tech-X Conference & Hackathon demonstrated the immense potential of a secure and federated data infrastructure in Europe, as well as how data is of great relevance for businesses and for European economic growth. The organisation looks forward to continuing to lead the way in promoting innovation and digital sovereignty in the tech industry. The Hackathon concluded with the announcement of the following three winning projects:

- **1st prize** - Implementing Verifiable Credentials in a real live use case;
- **2nd prize** - Self-description generation via infrastructure discoverability features;
- **3rd prize** - Data Product Passport with European Manufacturing & Gaia-X standards.

**Javier Esteve Pradera**, Area Coordinator of the Data Office of the General State Administration from the Spanish Ministry of Economic Affairs and Digital Transformation, stated: *"Tech-X has articulated the best use cases of the Spanish technological community, and not only. I was very pleased to see a comprehensive demo of what the Gaia-X deliverables and KPIs look like and a very clear picture of what is coming ahead*



*for Europe's digital economy."*

**Marco Schuldt**, the German Federal Ministry for Economic Affairs and Climate Action, added: *"Digital sovereignty aims to help SMEs make sovereign choices regarding data, how to control it, and how to manage it. Gaia-X is a global approach to how we can collect and share the data and also create digital value out of it."*

**Francesco Bonfiglio**, CEO of Gaia-X, expressed his enthusiasm about the event: *"Tech-X is a necessary next step to make sure that Gaia-X is understood by everybody and also that Gaia-X is made practically concrete. We need to remember that Gaia-X is complex and a combination of economic and technical endeavours. Hence why we decided to show at the Market-X event in March what it means to create data spaces in the market, and now we are showing here in Bilbao what it takes to make it happen."*

**Pierre Gronlier**, CTO of Gaia-X, also praised the event: *"Tech-X is the first Gaia-X event dedicated to technical presentations, and I am thrilled about the quality of the presentations, the level of engagement from the attendees during the Q&A, and the commitment of our hackers in the hackathon. There is a bright future ahead fueled by the passion and contributions of our members and a clearer goal for Gaia-X."*

## Gaia-X Summit 2023

The 4th Gaia-X Summit will be held on 9-10 November 2023 in Alicante, Spain, and it will bring together experts, stakeholders, and policymakers to discuss the latest advancements and challenges in establishing a secure and trustworthy data infrastructure in Europe. Save the date and stay tuned for more info!



For more information on Gaia-X events,  
visit our website:

[www.gaia-x.eu/events](http://www.gaia-x.eu/events)





07

# CONCLUDING REMARKS



07

# Conclusion:



## Gaia-X Editorial team

The Gaia-X magazine provides a comprehensive overview of the latest developments in the tech world with a specific focus on Gaia-X and its partners.

To highlight the work of Gaia-X and its partners, this issue of the magazine also features a new section dedicated to women in tech. This section showcases the contributions of women in the industry and their inspiring stories, providing valuable insights into the experiences of women in a field that has historically been male-dominated.

The Market-X partners stories section showcases the diversity of Gaia-X's partners and their innovative solutions, which are driving digital transformation across various industries. This section provides a platform for Gaia-X's partners to showcase their work, share their experiences, and highlight their impact on the tech industry.

The community stories section highlights the collaborative efforts of Gaia-X members, demonstrating how the initiative is bringing together stakeholders from across Europe and beyond to build a sovereign and secure data

infrastructure. This section showcases the power of collaboration and the importance of working together to achieve a common goal.

Lastly, the Gaia-X events section offers insights into past and upcoming events and conferences, providing a platform for stakeholders to come together and exchange ideas. This section highlights the importance of community engagement and the value of bringing stakeholders together to discuss the latest developments in the tech industry.

Overall, the Gaia-X magazine offers a valuable resource for those interested in the latest developments in tech and those invested in building a secure and trustworthy data infrastructure for the future. By highlighting the work of Gaia-X and its partners, as well as the experiences of women in tech and the power of collaboration, the magazine offers a comprehensive and informative perspective on the tech industry and its potential for the future.

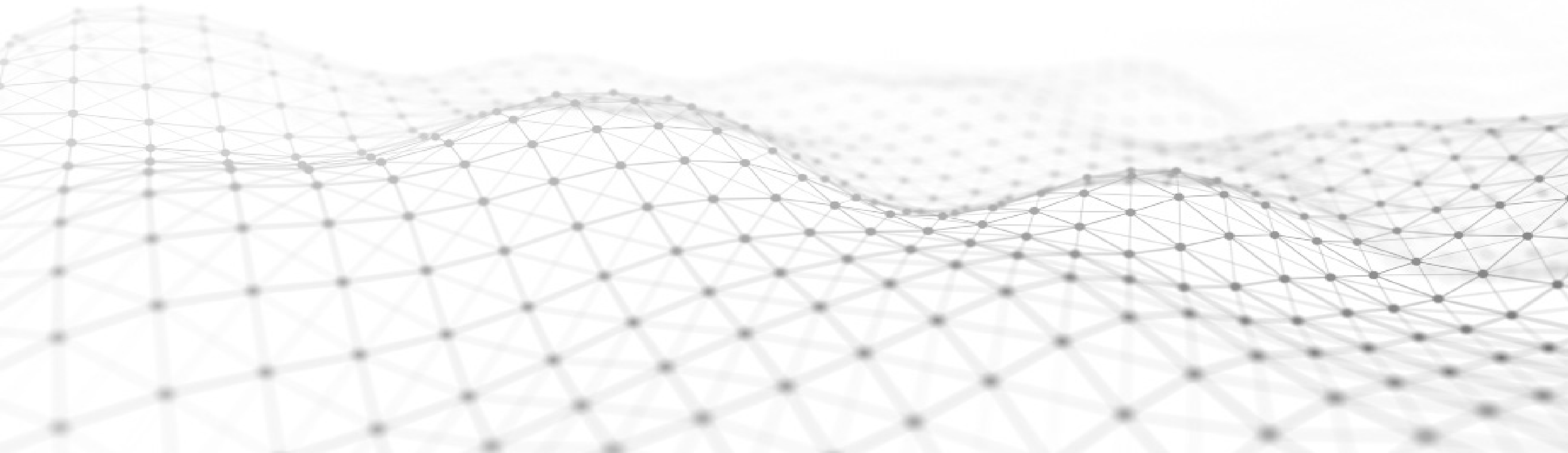


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**Stay tuned.**

**Gaia-X is here  
to stay.**



# Gaia-X magazine

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