Gaia-X Voices:
Use-Case Testimonial

Ideal Component Matching

EuProGigant

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Contents

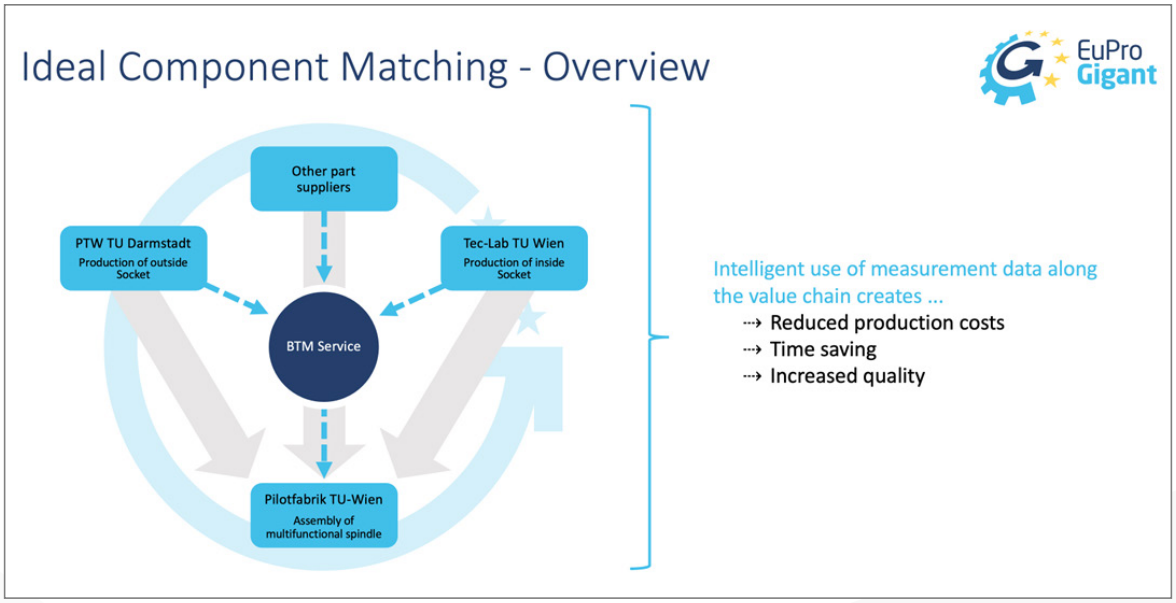
1. Introduction

a. *Brief overview of organisation and Industry*

EuProGigant is a joint Austrian-German initiative focusing on creating a secure, sovereign data exchange ecosystem for the European manufacturing industry. The project aims to establish a federated Gaia-X compliant production ecosystem by 2025. Our organisation emphasises data sovereignty, cross-company data value chains, and the development of new data-driven business models. Overall, the project is dedicated to enhancing collaboration by establishing a successful data space for manufacturing companies and related parties to securely exchange their data while ensuring sovereignty.

The manufacturing industry demands high precision and efficiency to remain competitive and sustainable. Tight tolerances are critical to ensure components fit together perfectly, which is essential for the final product's functionality and reliability. However, achieving these tight tolerances across different manufacturers is challenging due to variations in production processes and quality control standards.

As indicated above, we operate within the manufacturing industry specifically targeting sectors where precision is critical for reducing waste and increasing efficiency. In the example of component matching of a CNC spindle, we demonstrate that individual parts can be produced with relaxed tolerance requirements if components from different suppliers are matched individually at the assembly line. Our work spans multiple industries, including automotive, aerospace, and industrial machinery, where tight tolerances and resource efficiency are crucial. This pushes the industry to work with tighter tolerances, even in sectors where it is not yet as common.



b. *Main stakeholders and the roles they play in designing the use-case*

PTW TU Darmstadt:

- **Role**: Production of the outside socket which is used in combination with the inside socket. These two parts need to be perfectly and tightly aligned for the spindle to function properly. This illustrates the importance of ideal component matching as such instances are common in the manufacturing industry.
- **Responsibility**: Manufacture the outer bushing component with tight tolerances and share the measurement data for matching.

Tec-Lab TU Wien:

- **Role**: Production of the inside socket which needs to be in-sync with the corresponding outside socket to ensure functionality. TU Wien is providing its expertise in producing both the inside socket and creating the "Profitrainer" which uses the final assembled spindle.
- **Responsibility**: Manufacture the inner bushing component with precise specifications and contribute measurement data for optimal matching.

Service Provider concircle GmbH - Ideal Component Matching Service (BTM – Bauteil-Matching-Service):

- **Role**: Service provider for measurement data processing and component matching.
- **Responsibility**: Provision of service for analysing measurement data to ensure precise matching of components and maintaining data sovereignty and transparency.

Other Part Suppliers:

- **Role**: Supply additional components required for the assembly of the multifunctional spindle.
- **Responsibility**: Ensure their parts meet the required standards and integrate them with the Ideal Component Matching Service for data sharing.

Pilotfactory TU-Wien:

- **Role**: Assembly of the multifunctional spindle.
- **Responsibility**: Utilise the precisely matched components to assemble the final product, ensuring reduced reworking efforts and increased efficiency.

2. Context & Challenge

a. *Brief description of the problem that the use-case addresses*

The *Ideal Component Matching* use case within the EuProGigant project, aims to address these challenges by implementing a secure, transparent, and efficient data ecosystem. This ecosystem leverages measurement data to ensure components are matched accurately, reducing waste, minimising rework, and enhancing overall production efficiency. By fostering data sovereignty and secure data exchanges, the project aims to build trust among participating companies, encouraging them to share critical data without compromising their competitive edge.

Rework and Higher Efforts:

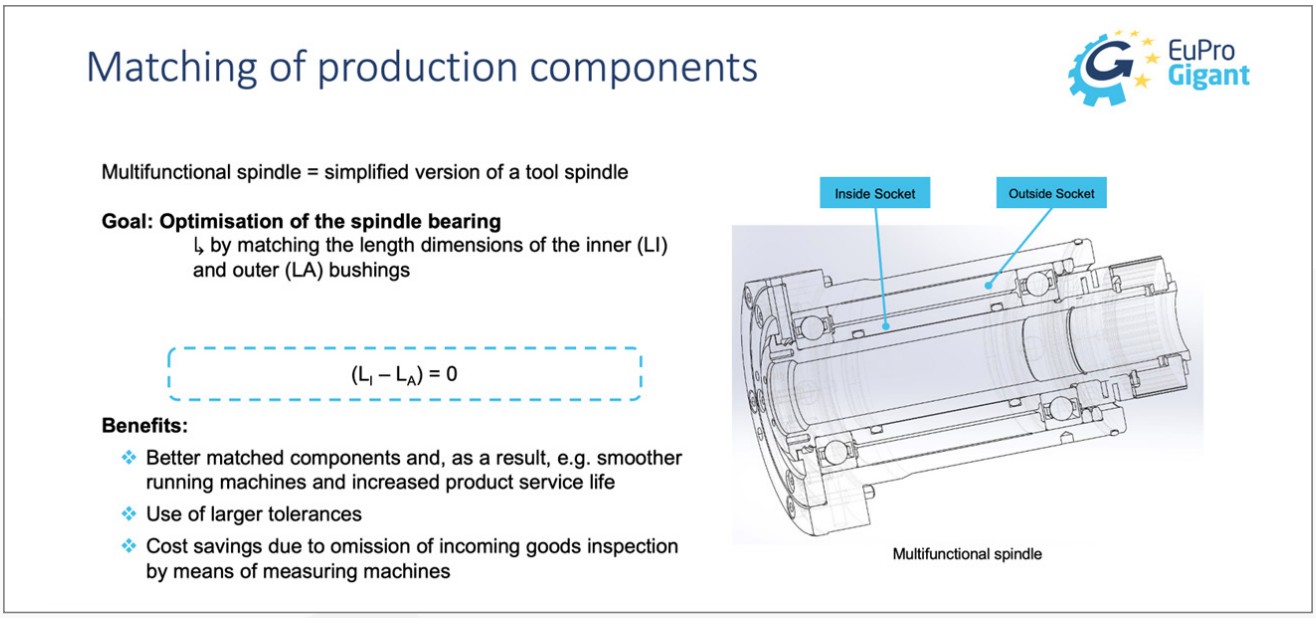
When components do not fit together as required, significant rework is needed to bring them to the desired tolerances. This rework process is time-consuming and labour-intensive, leading to increased production efforts and higher operational costs.

Lower Quality Due to Mismatched Components:

Mismatched components often result in lower overall product quality. Even slight deviations from the specified tolerances can affect the functionality and reliability of the final product, leading to potential failures and reduced customer satisfaction.

Efforts for Measuring and Finding the Best Match:

Identifying and measuring components to find the best possible match requires substantial effort. This process involves precise measurement and analysis, which can be resource-intensive and time-consuming. The need for constant monitoring and adjustment to ensure components meet the necessary specifications further complicates the manufacturing process.



3. Solution description

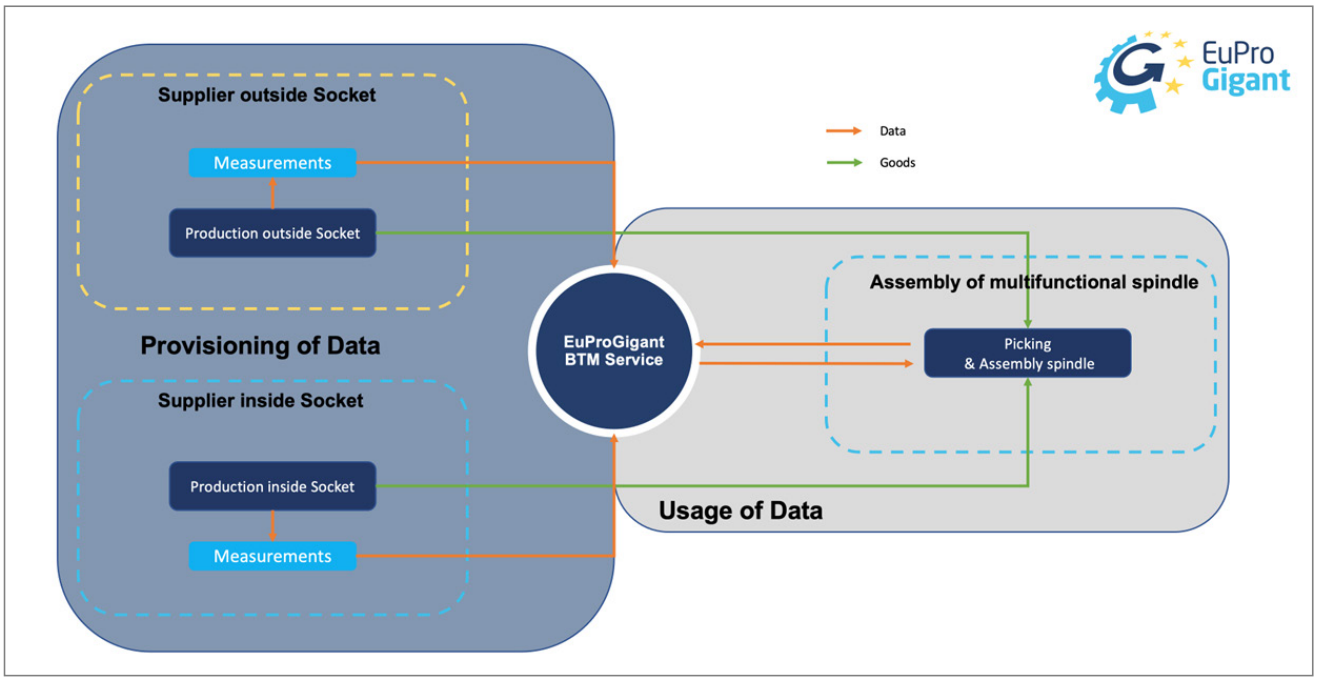
a. *Solution implemented to address the identified challenges*

The *Ideal Component Matching* use case implements a comprehensive solution designed to address the inefficiencies and quality issues associated with mismatched or non-matched components. The solution involves several key components and processes:

Measurement Data Collection and Analysis: Components manufactured by different suppliers are measured with high precision to capture their exact dimensions and tolerances. This measurement data is collected and stored securely.

BTM Service: The BTM Service acts as a service where measurement data is processed and analysed. This service ensures that only components meeting the tight tolerances are paired together. It facilitates secure and transparent data exchanges between different stakeholders.

Integration with existing systems: The solution is designed to integrate seamlessly with the existing manufacturing execution systems (e.g.: SAP Digital Manufacturing) and processes of participating companies.



b. *Role of technology in the development and deployment of the solution*

The *Ideal Component Matching* use case leverages multiple advanced technologies to ensure precise component matching and efficient manufacturing processes. By utilising state-of-the-art cloud computing platforms, containerisation, and secure data management solutions, the implementation not only enhances performance and scalability but also ensures data sovereignty and security. Below is an overview of the key technologies employed:

Cloud Computing Platforms - A1 Exoscale: A1 Exoscale is currently in use, providing the cloud infrastructure needed for improved scalability and performance.

Containerisation with Docker: Docker is used to create and manage containers that encapsulate the JavaSpringBoot backend and MongoDB. This ensures a consistent and portable deployment environment.

Container Orchestration with Kubernetes: Kubernetes manages the deployment, scaling, and operation of Docker containers, ensuring efficient resource utilisation and high availability.

SpringBoot and MongoDB: The JavaSpringBoot framework is used for developing the backend, managing dependencies, and maintaining clean code. MongoDB, a non-relational database, runs within the SpringBoot environment and is managed as a Docker image, providing flexible and scalable data storage.

Security and Data Sovereignty with Gaia-X, Keycloak and deltaDAO: Keycloak handles authentication and authorisation, managing tokens for OAuth to secure data exchanges. DeltaDAO, using the Pontus-X network, ensures the solution aligns with the Gaia-X architecture, facilitating secure and sovereign data integration.

4. Implementation

a. *How the solution was integrated into the use-case organisation's existing systems or processes*

The solution was integrated into the organisation's existing systems by connecting to the *Manufacturing Execution System (MES)*. Previously, measurement data was either not captured, or recorded manually on paper; now, it is digitally captured and securely stored. This digitisation allows for real-time data processing and improved precision in component matching, enhancing overall efficiency and reducing the need for rework.

b. *Significant milestones or challenges during the implementation phase*

Stakeholder	Description of challenge	Dimensions					Level of difficulty experienced (Low, Medium, High)
		Design of the use-case	Governance of participants	Development of elements & apps	Integration of systems & participants	Using the use -case	
MES imple-mentation partner	Ecosystem not advanced enough yet			✓	✓		High but progressively declined during project
Component matching solution pro-vider	Using compute-to-data correctly	✓		✓		✓	Medium

5. Benefits & Impact

a. *Measurable use-case implementers' benefits observed since implementation*

Description of benefit	Role this benefit applies to	Dimensions			
		Technological	Operational	Functional & participant-related	Governance & legal
More mature ecosystem	Solution provider and production companies	✓	✓		
Enhanced compute-to-data capabilities	Solution provider and production companies	✓		✓	

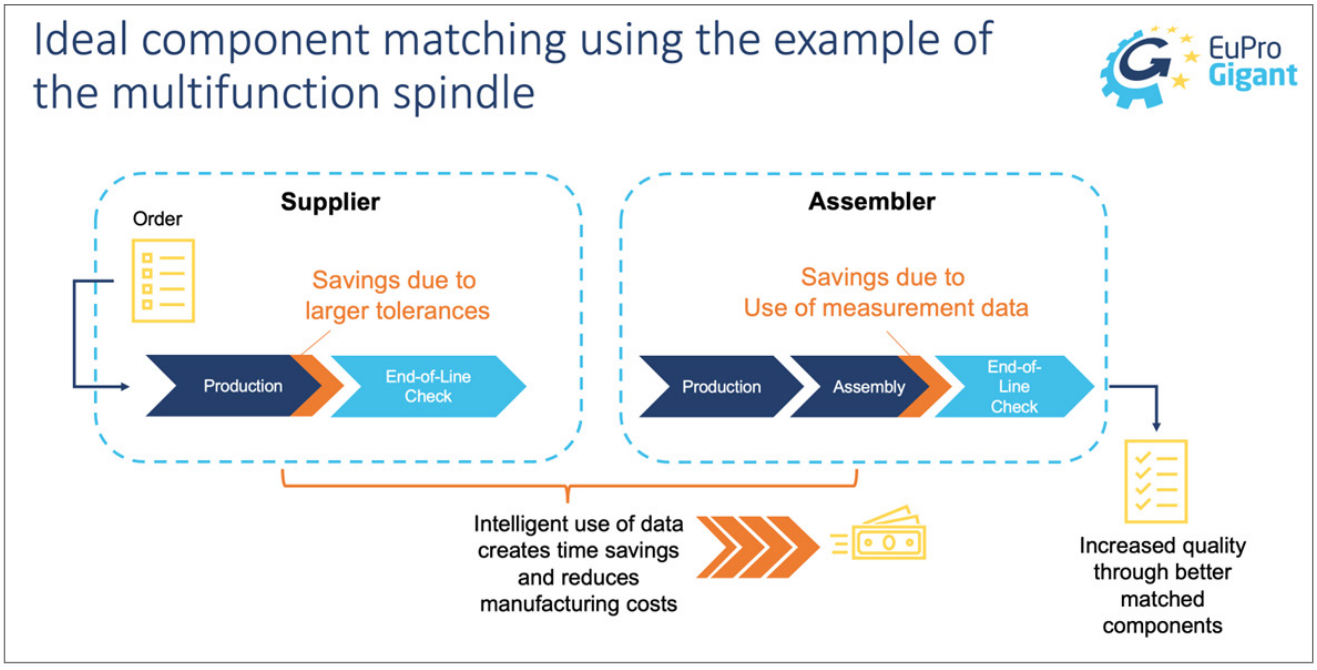
b. *Benefits for the end-users*

Increased Quality: The use of precise measurement data ensures that components are better matched, leading to higher-quality final products. For instance, using the example of the multifunction spindle, the improved matching of components results in a more reliable and efficient spindle assembly.

Cost Savings: End users benefit from significant cost savings due to reduced rework and wastage. The intelligent use of data allows suppliers to work with larger tolerances, minimising the need for precise adjustments and reducing production costs.

Time Saving: End users save time by integrating precise measurement data into the production and assembly processes. This efficiency gains streamline production timelines, allowing for faster assembly and quicker time-to-market for final products.

Enhanced Efficiency: The process improvements lead to overall enhanced efficiency in manufacturing operations. The streamlined production and assembly processes reduce the need for end-of-line checks and rework, freeing up resources and improving throughput.



6. Added Value through Gaia-X

a. *Alignment with the Gaia-X vision*

The *Ideal Component Matching* use case within the EuProGigant project is designed to closely align with the Gaia-X vision of fostering a secure, federated, and sovereign data infrastructure for Europe. The alignment focuses on several core principles of Gaia-X:

- Data Sovereignty and Security: Gaia-X emphasises that data remains under the control of its owners. In our use case, the BTM Service ensures that all data transactions are secure and transparent, allowing companies to maintain control over their proprietary information. This adherence to data sovereignty is fundamental to building trust among participants.
- Transparency and Trust: Gaia-X aims to create an environment where data exchanges are transparent. The Ideal Component Matching use case implements transparent logging of all data transactions, ensuring traceability and accountability, which are key to establishing trust among stakeholders.
- Interoperability and Federated Services: Gaia-X promotes the use of interoperable standards and federated services to connect diverse data ecosystems. Our solution integrates various existing systems and utilises standardised data exchange protocols to ensure seamless interoperability. The use of federated services enables efficient data processing and sharing across the network.
- Innovation and Efficiency: By leveraging advanced digital technologies, the project drives innovation in manufacturing processes. The integration of precise measurement data and automated matching algorithms enhances efficiency, reduces waste, and improves overall product quality, which aligns with Gaia-X's goal of fostering innovative digital ecosystems.
- Compliance with European Legal Framework: Gaia-X facilitates that all data transactions comply with European legal standards, including GDPR. The EuProGigant project adheres to these regulations, providing a legally secure framework for data exchanges.

Throughout these alignments, the Ideal Component Matching use case not only addresses immediate manufacturing challenges, but also contributes to the broader objectives of Gaia-X, promoting a resilient, innovative, and sustainable digital infrastructure for Europe.

b. *Alignment of current architecture and technology stack with the Gaia-X technology model, and any convergence needs*

By using the Pontus-X network (managed by deltaDAO) we are strongly ingrained in the Gaia-X architecture. Likewise, the use case has adopted the Trust Framework 23.10, including registering services as per the rules thereby prescribed. Furthermore, we also investigated the potential of incorporating some Eclipse XFSC cross-federation services components within the use case.

7. Use-case scaling

a. *Requirements and steps for a new member (user, provider, or service providers) to join use-case*

Compliance with Gaia-X Principles: New members need to join the EuProGigant ecosystem and adhere to the requirements of Pontus-X, as set by deltaDAO. These involve all participants to use Self-Sovereign Identities (SSI), acting as a legal person with validated identities against official registers, in adherence with the Gaia-X Trust Framework. Furthermore, there are also requirements to be fulfilled at the time of onboarding. These include compliance to the Gaia-X Trust Framework. Furthermore, for identification purposes a legal name as well as a valid European Unique Identifier (EUID), Economic Operations Registration and Identification Number (EORI), VAT identification number (vatID) or unique LEI number are necessary. In addition, the onboarding process requires the physical location of the headquarters to match the documented legal registration of the legal person. Additionally new participant credentials need to be created, or previously-existing Gaia-X participant credentials are supported in the process. Lastly, operating members need an identifiable unique public network controlled by a private key which can be added in the participant registry. All these measures in the onboarding process ensure that all participants align with the overarching goals of secure and sovereign data exchanges.

Technological Infrastructure: Organisations should have compatible technological infrastructure and interfaces, which ensures seamless integration. This could include open standards such as HTTPS Web Services or S3 Buckets to provide data access. To use compute-to-data a Kubernetes cluster is recommended.

Commitment to Quality and Efficiency: New members should be dedicated to improving manufacturing efficiency, reducing waste, and enhancing product quality through precise component matching and advanced digital technologies.

b. *Other sectors that could benefit by making use of the resources in this usecase*

Automotive Industry: The automotive industry relies heavily on precise manufacturing to ensure the reliability and safety of vehicles. Implementing the Ideal Component Matching use case can significantly enhance the precision of automotive parts, reducing the need for rework and lowering production costs. Additionally, better-matched components lead to improved vehicle performance and customer satisfaction. This precision is crucial for components such as engine parts, where even slight mismatches can lead to significant performance issues and potential safety hazards.

Aerospace Industry: The aerospace sector demands the highest standards of precision and reliability due to the critical nature of its applications. Precise component matching ensures that all parts fit together perfectly, reducing the risk of failure, and improving the overall safety and performance of aircraft. This can lead to reduced maintenance costs and enhanced operational efficiency, which are vital in an industry where safety and reliability are paramount.

Healthcare and Medical Devices: In the healthcare sector, the precision of medical devices is directly linked to patient safety and treatment effectiveness. Implementing the Ideal Component Matching use case can ensure that medical devices are assembled with high accuracy, leading to better functionality and reliability. Secure and transparent data sharing, as facilitated by Gaia-X principles, also ensures compliance with regulatory standards, and enhances trust among stakeholders.

8. Next steps

a. *What are the next steps of your project functionally-speaking?*

The overarching goal of the EuProGigant project is creating a secure and sovereign data exchange ecosystem for the European manufacturing industry. In this sense, this first Ideal Component Matching use case already proves that measurement data can be leveraged to ensure a more accurate matching of manufacturing components, overall enhancing production efficiency.

Equally, multiple further enhancements can also be achieved in the future, for which a stronger standardisation of industrial technical devices would still need development. This also goes hand in hand with leveraging common industrial technologies like the Asset Administration Shell (AAS), a topic already being explored (see e.g. Pepperl+Fuchs PFG001 P-F Kabel-02 Nameplate via Neoception Digital Twin Infrastructure (DTI) Asset Administration Shell (AAS), or CliCE-DiPP x ESCOM Algorithm - PCF-Service).

b. *How these functionalities leverage the Gaia-X vision*

By leveraging industry standards for connectivity, we are able to grow the impact footprint of this use case onto a much larger audience. Moreover, by employing the Gaia-X model and different developments across its ecosystem, we are able to natively connect stakeholders from the manufacturing industry to other similar Gaia-X-based domains, opening doors to potential data-driven synergies as well as growing the overall Gaia-X user base.

c. *Next steps of your project in relation to the current (and near-future) versions of the Gaia-X architecture, and/or Policy Rules Compliance Document, and/or GXDCH release*

Next steps for the project include switching onto the newer generation of deltaDAO's autonomous network. This stores the state of the ecosystem including the catalogue data, payments, logs, contracts, governance decisions (and others) in an immutable distributed ledger. These capabilities guarantee free access to the network, its availability, resilience, and federated participation without a single point of failure, and will now see an upgrade of privacy, cybersecurity and scalability features. This was a demand by network participants and will now have the ecosystem running in *Trusted Execution Environments (TEEs)*.

Interestingly, the upgrade has evidenced the lack of lock-in, with identities not experiencing any changes and thus a seamless transition into the new ecosystem. This also provides a positive example for follow-up Gaia-X-based projects, as well as potential future collaborations with this project's partners.

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gaia-x

Gaia-X

European Association
for Data and Cloud AISBL

Avenue des Arts 6-9

Bruxelles, Belgium

P.C. 1210

info@gaia-x.eu