Document Control Sheet

1. ISBN or ISSN planned	2. type of document (e.g. report, publication) Report
3. title Verbundabschlussbericht Gaia-X 4 ROMS	

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	6. publication date August 2025
	7. form of publication

8. performing organization(s) (name, address)

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9. originator's report no.
10. reference no. 19S21005A
11. no. of pages 123

12. sponsoring agency (name, address) Bundesministerium für Wirtschaft und Klimaschutz (BMWK) 53107 Bonn	13. no. of references 1
	14. no. of tables 3
	15. no. of figures 72

16. supplementary notes
17. presented at (title, place, date)

18. abstract

1. Current State of Science and Technology

The digitalization of mobility is in a dynamic development stage. Existing systems for passenger and freight transport are still largely based on proprietary platforms with limited interoperability. However, research projects under Gaia-X have demonstrated that federated data spaces, IoT integration, AI-based forecasting, and automated fleet management can significantly advance the state of the art. Foundational technologies such as Gaia-X Federated Services, Self Descriptions, and edge-cloud architectures have already been implemented in prototypes and form the basis for scalable mobility solutions.

2. Objective of the Study

The project set out to establish a secure, interoperable, and scalable data ecosystem for mobility and logistics. The underlying rationale was to enable decentralized services in both passenger and freight transport to interconnect seamlessly. This required the development of rendezvous-based transport logics for freight fleets, the integration of remote operation and dispatching capabilities into public transport, and the identification of innovative business models for data-driven services. The overarching goal was to create the technical and organizational foundations for sovereign data exchange and standardized interfaces, thereby reducing reliance on siloed solutions and strengthening Europe's competitiveness and digital sovereignty.

3. Methodology

The methodological approach was interdisciplinary and practice-oriented. Development was guided by concrete use cases such as the Smart Managed Public Transport Fleet and the Smart Managed Freight Fleet. Agile implementation strategies ensured flexibility and iteration, supported by laboratory tests, field trials, and a final public demonstration. Federated Gaia-X services, including identity management, service catalogs, and EDC connectors, were integrated throughout the project. Strong collaboration between industrial partners and research organizations,ensured that the results were both scientifically grounded and practically applicable. Evaluation was carried out through simulations, live demonstrations, and user studies.

4. Results

The project achieved a number of tangible results. Among the most significant was the development of a booking platform with rendezvous logic, enabling synchronization between shipping orders and autonomous transport robots. Interoperable interfaces and federated data spaces were established to ensure secure integration of data along the transport chain. AI-based forecasting models for route planning, estimated time of arrival prediction, and traffic flow optimization were developed and validated. Demonstrators were built to showcase innovative solutions such as AR-supported safety inspections with freight-fleet glasses, remote vehicle operation, and stop management with third-party utilization. In parallel, scalable business models including pay-per-use, subscription-based approaches, and dynamic pricing mechanisms were identified and tested.

5. Conclusion / Application Potential

The findings of the project demonstrate that Gaia-X-based solutions are both technically feasible and economically viable. For logistics providers, the results enable more efficient fleet utilization, greater supply chain transparency, and new monetization opportunities through data services. In public transport, the integration of remote operation and data-driven dispatching allows for improved service management, enhanced passenger information, and the incorporation of on-demand mobility offerings. For industry, the outcomes serve as a blueprint for building proprietary data spaces and leveraging data-driven business models, while the research community benefits from the further development of standards for interoperability, security, and federated identities. In sum, the project contributes to the establishment of a European data infrastructure and to the strengthening of digital sovereignty in the mobility sector.

19. keywords

Gaia-X, Federated Data Spaces, Digital Sovereignty, Edge-Cloud Architecture, Data Interoperability, Identity Management, Standardization & Interoperability, Open Ecosystems, Smart Mobility, Smart Managed Freight Fleet, Public Transport Fleet, Rendezvous Logic, Remote Operation, Autonomous Vehicles, Booking Platform, Multi-Agent Systems, AR-supported Inspections, AI-based Forecasting, Route Planning & ETA, Data-driven Business Models, Pay-per-Use, European Data Infrastructure

20. publisher	21. price