Fraunhofer ISST

Fraunhofer Institute for Software and Systems Engineering ISST

We build fair, sovereign and value-adding data spaces.

Annual Report 2023

Introduction

Dear readers,

Just like you, on a daily basis I am reminded of the sheer extent to which our lives are networked, and how much information needs to be exchanged every single second in order to keep society and the economy running at a certain speed. When I am at the office, I have an up-close view of the freight traffic at Dortmund Port, and the interaction of ships, cranes and goods trains there illustrates how important speed and data availability are to industry.

Meanwhile, when I'm on vacation, I get an insight into the challenges of our mobile world as more than just an observer. I can see first-hand just how much more potential could be leveraged if our mobility and our infrastructure were networked in a better way, and if information really could be exchanged in an integrated way across system and corporate boundaries. Not to mention how much easier our work and our lives would become if we improved how data items interacted.

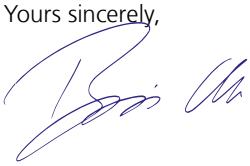
Research into digitalization is not abstract, and it is not distant from real life. It gives us a basis for deciding how we can and want to organize our lives in a networked, globalized world in the future. That is why, alongside our work on specific implementation projects in industry, we at Fraunhofer ISST are passionate about collaborating on central initiatives and infrastructure projects, like the EU-funded Data Spaces Support Centre. These set the standards and framework for a sustainable digital transformation that aligns with our European values. Of course, this work is not just about improving the availability of information from data — it is also about handling data in a sovereign and secure way, processing it in the most user-focused way possible and leveraging its value.

In 2023, we achieved outstanding results in this regard at the Fraunhofer Institute for Software and Systems Engineering, from both a research-oriented and an economic perspective. We have been able to make significant advances in developing data spaces in industry that are fair and sovereign, and add value. Initiatives such as the Catena-X Automotive Network or Manufacturing-X for the production industry are excellent examples of lighthouse projects.

Speaking of lighthouses, in 2023 we settled into our new institute building, the Leuchtturm (Lighthouse) on Speicherstrasse, next to Dortmund Port. As well as physically moving into the new space, we also brought a new organizational structure with us to the institute. With our new arrangement that is split into the four business units of Industrial Manufacturing, IT Service Providers, Healthcare and Mobility & Smart Cities, supplemented by a basic working group for Data Space Technologies, we have established structures that will serve the growing institute well. You can read about all of this on the next pages of our annual report.

At this point, I would like to express my gratitude to all our partners, clients and networks who placed their trust in us in 2023 and continue to do so. Together, we create innovations from data that drive digitalization in Germany, Europe and the world. I look forward to leveraging this digital potential even more with you in the future.

Yours sincerely,



Prof. Boris Otto, Institute Director at the Fraunhofer Institute for Software and Systems Engineering ISST

Contents

Fraunhofer ISST

We build fair, sovereign and value-adding data spaces.

The Fraunhofer Institute for Software and Systems Engineering ISST develops data space technologies for sovereign data exchange and works with its partners to build the data ecosystems of the future.

Fair

Data spaces can only succeed if everyone involved benefits. That is why we adopt a leading role in strategic digital initiatives, such as the International Data Spaces Association (IDSA) and Gaia-X AISBL, which establish a basis for a fair data economy. In the EU-funded Data Spaces Support Centre and as a member of the Eclipse Dataspace Working Group, we support the exchange and development of standards that will provide the foundation for future open-access data spaces.

Sovereign

Those who disclose data must be able to retain control over what happens to it. This is why we create data spaces for secure and controllable data use across corporate boundaries — for Germany, Europe and worldwide — together with our customers and partners from the business community and as an advisor to policymakers.

Value-adding

Data is a strategic resource with value that needs to be exploited. This is why we work with companies in the areas of Industrial Manufacturing, Healthcare, Mobility & Smart Cities and IT Service Providers to identify the strategic value of their data and turn it into a useful asset in sovereign data spaces. From data preparation to the development of new business models, we offer complete system solutions.

#InnovationsFromData

Data Strategies for Sustainable Success: We Support Your Transformation.

As a co-initiator and an early data space inventor, we have a very detailed understanding of the developments in the data economy, and its inherent opportunities and challenges. We want to pave the way for you to access the data economy and make the most of its possibilities — from workshops, analyses and market studies to strategic data management and participation in data spaces.

From research to practice

The strategic use of data as a resource within companies and throughout value chains is becoming more and more important to the future viability of successful enterprises. As a technology pioneer and solutions developer, we can offer you our development and consultation expertise so that you are ideally prepared for the opportunities and challenges of the data economy. We will work with you to identify the strategic value of your data and turn it into a useful asset for your business processes.

Flexible opportunities for collaboration

We give you the opportunity to access development and consultation expertise on demand whenever you need it, from knowledge building in workshops and analyses through to the targeted optimization of existing technologies and processes, as well as the strategic development of new, data-driven innovations. The project format is customized to meet your specific needs. This allows us to give you the best possible support, considering your specific issues and your direction in the complex field of the data economy.

Workshops and training: expanding internal expertise through practical experience

Do you want to initiate innovative data projects in your organization? Or acquire practical skills in data management? We offer custom workshops and training programs in which you can explore the opportunities that are relevant to you when it comes to data as a key resource.

Analyses and commissioned studies as a basis for your strategic planning

Do you want to initiate digitalization projects in your organization and gain an overview that will let you make future plans? We offer comprehensive and neutral analyses and studies plus relevant consultation services, giving you targeted support for your innovation and development projects.

Project orders: Improve your business processes through research and development expertise

Do you need support in optimizing and developing products and services, technologies and processes, or your business model? We use agile methods to develop specific solutions, then work with you to implement them while giving advice as an independent partner, without the need for you to set up and fund your own development department.

Specific project formats: comprehensive, systematic support for strategic innovation processes

As well as direct commissioning of individual projects, we can offer you formats aimed at longer-term support: This includes our **Enterprise Labs**, in which innovation teams made up of experts from your organization and ours are able to collaborate on strategic innovation topics.

For additional opportunities for collaboration, as well as specific services for your industry and technological issues, plus relevant example projects, visit our homepage.

What our partners value about working with us

Fraunhofer ISST is active in all areas relating to data exchange, data ecosystems and data spaces, whether they operate at a political, economic or technical level. By collaborating with us, you will benefit from our expertise in research, business administration and technology, as well as our practical experience and extensive network:

Non-profit and independent: As a non-profit organization and a trustworthy, neutral R&D consultant that can provide support over the long term, we will help you find the right solutions and partners for your needs.

Outstanding research and practical expertise: We are not just researching the future of the data economy — we are also applying this knowledge directly to implementation-focused, practical concepts and solutions.

Global reach and network: We promote the exchange of experiences in (industry-specific) initiatives and networks, and open up access to relevant actors and partners, both locally and internationally.

Close involvement with standards and policy: By collaborating with us, you will receive a first-hand overview of new regulations as well as trends in the data economy.

We look forward to working with you

Are you interested in collaborating or do you have any questions about our services? Our experts will be happy to help.

Dean Hayton

Head
Business Development
Phone +49 231 97677-339
dean.hayton@isst.fraunhofer.de

Highlights 2023

Projects, studies, white papers, spin-offs and innovations

Manufacturing-X
Construction Plan Study: Manufacturing-X Data Space — What is a Successful Data Space in the Context of Industry 4.0?

IDERHA
A Data Space for Improved Clinical Decision-Making and for Access to Health Innovations

Edge Data Economy
Edge Computing Solves Key Challenges in the Data Economy

Catena-X
From an "Ego System" to a Digital Ecosystem

The Data Space Lab
Open Data Space Components as a Service

Valoon and SIMPL
Bold Spin-offs With Fraunhofer ISST

Construction Plan Study: Manufacturing-X Data Space — What is a Successful Data Space in the Context of Industry 4.0?

A study commissioned by the German Mechanical Engineering Industry Association (VDMA) and the German Association of the Electrical and Digital Industry (ZVEI), and conducted by the Fraunhofer institutes ISST, IOSB and IPA, shows for the first time how a data space could be designed for the Manufacturing-X data ecosystem, which represents the next major step in the implementation of Industry 4.0. The study primarily takes account of the specific requirements of medium-sized manufacturing companies and their expectations for a reliable digital data economy that creates value.

"The construction plan study provides important impetus for the future Manufacturing-X data space and represents a milestone in its design and development," says Hartmut Rauen, deputy executive director of the VDMA. "This is because the architecture of Manufacturing-X will play a crucial role in determining what type of added value companies can derive from the data space in order to make the best possible use of production data and increase efficiency as a result."

Focus on flexibility and data security

To create an innovative and secure data space from the outset, the study has chosen to take a comprehensive approach that covers basic services and organizational aspects in addition to the digital architecture. The flexibility and scaling of the data space are vitally important in this context. The goal is also to design Manufacturing-X in a way that allows the specific requirements

of the participating companies to be immediately incorporated and developed dynamically.

"In the future, small and medium-sized enterprises in particular will be able to exchange their data more easily and share it on equal terms with third parties. Data sovereignty and security will remain protected. With Manufacturing-X, we are drawing on existing standards, from Asset Administration Shell to OPC UA standards in the umati environment or the use of EDC connectors. Ultimately, the goal is to ensure maximum interoperability when integrating as many stakeholders as possible," states Gunther Koschnick, head of section for industry at the ZVEI. "The construction plan study shows us how this interaction can look."

Boris Otto, institute director at the Fraunhofer Institute for Software and Systems Engineering ISST, is convinced of the benefits of data ecosystems and of rapid distribution: "Data spaces enable the shared use of data while protecting the confidentiality and data sovereignty of the participants, without the lock-in effects of traditional platform architectures. The resulting data ecosystems generate benefits for a wide range of different participants, overlapping heavily with the structure of mechanical engineering and the electrical industry. Manufacturing-X is a unique opportunity for the industry to increase its resilience, competitiveness and sustainability. In addition, many of the foundations have been laid through Catena-X and the work on IDS and Gaia-X, enabling rapid implementation."

The **data ecosystems that are created generate benefits** for a wide range of different **participants**

Further development with corporate partners

The next step is to refine the construction plan study for Manufacturing-X in close collaboration with partners from the manufacturing industry. The feedback and experience from these deep dives will be used to optimize the final implementation of Manufacturing-X and to ensure that it meets the specific needs of the industry.

About Manufacturing-X

Industry 4.0 requires data to be networked in a way that is readily available, secure and integrated. This is what Manufacturing-X sets out to achieve. The goal is to establish a federated data ecosystem that enables trustworthy data exchange between companies based on open standards while offering companies digital sovereignty. The German federal government is promoting Manufacturing-X through an ongoing invitation to tender by the Federal Ministry for Economic Affairs and Climate Action (BMWK) and is continuing the successful development of Industry 4.0. The aim of Manufacturing-X is to turn the added value of digital technologies, like the Internet of Things (IoT), artificial intelligence (AI) and machine learning, into more useful assets so that new and competitive business models can be developed for industry.

Once Manufacturing-X is established, the hope is that it will provide an alternative to central platform solutions. This will help companies of all sizes to maximize the development of their digital value-added services.

Role of Fraunhofer ISST

Fraunhofer ISST is involved in many areas of the Manufacturing-X project family, including Aerospace-X and Factory-X. **Aerospace-X** will create a digital ecosystem that will establish uniform standards for supply chains in the aviation industry. In this project, Fraunhofer ISST draws on its experience in related projects, such as Gaia-X, Catena-X, Plattform Industrie 4.0 and IDTA, and applies it to the aviation industry. This includes identifying the need to make adjustments, as well as implementing solutions that enable collaboration across data throughout the supply chain. The goal is to organize supply chains in a resilient and sustainable way, and establish a technological basis as an effective means of tackling future challenges. **Factory-X** creates a sovereign data space for the mechanical engineering industry. In the Factory-X kernel, Fraunhofer ISST helps to develop the basic technological functionality of the data space, which is based on a decentralized architecture and will be provided in an open-source repository.

Construction Plan Study: Manufacturing-X Data Space — What is a Successful Data Space in the Context of Industry 4.0?

Download the study as a PDF

IDERHA: A Data Space for Improved Clinical Decision-Making and for Access to Health Innovations

IDERHA (Integration of Heterogeneous Data and Evidence towards Regulatory and HTA Acceptance) is a European public-private partnership that was launched in April 2023. The goal of the project is to use design and technology to overcome interdisciplinary obstacles in accessing, integrating and analyzing healthcare data, with the aim of maximizing the value of this data for patient care and medical research.

The challenge: Database research is difficult due to distributed storage of healthcare information

In a medical context, healthcare information is often stored in a distributed and separated way across different hospitals and patient files, which makes it difficult to conduct database research, particularly the development of new AI algorithms aimed at improving individual treatment options (such as closed-loop precision medicine). The purpose of IDERHA is to create a state-of-the-art and dynamically scalable data ecosystem that will ensure seamless integration and linking of different forms of healthcare data so that healthcare provision can be optimized, autonomous and innovative for healthcare professionals (such as physicians), patients and researchers alike.

IDERHA
integrating health data

Control over personal **healthcare data**

Its goal is to support better treatment, a state-of-the-art healthcare management system and personalized care. To this end, the IDERHA data space links healthcare data from various European hospitals on a large scale, taking account of legal, ethical and technical restrictions. It also implements ultra-modern federated learning methods that enable research innovations to be achieved within this data space on the basis of jointly developed standards and procedures.

Our contribution: implementing the IDERHA data space and the Federated Learning Framework

Fraunhofer ISST is largely responsible for the technical implementation of the IDERHA data space and the integrated Federated Learning Framework. Based on the Eclipse Dataspace connectors, an interoperable network is being developed and operated to enable data integration and interoperability for multimodal data from a volume of data sources that can be scaled as required, and to support the large-scale development of cutting-edge AI/ML algorithms. In addition, the data space is intended to give patients control over their own healthcare data. IDERHA therefore follows the European principle of data sovereignty, which is regarded by the European Union as a crucial element of modern information societies.

Part of the European Cancer Plan

IDERHA is part of the European Cancer Plan. As a use case within the project, artificial intelligence and machine learning will be used to link and analyze various forms of human healthcare data in order to improve the early detection of lung cancer and the quality of life of people with lung cancer. To this end, one of the first pan-European health data spaces is being established in the spirit of the European Health Data Space. To scale up benefits, IDERHA seeks to accelerate policy development by supporting regulatory approval and health technology assessment (HTA).

IDERHA online

Edge Data Economy: New Study Recommends Actions for Secure, Economical Use of Corporate Data

The use of edge computing technologies offers companies significant potential to optimize processes and develop new products and innovative business models. However, small and medium-sized enterprises (SMEs) in particular still lack knowledge of edge computing and its possible applications in practice. With this in mind, the goal of the study "Datenwirtschaft und Edge-Computing — Potenziale, Herausforderungen und Handlungsempfehlungen für Unternehmen" ("Data economy and edge computing — potential, challenges and recommended actions for companies"), published in 2023, is to help companies — and especially SMEs — to develop their own edge computing use cases. The study was authored in 2023 by Niels Jahnke and Nicolas Niehoff from Fraunhofer ISST as part of the research supporting the edge data economy technology program.

Like work and capital, data is a resource that is crucial to corporate success in today's world. The value of the huge volumes of data that are generated every day in all areas, from production to logistics and healthcare, is often underused, if it is exploited at all. At the same time, more diverse options for taking advantage of this data are opening up, provided it can be exploited, analyzed and processed (or pre-processed) using innovative technological approaches. Data can then become

DATA ECONOMY AND EDGE COMPUTING
Potential, challenges and recommended actions for companies

Download the study as a PDF

a support tool in continuously improving core processes, corporate decision-making and the automation and integration of business processes.

Ultimately, data itself can become a product that is traded in data marketplaces or through data brokers. However, many companies are currently hesitant to use new digital technologies such as edge computing, expressing worries about data security and protecting data sovereignty using technical methods.

This study shows that, if companies engage with edge computing technology, they can use data in a targeted manner as an economic resource while guaranteeing data protection, data security and data sovereignty. They may do this in order to reduce existing costs or generate profits through new business models.

If edge computing power is integrated into machinery, buildings or existing telecommunications infrastructure, for example, the increased speed and process reliability in data transmission channels and local data processing functions will reduce data processing latencies, allowing processes to be automated and adjusted or controlled in real time. In addition, the technology simplifies compliance with legal regulations on data processing. Alongside these factors, the use of edge computing can reduce consumption of resources such as energy while increasing user satisfaction.

The study gives managers and decision-makers some important definitions of terms, and sets out requirements relating to the use of edge computing throughout their own data value chains. It illustrates these aspects using selected application scenarios and provides readers with specific recommended actions.

The results of the study are based on an analysis of edge computing use cases that are being developed as part of the ten projects that were in the edge data economy technology program, funded by the German Federal Ministry for Economic Affairs and Climate Action (BMWK), at the time of the study's publication.

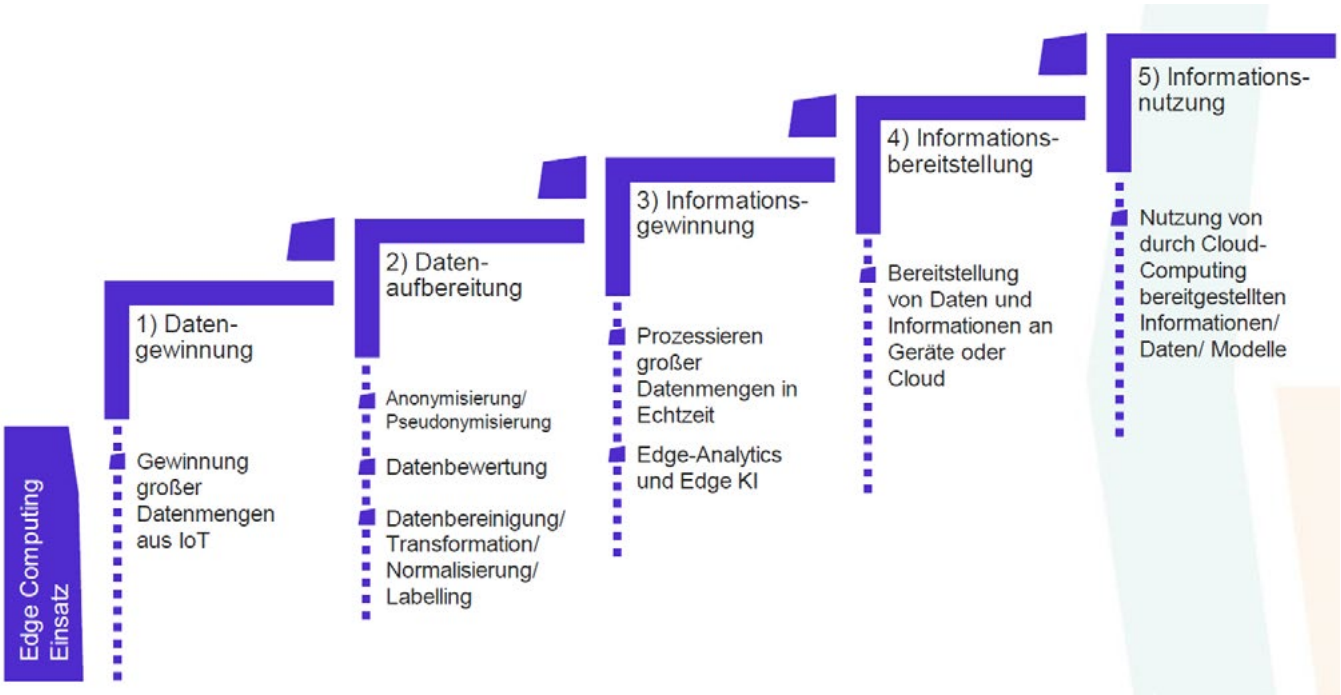


Figure: The role of edge computing in the data value chain (from the study "Data economy and edge computing," p. 13)

Frankfurter Allgemeine | October 23, 2023 — updated: October 25, 2023, 06:36
https://www.faz.net/-j9c-bgvu9

Catena-X: From an "Ego System" to a Digital Ecosystem

How European companies can continue to play an important role in digitalization.
A guest article by Oliver Ganser and Boris Otto

In this country, we need to accept that there are very few fields of innovation left in which we can differentiate ourselves on the digital world stage. Artificial intelligence, quantum computing, cybersecurity, semiconductors, software platforms and cloud services have become concentrated in non-European hands or large corporations.

As companies, as industries and as European countries, we are struggling with the digital transformation — perhaps because the digital transformation is changing the existing boundaries, and thereby altering power structures. Or perhaps the issue lies in the German and European culture and way of working, which puts the ultimate optimization of the individual ahead of a common, focused and systematic solution. This may be true.

As examples show, however, it is also possible and expedient to rethink how we are doing things. Data spaces are one of the few remaining fields of digital innovation in which Europe is playing a pioneering role and is able to generate economic value for many industries and stakeholders. Behind this abstract term there is a revolutionary principle based on the ability of companies to share data via data spaces without losing control over what happens to it. Data providers set out data usage conditions — the "general terms and conditions of the data economy" — to ensure their data is only used under defined conditions, which could mean a specific purpose or a specific period of time, for example. This means they retain data sovereignty.

Catena-X
Automotive Network

Leverage for **collaborative innovation** and **efficiency**

Source: FAZ.NET

https://www.faz.net/-j9c-bgvu9

Meanwhile, data consumers can rely on the fact that the data comes from a trustworthy source, since all of the participants in the data space are qualified through standardized procedures. The use of common standards safeguards interoperability; that is, the ability of different systems to communicate with one another. This promotes efficiency and cross-company interaction during data exchange. A data space is a distributed platform with no centralized data storage. Rather than belonging to one corporation, it represents a collaborative approach between all its participants. Through trust, sovereignty and interoperability, it offers value that is scalable and differentiating — both of which are attributes that have so far been lacking in the European approaches to the digital transformation.

Among the data spaces that are currently the most advanced is Catena-X, an automotive industry network. Its name is derived from the Latin word "catena," meaning "chain." The goal of Catena-X is to radically optimize current and future core processes in the automotive industry (including quality management, supply services, CO2 reporting and the circular economy) through digitalized processes and interfaces, or even to make these processes possible for the first time. This gives the entire industry and every participant in a value chain leverage for collaborative innovation and efficiency.

A new operating model for the digitalized industry

Why has the automotive industry — which is characterized by strong stakeholders engaged in intense competition and individual-focused behavior — chosen to take an industry-wide, collaborative and open approach? The answer is not obvious.

Winston Churchill would probably have described this situation with his famous quote, "Never let a good crisis go to waste." The last few years and the challenges that lie ahead of us have been and continue to be defined by experiences and expectations that expose the limitations of the operating models currently used in the automotive industry. No management task force, however brilliant, can solve problems relating to material supply, quality or sustainability without taking a new and radical collaborative approach. Until now, it has only been possible for each stakeholder to optimize and design a fragment of the value creation process for themselves and their immediate partner environment.

To solve these problems, however, it is necessary to rethink the value creation process as a whole, from beginning to end, and to make it collaborative. What is needed, therefore, is a new industry operating model for mapping out and harnessing digitalized business processes that companies in a shared value chain can use in a sovereign way to increase value.

It was this realization that led an initial group of six companies to form the Automotive Alliance in mid-2020. They believe that rigorously pooling the skills and individual activities of vehicle manufacturers, suppliers, recycling companies, factory outfitters, software and service providers, and researchers is the only way to resolve and improve upon the problems faced in today's value streams. With the support of political measures, the six partners became twelve within five months. This number had grown to 28 after eight months, and after two years there were 166 international companies that wanted to solve specific business problems via the Catena-X data space.

With 275,000 companies, more than 1,000,000 locations and a highly complex structure with many branches, the global automotive industry faces huge challenges — and these are challenges that can be applied to other industries, too. That is why the Manufacturing-X initiative was launched in early 2023 by Plattform Industrie 4.0 and its global partners, with the goal of promoting additional industrial data spaces based on the model of Catena-X. In August, the German Federal Ministry for Economic Affairs and Climate Action (BMWK) published a new grant guideline for this purpose, intending to secure a place for Europe on the global digitalization stage (Federal Gazette (Bundesanzeiger): Manufacturing-X).

The Data Space Research Lab: A New Dimension in Cross-Border Data Exchange

The Data Space Research Lab is a collaboration initiated in 2023 between Huawei Technologies and Fraunhofer ISST. The lab's goal is to overcome the digital challenges of our time and support companies around the world through technical innovations in the data economy.

The focus of the Data Space Research Lab is on international, cross-border data exchange from an industrial perspective, taking account of European associations such as the International Data Spaces Association (IDSA) and Gaia-X AISBL. In the lab, we work with partners from industry and research to implement international standards. Our goal is to open up new dimensions in shared data use. **The lab offers companies in Europe, China and around the world an innovative and mature infrastructure for the shared use of their valuable data resources**. This enables companies to use their data for innovative business models and the associated digital transformation — a factor that is becoming more and more important to companies in view of the increase in generative AI.

"Our goal at Fraunhofer ISST is to share ambitious ideas and engage in joint agile experiments in order to achieve international success. With Huawei Technologies, and particularly colleagues from the Huawei Munich Research Center, we have found a strong partner for validating concepts and solutions that meet the requirements of the Chinese market and tackle cross-border challenges. The Data Space Research Lab is

an outstanding example of how international collaboration between Fraunhofer ISST as a research institution and technology platform providers can be used to derive tangible benefits for the economy from our research," says Prof. Boris Otto, institute director at Fraunhofer ISST.

The lab makes a major contribution to international standardization and specification activities in relation to the interoperability of data in cases where it is shared and used jointly. The Data Space Research Lab makes a valuable contribution to anchoring joint research activities in the global economy. This is evidenced by the direct applicability and anchoring of research results in practice.

> It's great to see how Fraunhofer ISST and Huawei Technologies have built the **Data Space Research Lab** together to supply companies with data space solutions that run on the Huawei Cloud while also being compliant with IDSA and Gaia-X. Together, we have also made some important contributions to international specification and standardization activities in this field, helping to promote the interoperability of data spaces at a global level. Huawei is delighted to have built such a strong partnership."
>
> Liang Chen, Director, Huawei Europe AI and Data Space Standardization and Industry Development

Joint commitment to the use of open-source software (OSS)

This is one of the reasons why the solutions from the Data Space Research Lab **use existing open-source software (OSS) projects like** Eclipse Dataspace Components (EDC) to develop services that are suitable for business. Fraunhofer ISST and Huawei Technologies make a significant contribution to these OSS projects, helping to promote a joint basis for data-supported collaboration. The components enable service providers, such as independent software vendors (ISVs), **to operate data spaces as standard infrastructure technology for the joint use of data** in accordance with global standards and specifications.

Boot-X: a data space environment for global data exchange

One example is the Boot-X project, which is currently running in the Data Space Research Lab. This project takes the available open components and combines them with new approaches to research questions in the field of data exchange (such as usage control, RAG and decentralized identity management). Boot-X aims to establish a global data space environment for cross-border data exchange. The infrastructure that is provided and the technology stack are used to set up a complete data space or participate in existing data spaces. Boot-X enables real business cases to be operated while integrating existing applications from various areas. Working on the basis of a joint data space infrastructure that offers expansion possibilities, users can therefore focus on their core business and simply use the **data space as a cloud service**.

The lab makes ideas tangible, taking them from theory to actual cloud services. The positive experiences from the initial pilot projects, such as the one conducted with Tecnalia (based in Spain), demonstrate the significant added value and the opportunities presented by this form of collaboration, which is set to run for at least another two years.

Test bed for collaborative research activities together with companies

Fraunhofer ISST and Huawei Technologies are inviting more industry partners to take part in joint research projects relating to data spaces as part of the Data Space Research Lab. **The collaboration offers the opportunity to drive the international growth of this research field and improve services** through a joint approach. In this way, companies' global market requirements for data sharing can be supported in the best possible way, as can their participation in data spaces. Together with industry partners, the team at the Data Space Research Lab is discussing new concepts and approaches, completing proof of concepts (PoCs) and turning them into robust pilot projects — either through the use of existing research results or through individual new developments.

Funded research projects can also benefit from the developments in the Data Space Research Lab by using the available results in their projects and relying on a technical infrastructure evaluated by the community. On this solid basis, they can concentrate on their valuable business cases within their project.

Invitation to collaborate in the Data Space Research Lab

Are you interested in the Data Space Research Lab from Huawei Technologies and Fraunhofer ISST? Get in touch with us to reap the benefits of our many years of experience in the fields of digital business and data space technologies. If you are interested, please contact Heinrich Pettenpohl✉ from Fraunhofer ISST, who will be happy to help.


Team Valoon


Team SIMPL

Valoon and SIMPL: Bold Spin-offs With Fraunhofer ISST

There are frequent examples of employees at Fraunhofer ISST who are looking for a way to found their own company — perhaps drawing on their own experience in projects. They often pick up on the fact that Fraunhofer institutes can only support their customers as far as the development and testing of prototypes. The next stage involves creating a spin-off in which prototypes undergo further development and are operated for customers on a long-term basis.

In 2023, two new spin-offs were launched from Fraunhofer ISST: Valoon and SIMPL, whose founders are, respectively, Marvin Rosian and Dr. Can Azkan, both of whom were previously research scientists at Fraunhofer ISST. In an interview with the Fraunhofer ISST podcast Die Datenräumer (The Data Space Experts), the pair explained how Fraunhofer served as a springboard to independence. Below are a few excerpts from the podcast.

What is the core business of Valoon and SIMPL?

Dr. Can Azkan: At SIMPL, we are developing a solution for mechanical engineering that will help to make servicing, commissioning, repair and maintenance of machinery and equipment much more efficient.

Marvin Rosian: Valoon is fundamentally construction management software. That means we take care of the communication and documentation between employees at the construction site itself and in the offices, and try to simplify those processes.

Where did you get the idea to found a spin-off from Fraunhofer ISST?

Image: Marvin Rosian

Marvin Rosian: Can and I have actually been dealing with spin-offs for the last four years since our time at Fraunhofer. Before SIMPL and Valoon, we had lots of ideas that we worked through from time to time, and I think that underlines the benefits of the Fraunhofer model somewhat. To be honest, I didn't go to Fraunhofer because I really love research — it was more because it's able to act as an interface between research and industry. At Fraunhofer, we had the opportunity to experience the research side of our fields and can now bring the innovations into the industry.

Dr. Can Azkan: Yes, Fraunhofer provided a very good background. We researched some exciting topics relating to the Industrial IoT, ecosystems and predictive maintenance, and we wanted to take a look beyond that scope, looking at how companies are actually already working in those areas. We soon realized that conventional medium-sized mechanical engineering companies — which are our target group — have an especially high interest in predictive maintenance, but are a long way from putting it into practice. They still use lots of paper on clipboards because their service technicians working on maintenance jobs are still using analog methods. So it made sense to us that companies need a totally different solution first and foremost before it's possible to move onto highly innovative topics.

What did Institute Director Boris Otto say when he first heard you talk about going independent?

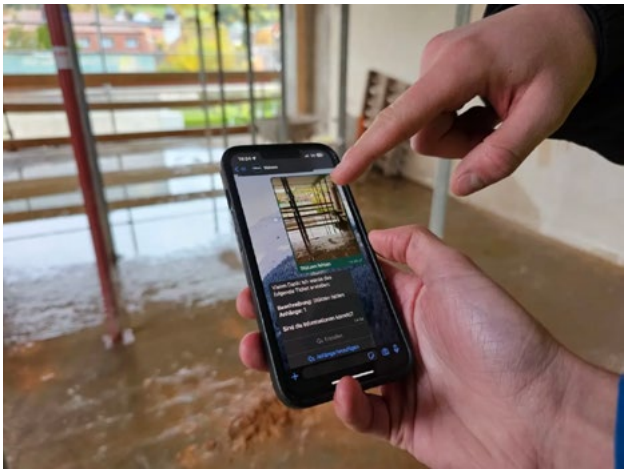
Dr. Can Azkan: Boris Otto is really open to things like that, so he supported us right from the outset.

Marvin Rosian: Yes, I can only agree with that. I can't remember exactly what he said, but it was something along the lines of "let's go." Boris Otto and our former Department Head Markus Spiekermann were very, very big supporters of SIMPL and Valoon right from day one, and took a leading role in getting us where we are now.

What support did Fraunhofer ISST offer in the startup phase?

Image: Dr. Can Azkan

Dr. Can Azkan: There were various things. It started with Fraunhofer AHEAD, a kind of startup incubator within the Fraunhofer-Gesellschaft. It gives all of the research teams an initial point of contact where they can have their ideas validated. Is there a market for the idea? Does it solve problems? What are the technological challenges? How can they be overcome? There's also a kind of boot camp where you go through a program called the "washing machine" — and that really shakes things up as it involves various industry experts who test the stability of your ideas. Once we'd done that, we were given time to develop the idea over an extended period with financial support before we actually launched the SIMPL spin-off for real.



Networked communication makes it easier to coordinate trades on the construction site. (Photo: Valoon)

What were the biggest challenges in the initial phase?

Marvin Rosian: There were several challenges. First and foremost, we had to ask ourselves what we were actually doing — in other words, what is Valoon? What is our product? Who are our customers? What problem are we solving? What does the team look like? How ready are we to set it up? With startups, it's extremely important to put your heart and soul into everything, and I'm incredibly happy that I now have a team that I trust and can work with seamlessly. I'm also happy that we understand the product and customer in depth, and know what they really need.

What are the most important factors in your success?

Marvin Rosian: The team. Customers will come and go. The product will always change, particularly in the early phase, which is where SIMPL and Valoon are. You notice that you have a lot of ideas, you develop and pilot a lot of things and keep having to adapt. But it's the team that matters above all else. If you have a good and capable team that does its job well, then you can always adapt the product and find new customers. For me, that is by far the biggest factor in a startup.

How are SIMPL and Valoon doing right now?

Dr. Can Azkan: We founded SIMPL a year ago and already have one solution that a customer is actively using — it also provides that company with a key added-value element. We are currently expanding the product so we can reach more customers.

Marvin Rosian: We founded Valoon six months ago and have already tested the product on our customers' construction sites. We now have paying customers and the product is fully on the market.

What are the next steps in the development of Valoon and SIMPL?

Marvin Rosian: For us, it's the classic question of market fit. We have lots of different customers — construction companies, craft enterprises, architect's offices — and we believe it's extremely important that we find our focus over the next year. We'll then look at scaling, which means taking what we are already doing on a few construction sites with a few construction projects and really expanding this to reach the mass market.

> "By the **end of the year,** we want to have developed our **product** to such an extent that you can **buy it off the shelf.**"
>
> Dr. Can Azkan, founder and managing director of SIMPL

Dr. Can Azkan: We already have a good understanding of our customer profile: classic machinery and equipment manufacturers that are small or medium-sized enterprises. So our main focus now is scaling. By the end of the year, we want to have developed our product to such an extent that you can buy it off the shelf.

Learn more about the two Fraunhofer ISST spin-offs:

Valoon: https://valoon.chat/en/

SIMPL: https://www.simpl.de/en

What experiences and skills did you gain at Fraunhofer that help you today?

Dr. Can Azkan: A lot, undoubtedly. At Fraunhofer ISST, we had the opportunity to develop and help shape some amazing, exciting ideas relating to highly innovative areas like Industrial IoT and platforms. We were able to find out which areas are really relevant to potential customers and build on this to develop our own idea — and a product that we are now able to offer. We also learned how to work on a wide range of projects with lots of different partners at the same time. When you conduct research in innovative fields, there is generally no-one there to tell you what to do, so you learn to think for yourself about the next steps to take and how to reach your goal in a creative way. All of that really helped me transition to a startup.

Marvin Rosian: If I could just add one more thing, then it would be analytical and critical thinking. Before founding Valoon, we spent years at Fraunhofer working in the areas where we are now active. We learned a lot about the construction industry and artificial intelligence, and we saw what didn't work. Ultimately, this led to us developing the idea for a startup.

When you think about the path from Fraunhofer to independence, would you recommend it to other colleagues?

Marvin Rosian: Absolutely. It's a roller coaster. But personally, I love what I do and what we do at Valoon. It's important to love it or leave it. And if you do it, then be brave.

Die Datenräumer podcast

In our Die Datenräumer podcast, listeners are given comprehensive insights backed by research and hear about specific examples of how companies are already using data to their advantage — and will benefit from it even more in the future.

The podcast is available wherever you get your podcasts, and at www.isst.fraunhofer.de/en/publications/podcast.html .

Customized Solutions Based on Industry Expertise

Our business units

The Fraunhofer Institute for Software and Systems Engineering ISST works with companies to identify the strategic value of their data and turn it into a useful asset. In the Industrial Manufacturing, IT Service Providers, Mobility & Smart Cities and Healthcare business units, researchers examine how data in data spaces can be handled in a sovereign way.

Industrial Manufacturing

Onward to Industry 4.0 with data spaces

Industrial Manufacturing

Efficient and sovereign data use in production

Industrial Manufacturing online:

Projects
Technologies
Publications

New economic and geopolitical challenges are driving manufacturing companies to respond flexibly to bottlenecks in supply chains or in the supply of raw materials and energy. These companies are able to access more and more movement and process data, which need to be processed and put to good use. Flows of goods networked not just physically, but also digitally. The right information needs to be provided in the right place at the right time.

In the Industrial Manufacturing business unit, Fraunhofer ISST is improving complex production and supply chain processes by establishing a strategic data management system and optimizing internal and cross-company data usage with the help of data spaces.

Dr. Jürgen Schmelting

Head of Department
Industrial Manufacturing
Phone +49 231 97677-463
juergen.schmelting@isst.fraunhofer.de

The digital solutions developed by the Industrial Manufacturing business unit help companies to implement lean, responsive and forward-looking business processes in an independent way with an eye on the future. Researchers there support specific corporate digitalization initiatives, from the design stage right through to prototype implementation. The business unit has a specific focus on optimizing demand and capacity management, and on processing customer orders. Through numerous projects and initiatives, Industrial Manufacturing supports individual companies and entire industries throughout their transformation process leading to Industry 4.0 — from Catena-X for the automotive industry to Factory-X for the manufacturing industry and Aerospace-X for aviation.

Overview of services

The Industrial Manufacturing business unit focuses on the following areas:

- Developing concepts and technologies for **data sovereignty**
- Developing strategies and concepts for **industrial data management**
- Designing and building **software architectures** for companies

- Developing individual **software solutions** that are customized to meet the requirements in question
- Capturing and integrating different data formats and sources through **information mapping and semantics**
- Developing **digital business models and data analysis** from existing data sets
- **Monitoring** system statuses and **analyzing and predicting** process results

These areas are clustered in two research focuses.

Strategic data management research focus: Consistent data usage as the key to corporate success in a data-driven world

As data is increasingly being used on a company-wide level, there needs to be a change in the strategy used to handle data. Decisions that are critical for success and automated processes are based on reliable data and structures. Strategic data management develops the necessary structures for organizing data. Strategically positioning data organization makes it possible to align data domains, data roles and data applications with sustainability in mind.

The researchers at Fraunhofer ISST offer custom solutions for sustainable data management that enable the effective use of data as a resource. Part of the service offering involves strengthening in-house data expertise in companies and developing a data strategy that is tailored to meet the corporate goals.

Fraunhofer ISST develops the components of strategic data management that ensure success for data-driven innovations. The goal is to introduce and optimize an internal company data organization to realize data democratization.

Establishing a data organization increases data quality and usability of AI applications, reduces data search processes and improves the adoption of data applications. Within its framework, the necessary data capabilities are developed, sustainably established and continuously measurable. The basis for data organization is the establishment of a data strategy that defines long-term specifications, such as the prerequisite for participation in data ecosystems or the type of data storage. The data organization is based on these specifications and integrates them into the data governance approaches, something that is ensured by means of decentralized and/or centralized corporate units and suitable data roles such as data owners and data stewards. For efficient implementation of the workflows, the concepts are realized in data catalogs and data quality software and rolled out company-wide.

More information about the research focus of strategic data management

Link to the website

Participation in data spaces research focus: comprehensive consultation services and support when introducing and using data spaces

In this research focus, Industrial Manufacturing supports its partners with comprehensive digital solutions in the field of data spaces — from the design and development of custom data space solutions to the provision of analyses and training in order to guarantee successful participation in existing initiatives. The goal is to support transformative growth of companies through data-driven innovation and digitalization.

The services offered in this area include researchers developing an appropriate design for a custom data space based on their extensive knowledge and best-practice experience in the relevant industry. They analyze the extent to which a company is prepared to participate in data spaces and provide insights and recommendations for the purposes of decision-making and successful implementation of data spaces. The existing technical resources at Fraunhofer ISST build on this to enable seamless integration into data spaces — from API integration to the development of connectors and infrastructures. To this end, Fraunhofer ISST also contributes to the development of open-source components. In specialized training programs, individuals and teams can develop the key skills to ensure data spaces are a success. The training covers areas such as governance, data protection, technical components and collaboration.

More information about the research focus of participation in data spaces

Link to the website

A partner from the initial concept to the finished data space

Fraunhofer ISST is one of the first initiators of data spaces in Germany and Europe. Drawing on its many years of experience at a technical level and in economic policy and corporate strategy, the institute offers neutral and expert support for industrial manufacturing companies that want to future-proof their data usage, from establishing a fundamental data strategy to the technical implementation of data space solutions and integration into existing industry data spaces.

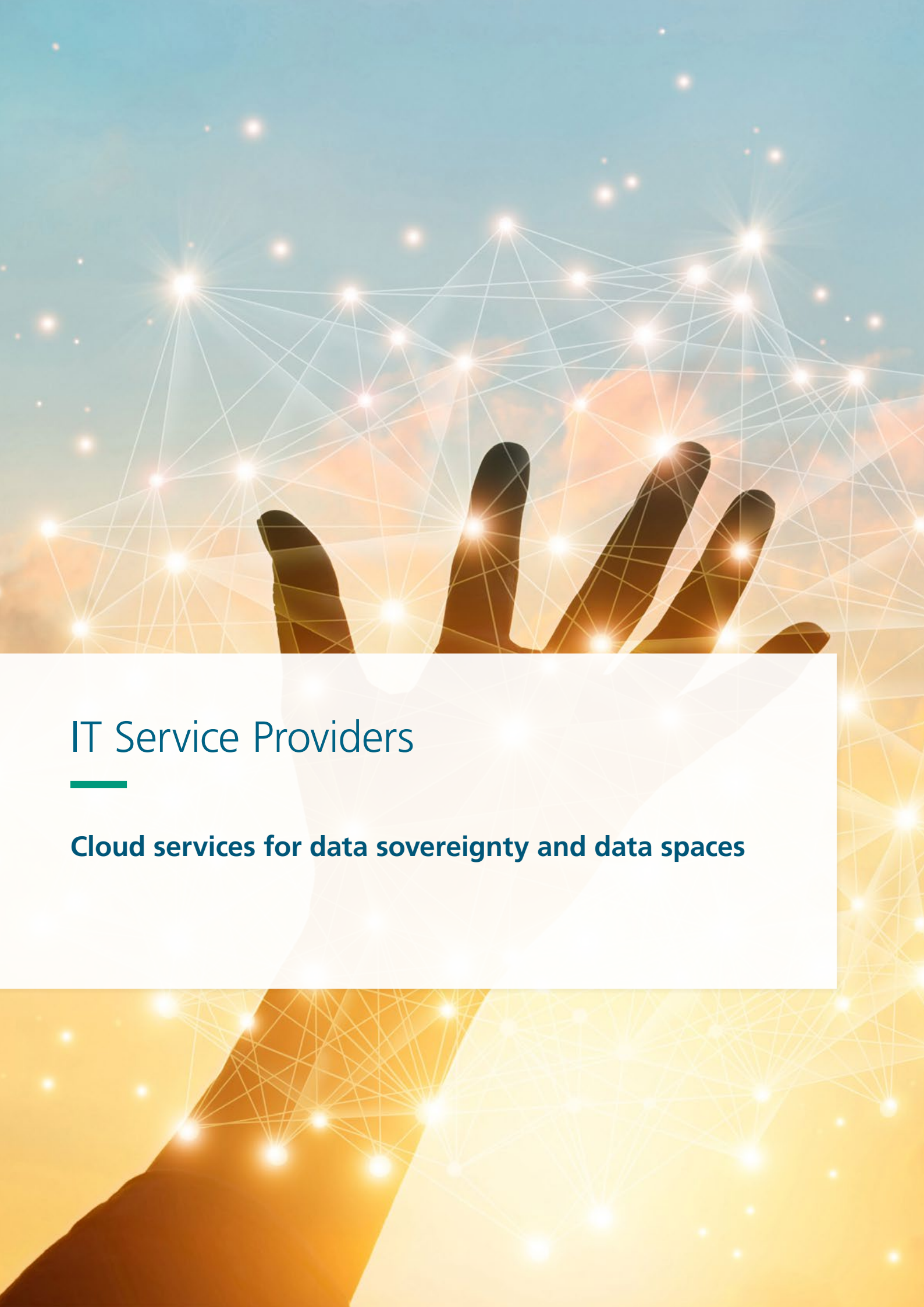
More information about selected lighthouse projects online:

Factory-X : A sovereign data space for the mechanical engineering industry.

Aerospace-X : The data space for aerospace.

Catena-X : An open data ecosystem for the automotive industry.

Heraklion : Heuristic resilience analyses for municipalities using data space functionalities.



IT Service Providers

Cloud services for data sovereignty and data spaces

IT Service Providers

Cloud solutions for data sovereignty, cost management (FinOps) and sustainability (GreenOps)

IT Service Providers online:

Projects
Technologies
Publications

The sovereignty of the user is important to consider in the context of the cloud. Companies in particular face the question of whether they have sovereignty in determining how their data is handled in the cloud. The European Union recognizes the urgency of this question, which is why it is currently investing around 2.4 billion euros in the IPCEI CIS program with the aim of strengthening digital and technological sovereignty in cloud and edge computing. Fraunhofer ISST has been researching data sovereignty since 2015. The IT Service Providers business unit focuses on the research and development of cloud-specific solutions for establishing data sovereignty and data spaces. The team also works to optimize cloud configurations in order to lower the cost of cloud infrastructures and reduce the carbon footprint, for example.

Heinrich Pettenpohl

Head of Department
IT Service Providers
Phone +49 231 97677-461
heinrich.pettenpohl@isst.fraunhofer.de

In the IT Service Providers business unit, Fraunhofer ISST combines its expertise in the data-driven operation of cloud infrastructures. Its researchers develop custom solutions for monitoring the cloud (or edge cloud) and develop appropriate suggestions relating to best-practice deployment configurations for cloud users. Their current focus is on managing operating costs (FinOps) and carbon footprints (GreenOps). This is a particularly urgent topic where companies are concerned: Surveys by Flexera and IDC indicate that the two biggest cloud-related issues for business are expenditure management (with 82% of companies stating that this is a challenge) and sustainability (the top-ranked area of expenditure).

More effective use of human resources

Specialist human resources are needed to manage cloud resources. Not every software developer and DevOps engineer is trained to execute deployments optimally, especially on the many self-service platforms (such as AWS, Azure and GCP) and on-premises Kubernetes clusters out there. By analyzing the deployments and comparing them with best practices, automated (or partially automated) suggestions can be made in order to optimize a deployment. This gives human resources specialists the capacity to manage more exceptional cases, leaving the fundamental optimization work to be carried out by the users themselves.

FinOps: cost optimization in the cloud

"FinOps is an operational framework and cultural practice that maximizes the business value of cloud, enables timely data-driven decision making, and creates financial accountability through collaboration between engineering, finance, and business teams."
FinOps Foundation, Technical Advisory Council, December 2023 .

Cost transparency can also be established by analyzing the deployment. This transparent view is available centrally and to the users themselves. The **Fraunhofer ISST tool Automatic Recommender for Resource Configuration (ARRC)** uses analyses to generate automatic suggestions for optimizing the configuration of the deployment. This can enable a drastic reduction in operating costs in the context of further organizational FinOps measures; for example, by allowing employees to take responsibility for their cloud usage and being rewarded for their efforts by the company.

The approach can also be taken by cloud service providers in order to use their own hardware capacity more effectively, in turn enabling them to serve more customers.

GreenOps: improving sustainability through software

GreenOps focuses on how to operate software in a way that is highly sustainable. There is often a lack of transparency concerning how sustainable software is, which means it is important to monitor software in operation in order to calculate its carbon footprint.

The ARRC tool is used in this context, too: It monitors the software while it is running and offers suggestions for configuring the deployment in a more sustainable way.

The complete software life cycle also offers additional potential for optimization. For this reason, the team in the IT Service Providers department analyzed the measures that can be taken in project management, requirements analysis, software development and operation in its project entitled "Energieeffiziente Software als erster Schritt auf dem Weg zu einer grüneren IT" ("Energy-efficient software as a first step on the path to greener IT").

Our research will draw on this in the coming years, with the goal of providing software developers with appropriate key figures in a customized and dynamic way during the software development process. This will equip them with the tools to make better decisions about where optimizations need to be made in the program code.

Data spaces: customized data space technologies for individual integration into data spaces

Fraunhofer ISST is a central research partner in the development of sovereign data spaces — for example, in its role in the Catena-X Automotive Network (for detailed information, see page 14 of this Annual Report) and as a consortium leader in the European Union's Data Spaces Support Centre (DSSC) . The institute works with companies to develop software and

services for data spaces and customizes technology offerings for operators and service providers of data spaces, such as Huawei (see page 16 of this Annual Report). Fraunhofer ISST supports companies in all industries, from the initial steps toward data space usage to registration at clearing houses such as Cofinity-X and establishing the appropriate data infrastructure.

Data-driven business models — from design to monetization

The rapid development of digital technologies and artificial intelligence is generating a huge flood of data. This is disrupting traditional business models and turning data into a

strategic resource. Data-driven business models use this data to develop innovative solutions and access new sources of revenue. A central component of these models is the concept of data ecosystems, in which companies, organizations and individuals exchange data in order to achieve common goals.

The effective use of data gives companies a crucial competitive advantage. Data-driven business models make it possible to reduce operating costs, tap into new markets and drive product innovations. This is the starting point for projects such as Incentives and Economics of Data Sharing — IEDS, which is funded by the German Federal Ministry of Education and Research (BMBF). IEDS investigates the incentives and principles relating to data exchange in sovereign and secure data ecosystems.

Fraunhofer ISST helps companies to develop and implement data-driven business models:

- **Consultation and concept development:** Developing custom strategies for the effective use of data and redesign of business models.
- **Technology and tools:** Providing state-of-the-art technologies and tools for data collection, analysis and use, e.g., data spaces.
- **Training:** Training employees so they have the skills to use data-driven strategies and technologies successfully.

The IT Service Providers department is a partner and consultant with many years of experience. It works with companies that wish to use cloud services as sovereign, sustainable and cost-optimized data infrastructures.

In 2023, the team at the IT Service Providers business unit made some important advances in the fields of data sovereignty, FinOps and GreenOps. Our innovative solutions and projects contribute to the digital transformation and to sustainability in industry. In the coming years, we will be ramping up our research and development activities with the aim of helping companies achieve efficient and sustainable use of their cloud infrastructures. The IT Service Providers department is a partner and consultant with many years of experience. It works with companies that wish to use cloud services as sovereign, sustainable and cost-optimized data infrastructures.

More information about selected lighthouse projects online:

The Data Space Lab : The Data Space Lab was launched in 2023 with the goal of developing the existing Eclipse Dataspace Components from Huawei and Fraunhofer ISST into as-a-service components.

FAIR Data Spaces : Building a joint cloud-based data space for industry and science.

IEDS : Incentives and Economics of Data Sharing.

CCIT : Fraunhofer Cluster of Excellence Cognitive Internet Technologies.

NTT : Dataspace Connector Proof-of-Concept (PoC) / Connecting NTT with the International Data Spaces.

Mobility & Smart Cities

Digital solutions for our future networked lives

Mobility & Smart Cities

Boosting innovation, sustainability and climate protection through networked mobility and smart cities

Mobility & Smart Cities online:

Projects
Technologies
Publications

Our mobility and our cities are undergoing transformation. New and intelligent approaches are needed in the face of the mobility transition and the climate and demographic challenges that we face — coupled with our desire for greater sustainability and an improved quality of life. Digital solutions can make a crucial contribution to supporting our future mobile lives — and the Mobility & Smart Cities business unit is taking on this task with its comprehensive expertise and the technologies it develops in the areas of data sharing and data management.

Dr. Marcel Altendeitering

Head of Department
Mobility & Smart Cities
Phone +49 231 97677-461
marcel.altendeitering@isst.fraunhofer.de

In April 2024, Der Spiegel reported that people in Paris are increasingly leaving their cars at home, preferring instead to use alternative modes of transport. Less than five percent of journeys were being made by car, the publication's article said — encouraging figures that indicate a climate-friendly mobility transition is possible. According to the latest Mobility Monitor from Acatech, Germans are also demanding modernization of their transport infrastructure, and in particular expansion of the country's rail network. Improvements in the regional public transport network are seen as especially important. However, actual usage of public transport varies widely between the highly developed metropolitan regions and rural areas with limited transport infrastructure.

So what exactly is a smart city?

The EU Commission defines smart cities as follows: "A smart city is a place where **traditional networks and services** are made more **efficient** with the use of **digital solutions** for the benefit of its inhabitants and business. A smart city goes beyond the use of digital technologies for better resource use and less emissions. It means **smarter urban transport networks**, upgraded **water supply and waste disposal facilities** and more efficient ways to **light and heat buildings**. It also means a more interactive and responsive **city administration,** safer public spaces and meeting the needs of an aging population."

In other words, alongside a sustainable expansion of infrastructure, there is a need to network the mobility options that exist today with digital services as effectively as possible, optimizing their availability as a result. This is exactly the area in which researchers in Fraunhofer ISST's Mobility & Smart Cities business unit are working.

Mobility & Smart Cities can be defined as **all of the intelligent solutions** that are intended to create sustainable, efficient, safe, affordable and accessible **infrastructure and mobility**. A smart city uses digital solutions to **optimize traditional networks and services**. It improves the **quality of life of its population** and promotes **efficiency** in areas such as transport, water supply, waste disposal and building services engineering.

Mobility is one of the **key dynamics of urbanization**. A city is shaped by the infrastructure that connects it. In addition to aspects of sustainability and progress, mobility and smart cities are associated with **multi- and intermodality**, data integration, automation and the transformation of infrastructure and the mobility sector as a whole.

Why do we need digital solutions in Mobility & Smart Cities?

With the multiple crises they have faced, there is a need for companies, cities and the economy to become more flexible, resilient and sustainable. The digital transformation that is required must aim to promote innovation and increase efficiency, data sovereignty and security.

Digital solutions can make a crucial contribution to enhancing security and sustainability in infrastructure, as well as efficiency in city administration. Here are three examples:

- Freight traffic can be designed in a much more efficient way through the use of data-based approaches and automated systems. An overall increase in network capacity of up to 30 percent can be achieved through automatic train operation and the optimization of train journeys and rail operation.
- The processes involved in operating buildings are responsible for 35 percent of energy consumption and approximately 30 percent of carbon emissions in Germany. Significant energy savings can be made through data analysis and intelligent optimization of operations.
- Open-source software (OSS) improves our municipalities: According to a qualitative study by the German Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR), the city administrations that were surveyed believe the drivers of OSS are primarily digital sovereignty, reduced dependence on individual software providers and cost savings made possible through reuse by third parties.

Looking to the future of mobility: enabling fair data sharing in complex data ecosystems

The researchers in the Mobility & Smart Cities business unit are working on the digital transformation together with companies, municipalities and research organizations — from concept to implementation.

To this end, they promote **data sharing in data spaces** and develop suitable business models for shared data usage. They design **data trustees as neutral parties** in data ecosystems and work on the implementation of these. The team supports the development of **municipal data strategies** through its expertise in the fields of **data governance, data quality and data integration**, taking account of legal provisions such as the Data Act of the European Union.

Data quality and data availability play an enormously important role in this context. This is why Fraunhofer ISST helps cities and regions to develop their **digital twin**, with holistic and integrated data resources that serve as a basis for comprehensive approaches to mobility. The institute also develops cloud edge architectures and supports providers in their cloud adaptation processes.

Its range of services includes approaches for the secure and anonymized **evaluation of data resources** (using federated learning, for example). This can be helpful in the development of custom mobility concepts, for instance, since vulnerabilities can be identified and resolved within the mobility network.

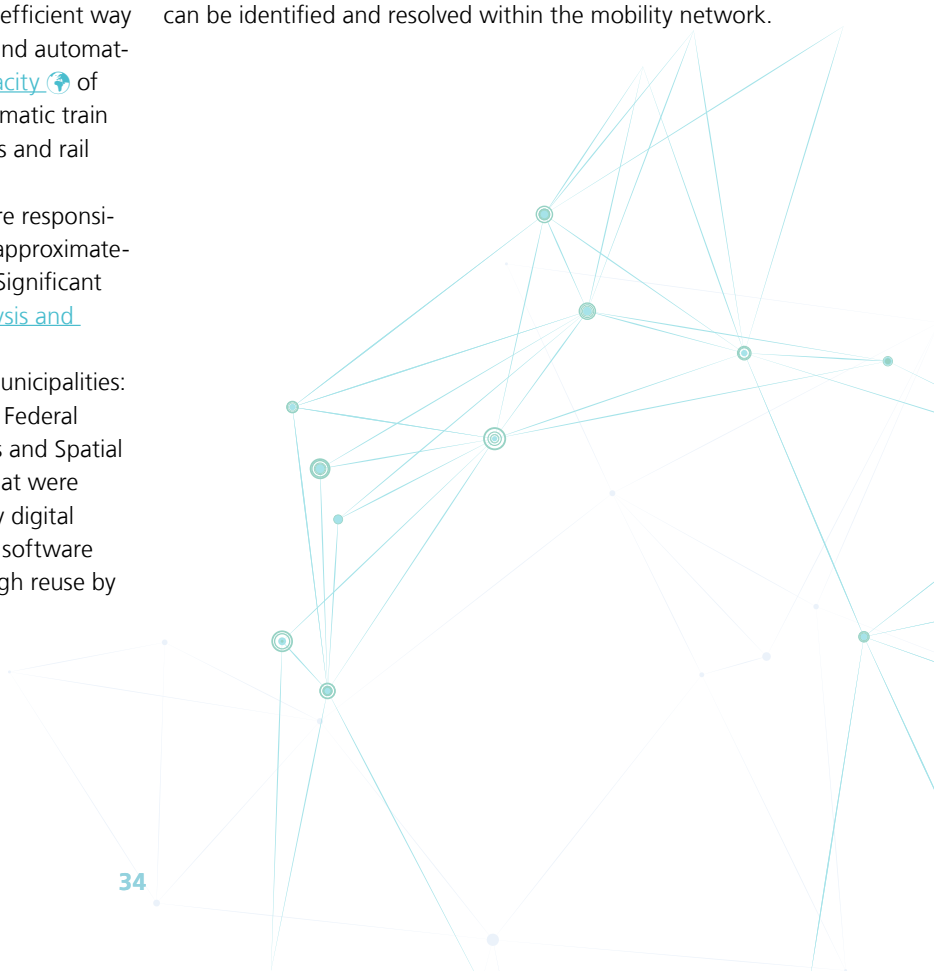


Figure: Target industries for Mobility & Smart Cities

Our customers: anyone who provides mobility or creates the conditions for a mobile world.

Fraunhofer ISST offers a range of services to support its customers in the context of growing digitalization in smart cities and mobility. The solutions that it develops contribute to the digital transformation and help to take advantage of the associated opportunities. Customers in this segment include mobility organizations and providers, automotive manufacturers, transport companies, transport infrastructure companies, municipalities and regions, municipal utilities and organizations, and tourism companies and associations.

More information about selected lighthouse projects online:

Mobility

MDSxNRW : Developing an intelligent recommendation engine for organizations to find suitable connectors to the Mobility Data Space.

MobiDataSol : Developing a data trust model for data exchange across organizations in a smart city.

GaiaX 4 AMS : Developing Gaia-X-compliant mobility services for autonomous driving, such as ODD-compatible routes and networked rescue corridors in order to increase safety and efficiency in road traffic.

Smart Cities

Opt-In : Integrating data sovereignty into the smart home to give citizens control over their data.

BuildingTrust : Developing a modular data trustee for building data in order to establish trust when sharing data and promote sustainable construction.

Short study : "Data economy and edge computing — potential, challenges and recommended actions for companies"

Healthcare

Using secure data spaces to drive innovation in medicine

Healthcare

Personalized and data-centric medicine with cross-sector data spaces for healthcare

Healthcare online:

Projects
Technologies
Publications

Healthcare is facing enormous challenges, ranging from cost pressure and increasing quality criteria to demographic change and the shortage of skilled workers. These aspects are the subject of significant public debate, but staff are also battling with structures that have grown over time and are full of bureaucracy, burdensome documentation requirements and paper-based workflows. The already fragmented service provision in various healthcare sectors is documented in monolithic, non-interoperable systems, making it more difficult for information to flow in this highly data-sensitive field. Treatment is based on a standard one-size-fits-all principle, where the focus of the system is on treating illnesses.

Improving the degree of digitalization in the healthcare sector can offer efficient solutions to many of these problems. This will enable medical personnel to put more of their focus on their core work of helping people recover.

Dr. Anja Burmann

Head of Department
Healthcare
Phone +49 231 97677-435
anja.burmann@isst.fraunhofer.de

In the Healthcare business unit, Fraunhofer ISST is working to develop data-driven optimization of medical care. Its researchers are investigating and developing software technologies for the data-based healthcare environment of tomorrow. This includes concepts and solutions for health data spaces, interoperability and the applications that build on this, such as clinical process optimization, mobile health apps and treatment algorithms.

Overview of services

The Healthcare business unit focuses on the following areas:

- Data spaces for shared, sovereign use of decentralized patient data in accordance with the special requirements that apply to data protection (IHE, HL7, FHIR) and regulations (EHDS, MDR) in healthcare (data-driven care process optimization)

- Implementing interoperable infrastructures and applications for seamless and paperless personalized medicine with automated workflows (closed-loop precision medicine, digital twins) and using artificial intelligence
- Integration into the Medical Informatics Initiative or the telematics infrastructure
- AI-based analytical tools for providing support in decision-making and for the further development of electronic patient records and digital health applications
- Personal health applications as a personalized, mobile addition to treatment with intelligent algorithms for measuring treatment success and for the federated, interoperable, transparent and sovereign use of individual patient data
- Developing data and digitalization strategies and offering consultation for the introduction of these strategies in companies or healthcare institutions
- Designing and developing complex health IT ecosystems and infrastructures based on Gaia-X AISBL (European Association for Data and Cloud) and the International Data Spaces Association (IDSA)
- Developing new business models and treatment offerings in future multi-domain data spaces and data ecosystems

When developing solutions, the researchers at Fraunhofer ISST take account of basic legal, regulatory and ethical conditions and aim to achieve open, fair and federated data use. Together with their partners and customers, they create value across industries through the development of transparent and trustworthy data usage mechanisms.

Reinforcing health IT for solutions providers

Sovereign use of health data ensures that health IT providers are fit for the European Health Data Space (EHDS). Solutions from Fraunhofer ISST support growing service provider organizations through scalable operating structures and standardized IT landscapes. This establishes a basis for efficient data use and the development of new forms of treatment through health infrastructures and applications. Specifically, solutions providers can benefit from the following:

- Data-based concepts, prototypes and components for creating cross-industry solutions and services using health data
- iVY.CONNECT (IHE-based support for records-based data exchange)

Through these services, the department enables interoperable data use in healthcare by breaking up monolithic data silos and harmonizing data formats and data quality with interoperability solutions. This establishes transparent results and real-world evidence between organizations in the healthcare supply chain. Intelligent data analysis and trust mechanisms for data use throughout the supply chain support the automation of workflows and personalized treatment approaches.

- Medical Informatics Initiative: use of and access to workflow management
- Expertise and tools for profiling and validating FHIR resources and implementation guides
- Data space concepts and components (EDC, Gaia-X, IDSA)
- Virtual consent assistant for passing on data in healthcare contexts

From real-world evidence to clinical decision support and full procedure solutions

Overarching infrastructures and interfaces for data sharing are the keys to creating data-based services and business models. With sovereign data use, they make it possible to establish close links and feedback between medical treatment and research, and ensure effective integration into the supply chain. Intelligent algorithms support the early detection of treatment success factors, while real-world evidence facilitates developments and improvements to services on the basis of data. All of these factors assist pharmaceutical and medical technology companies during their own digital transformations.

Fraunhofer ISST provides support through the following services:

- Developing cross-industry, digital ecosystems using data space concepts and components (EHDS, Gaia-X, IDS, EDC)
- The iVY.CONNECT interoperability suite (IHE-based support for records-based data exchange)
- Solutions for the federated, interoperable, transparent and sovereign use of individual patient records, e.g., for treatment support
- Virtual consent assistant for passing on data in healthcare contexts
- Algorithms for use in medical devices

Data use as the key to better healthcare

Using data in a sovereign way that goes beyond sectoral boundaries is essential to the digital transformation in healthcare. Fraunhofer ISST supports its customers and partners — from service providers such as hospitals and medical networks to providers of health IT infrastructure, pharmaceutical firms and medical device companies — through its many years of experience in developing data infrastructures in this particular industry, with all the special requirements that it involves. Fraunhofer ISST takes a leading role in the development of data space technologies, ensuring customers receive future-proof solutions that meet all regulatory and technical requirements and open up a path to completely new forms of data-centric cooperative healthcare.

More information about selected lighthouse projects online:

IDERHA : Using design and technology to overcome interdisciplinary obstacles in accessing, integrating and analyzing healthcare data.

Comprehensive IT strategy for the University Hospital of the Ruhr University Bochum as part of the SMITH project in the Medical Informatics Initiative.

HEALTH-X dataLOFT : Legitimate, open and federated health data space in Gaia-X.

DaRE : A data trust model for medical data, taking radiology as an example.

Our Areas of Expertise

Gaining a competitive edge through technological know-how

In order to use technology effectively and to the best advantage of their customers, companies need an in-depth understanding of it. Fraunhofer ISST focuses its research on developing data spaces in six areas of expertise, enabling data to be shared in a fair, sovereign and value-adding way.

Areas of Expertise

Data space technologies: Design and technological implementation of sovereign data spaces

The Fraunhofer Institute for Software and Systems Engineering ISST focuses its research on the development of data spaces, in which data providers retain control over what happens with their data, even after they share it. Without this data sovereignty, scenarios involving cross-company data exchange would be unfeasible in many industries and fields of implementation. For this reason, data sovereignty is the key to new value chains that are based on the fair and shared use of data. Data spaces are a key component of the European Data Strategy. They form the digital foundation for a future-proof economy in Germany and Europe.

Today, there are already numerous initiatives that consider the relevance of data spaces for the economy and society; for example, with the goal of developing standards or implementing example industry solutions. These include the International Data Spaces Association (IDSA), Gaia-X AISBL, domain-specific data spaces such as the Catena-X Automotive Network, Mobility Data Space and EONA-X, plus coordination projects like the EU-funded Data Spaces Support Centre (DSSC). At a technological level, the Eclipse Foundation has started developing its own Data Spaces Working Group, which aims to develop open-source software components for data spaces. Fraunhofer ISST is a key player in all of these initiatives and is one of the leading initiators of the data space approach.

As such, employees at Fraunhofer ISST have developed an in-depth knowledge of what it takes to implement the technology involved in data spaces. This comprises:

- **Technology:**
  - Implementing (OSS) data space components that are required to set up a data space environment
  - Providing all necessary data space components (e.g., Eclipse Dataspace Components)
  - Continuously enhancing the maturity of the solutions
- **Adoption:**
  - Easier development and configuration of new data spaces through adoption of existing components
  - Demonstration models and blueprints for various domain-independent scenarios
- **Concepts:**
  - Specifications for data space conceptual models
  - Designing value creation in and with data spaces through the development of business models and application scenarios
  - Requirements analysis and transfer to technical implementation
  - Transfer of concepts to formal standards

Development in six areas of expertise:

Fraunhofer ISST conducts extensive work on data space technologies in six areas of expertise in which its researchers, drawing on in-depth technological know-how and extensive market knowledge, can provide their customers and partners with support in shaping future data space-related markets.

Cloud transformation

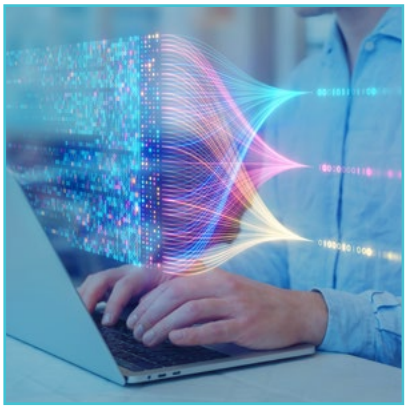
Researching trends and developments in cloud transformation, thinking ahead and putting them into practice.

VIEW AREA OF EXPERTISE

Data science

Harnessing the knowledge that lies within data.

VIEW AREA OF EXPERTISE



Software engineering

Developing innovative and pioneering software in close cooperation with research partners.

VIEW AREA OF EXPERTISE

Strategic data management

How to become a company that creates value through data.

VIEW AREA OF EXPERTISE

Data spaces and data ecosystems

Technologies for data ecosystems and digital products and services.

VIEW AREA OF EXPERTISE

Free and open-source software (FOSS)

Transparent and collaborative software development as an innovation driver for the digital economy and for establishing data spaces.

VIEW AREA OF EXPERTISE

Fraunhofer ISST

We build fair, sovereign and value-adding data spaces.

The Fraunhofer Institute for Software and Systems Engineering ISST develops data space technologies for sovereign data exchange and works with its partners to build the data ecosystems of the future.

#InnovationsFromData

employees at Fraunhofer ISST

An Institute on Track for Growth

Fraunhofer ISST in figures

Employees

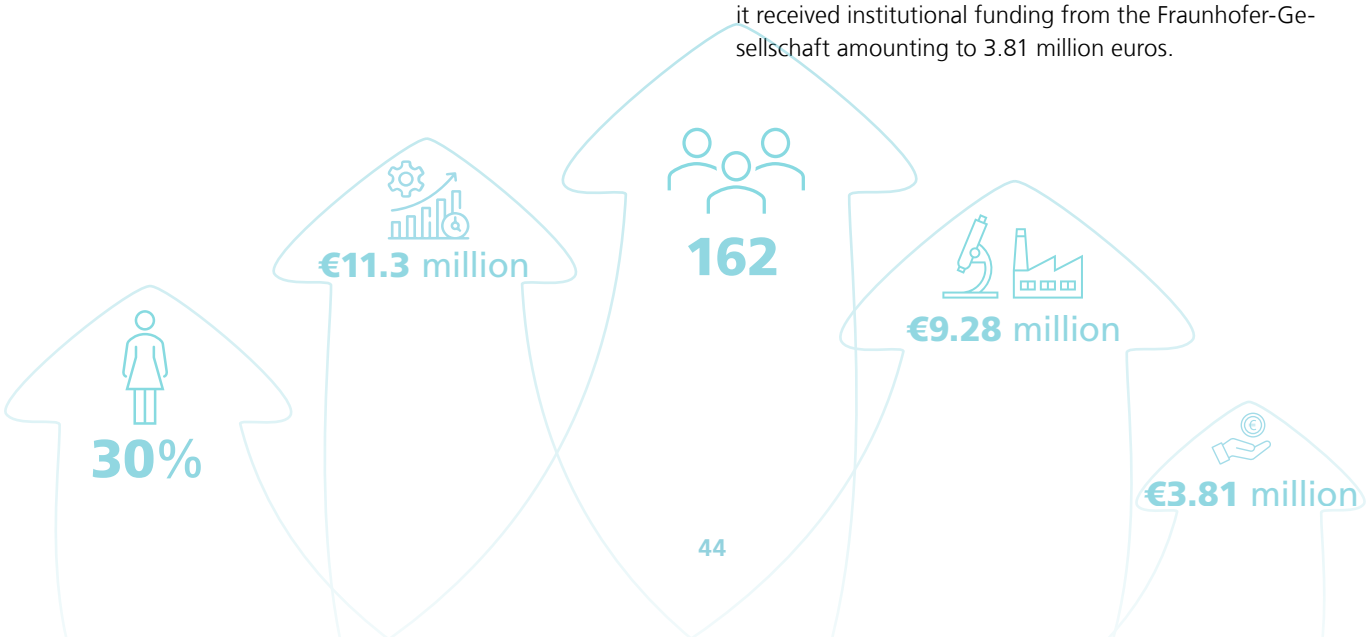
At the end of 2023, there were 162 employees at Fraunhofer ISST. Reflecting one of the key functions of a Fraunhofer institute — to support and train the next generation of scientists — Fraunhofer ISST is home to 55 student employees alongside its researchers and administrative staff.

The proportion of women this year was just under 30 percent. Around 10 percent of the institute team came from outside Europe.

Budgeted expenditure

The institute receives public funding, known as base funding, that finances pre-competitive research, strategic projects and investments. The total expenditure from the operating and investment budgets in 2023 was approximately 11.3 million euros. Personnel costs accounted for 70 percent of this figure.

In the 2023 financial year, Fraunhofer ISST generated revenue of 9.28 million euros from research and industry. In addition, it received institutional funding from the Fraunhofer-Gesellschaft amounting to 3.81 million euros.



Prof. Boris Otto

The Institute Management

Prof. Boris Otto

Director at the Fraunhofer Institute for Software and Systems Engineering ISST and Chair of Industrial Information Management at TU Dortmund University

Professor Boris Otto (born 1971 in Hamburg) is an industrial engineer and business information scientist. He has been director of the Fraunhofer Institute for Software and Systems Engineering ISST in Dortmund since 2017. Since 2013, he has also been Chair of Industrial Information Management at TU Dortmund University. Boris Otto received his doctorate in engineering from the Faculty of Mechanical Engineering at the University of Stuttgart and qualified as a university lecturer at the School of Management at the University of St. Gallen. In his research and teaching, he focuses on industrial data ecosystems, data spaces and data management in industrial companies.

He is Deputy Chairman of the Board of the Catena-X Automotive Network, a member of the Board of the Gaia-X European Association for Data and Cloud and the International Data Spaces Association (IDSA), a member of the Supervisory Board of the European Health Data Alliance (EDHA) and Coordinator of the EU Data Spaces Support Centre. Boris Otto is also chair of the steering committee of the Fraunhofer ICT Group and thus a member of the presidential council of the Fraunhofer-Gesellschaft. He is a founding shareholder and member of the Board of Directors of CDQ AG, St. Gallen, and a member of the Research Council Industrie 4.0, the Supervisory Board of SICK AG in Waldkirch, the Advisory Board for Mobility Data of the Baden-Württemberg Ministry of Transport and the Bosch Data Strategy Advisory Board.

The Advisory Board

Our advisors from business, research, politics and administration

Fraunhofer ISST is assisted by its advisory board. Its members support the market-focused approach to research at the institute with their practical experience and specialist knowledge from their respective technical fields.

Paul Schwefer
Management consultant at Fair Sourcing and chair of the advisory board

Dr. Reinhold Achatz
Coach for innovation, technology, entrepreneurship and sustainability

Maximilian Ahrens
Managing Director of T Digital at Deutsche Telekom

Prof. Svenja Falk
Managing Director at Accenture Research

Dr. Christiane Fricke
Head of the Non-University Research Organizations, EU International Affairs Group of the Ministry of Culture and Science of the State of North Rhine-Westphalia

Oliver Ganser
Vice President of Processes, Digitalization, Governance and Catena-X in the Purchasing and Supplier Network at BMW I Chair and director of the industrial consortium of Catena-X Automotive Network e.V.

Prof. Volker Gruhn
Chair of Software Engineering at the University of Duisburg-Essen and Chair of the Supervisory Board of adesso SE

Dr. Nicola Jentzsch
Lead for Innovation and Digitalization at Deutsche Bundesbank

Fabian von Kuenheim
Kuenheim Familiaris GmbH

Prof. Dr. Christine Legner
Head of the Information Systems Department at the University of Lausanne

Dr. Henriette Litta
Managing Director of Open Knowledge Foundation Deutschland e.V.

Dr. Sebastian Ritz
CEO of German Edge Cloud GmbH & Co. KG

Michael Schmelmer
Member of the Board of Managing Directors at C.H. Boehringer Sohn AG & Co. KG

Our Networks

It is impossible to build data spaces acting alone — such developments can only succeed if they are the result of a joint effort involving many different players. Fraunhofer ISST is therefore involved in numerous professional, regional and Fraunhofer-wide networks, allowing it to collaborate and exchange ideas with partners.

Memberships*

- Eclipse Foundation
- European Alliance for Industrial Data, Edge and Cloud
- Gaia-X, European Association for Data and Cloud
- Catena-X Automotive Network
- Data Competence Center for Cities and Regions (DKSR)
- German Association for Information Technology, Telecommunications and New Media (BITKOM e.V.)
- HL7 Benutzergruppe in Deutschland e.V. (German HL7 User Group)
- International Data Spaces Association
- MedEcon Ruhr e.V. (Network of the Healthcare Sector in the Ruhr)
- Alumni of Computer Science Dortmund e.V. (AIDO)
- Windo e.V. (Association of Scientific Institutions in Dortmund)
- EHDA e.V., European Health Data Alliance

* partly as coordinating institute for the Fraunhofer-Gesellschaft

Fraunhofer-Gesellschaft

- Fraunhofer Information and Communication Technology Group (iuk.fraunhofer.de/en.html)
- Working Group Digital Health in the Lead Market Health (Fraunhofer Group for Health)
- Fraunhofer Cloud Computing Alliance (cloud.fraunhofer.de/en.html)
- Fraunhofer Big Data and Artificial Intelligence Alliance (bigdata-ai.fraunhofer.de/en.html)
- Fraunhofer Cluster of Excellence Cognitive Internet Technologies (cit.fraunhofer.de/en.html)
- Fraunhofer Academy (academy.fraunhofer.de/en.html)

10 years of industrial information management at TU Dortmund University — celebratory event in October 2023

University Collaborations

As an institute of the Fraunhofer-Gesellschaft, we work at the interface between science and industry. Fundamental research at universities gives us valuable input that encourages transfer to industry with a focus on specific applications.

The following chairs and professorships form the core of our scientific network:

Prof. Boris Otto
Chair of Industrial Information Management, TU Dortmund University

Prof. Jan Cirullies
Professor of Business Administration (specializing in supply chain management and digital logistics), Fachhochschule Dortmund — University of Applied Sciences and Arts

Prof. Wolfgang Deiters
Professor of Health Technologies, University of Health Sciences, Bochum

Prof. Falk Howar
Professor of Rigorous Software Engineering, TU Dortmund University

Prof. Jan Jürjens
Institute for Software Engineering IST, University of Koblenz

Prof. Sven Meister
Chair of Health Informatics, Witten/Herdecke University

Prof. Frederik Möller
Junior Professor for Data-Driven Enterprise, Technical University of Braunschweig

Prof. Jakob Rehof
Chair XIV of Software Engineering, TU Dortmund University

Prof. Christian Schwede
Professor of Big Data Analytics, Bielefeld University of Applied Sciences

Press release, April 2023

New bachelor degree program in social data science strengthened by cooperation between Witten/Herdecke University and Fraunhofer ISST

Details online (only in german)

Studying for a PhD with Fraunhofer ISST

The Research Schools: achieving doctoral success together

Aimed at providing support to PhD students, the Research Schools at the Fraunhofer Institute for Software and Systems Engineering ISST are collaborations with professors from TU Dortmund University, Witten/Herdecke University, the Technical University of Braunschweig and the University of Koblenz.

At the Research Schools, doctoral students from Fraunhofer ISST work together with those from universities in a mutual dialog-based approach that teaches the basics of scientific research in interdisciplinary groups. The Research Schools span a variety of fields and disciplines: information systems, healthcare and computer science. They aim to not only enhance the scientific quality of dissertations at Fraunhofer ISST and its affiliated universities, but also provide support for strategically publishing findings in publication media that relate to the specialist fields. Hands-on workshops on different scientific subjects are organized in the Research Schools to allow doctoral students to benefit cumulatively from the knowledge they have acquired and share it with one another.

PhD Students 2023

Dr. Anja Burmann

“Expertenorganisation Krankenhaus — Untersuchung von Wirkungszusammenhängen und Auswirkungen des »Faktor Mensch« auf die Digitale Transformation”
(“Hospitals as expert organizations — investigation into the inter-dependencies and effects of the human factor on the digital transformation”)
Witten/Herdecke University

Dr. Anja Burmann

In her dissertation, Anja Burmann investigates hospitals as expert organizations and how the human factor affects the success of digitalization in hospitals. She identifies interdependencies and describes attitudes, expectations and fears in relation to the changes initiated by digitalization between profession, age, education and income groups within a complex form of organization that is facing ever-increasing cost pressure.

The results are incorporated into the design of digital solutions for service providers and help to make people the focus of digitalization processes.

Supervisor: Prof. Sven Meister (Witten/Herdecke University and Fraunhofer ISST); second reviewer: Dr. Johannes Just (Witten/Herdecke University)

Dr. Tobias Guggenberger

“Föderierte Datendienste in industriellen Ökosystemen”
(“Federated data services in industrial ecosystems”)
TU Dortmund University

Dr. Tobias Guggenberger

In his dissertation, Tobias Guggenberger investigates how federated data services can be designed to enable shared data use in industrial ecosystems. Through the development of a custom reference model, the paper offers valuable insights into the implementation of data spaces and contains important findings relating to standard processes, design principles and a typology of ecosystems.

The results are already being incorporated into the Data Spaces Support Centre, where they are playing a crucial role in the promotion of innovations and the design of future data spaces and industrial ecosystems.

Supervisor: Prof. Boris Otto (TU Dortmund University and Fraunhofer ISST); second reviewer: Prof. Frank Köster, German Aerospace Center (DLR)

Publications

Knowledge transfer is one of the most important functions of applied research at Fraunhofer ISST.

Fraunhofer ISST employees regularly publish articles for scientific and specialist journals. We also publish our scientists' conference papers, studies and white papers.

All of the scientific publications are listed on the Fraunhofer ISST website: https://www.isst.fraunhofer.de/en/publications/scientific-publications.html

A selection of the most important publications in 2023:

LIS, D., GELHAAR, J., OTTO, B., 2023. *Data strategy and policies: The role of data governance in data ecosystems.* In: (2023) Data Governance: From the Fundamentals to Real Cases, pp. 27-55.

RAMADAN, Q., BOUKHERS, Z., ALSHAIKH, M., LANGE, C., JURJENS, J., 2023. *Data Trading and Monetization: Challenges and Open Research Directions.* In: (2023) ACM International Conference Proceeding Series, pp. 344-351.

HOUTA, S.; BADER, A.; EFFERT, J.-S.; ESSER, B.; HENZE, J.; SPAIC, A.; ZOCHER, F.; LAUERER, M.; SURGES, R., 2023. *Digital health applications in the self-management of epilepsy—A survey on patients' perspective.* In: (2023) Epilepsia Open, 8 (4), pp. 1288-1299.

SCHEIDER, S.; LAUF, F.; GELLER, S.; MÖLLER, F.; OTTO, B., 2023. *Exploring design elements of personal data market.* In: (2023) Electronic Markets, 33 (1), art. no. 28, .

SCHOORMANN, T.; SCHWEIHOFF, J.; JUSSEN, I.; MÖLLER, F., 2023. *Classification tools for business models: Status quo, comparison, and agenda.* In: (2023) Electronic Markets, 33 (1), art. no. 7, .

BOUKHERS, Z.; BOUABDELLAH, A.; YANG, C.; JÜRJENS, J., 2023. *Beyond Trading Data: The Hidden Influence of Public Awareness and Interest on Cryptocurrency Volatility.* In: (2023) International Conference on Information and Knowledge Management, Proceedings, pp. 142-151.

SCHEIDER, S.; LAUF, F.; MÖLLER, F.; OTTO, B., 2023. *A Reference System Architecture with Data Sovereignty for Human-Centric Data Ecosystems.* In: (2023) Business and Information Systems Engineering, 65 (5), pp. 577-595.

WARNECKE, M.; HOLLE, D.; BURMANN, A., 2023. *Enabling Data-Driven Nursing Innovations: User-centered Development of a Nursing Data Module.* In: (2023) Current Directions in Biomedical Engineering, 9 (1), pp. 339-342.

BURMANN, A.; SCHEPERS, S.; MEISTER, S., 2023. *Acceptance factors of digitalization in hospitals: a mixed-methods study.* In: (2023) Health and Technology, 13 (5), pp. 843-859.

HELLMEIER, M.; PAMPUS, J.; QARAWLUS, H.; HOWAR, F., 2023. *Implementing Data Sovereignty: Requirements & Challenges from Practice. In:* (2023) ACM International Conference Proceeding Series, art. no. 143, .

BOUKHERS, Z.; GOSWAMI, P.; JÜRJENS, J., 2023. *Knowledge guided multi-filter residual convolutional neural network for ICD coding from clinical text. In:* (2023) Neural Computing and Applications, 35 (24), pp. 17633-17644.

HASSO, H.; GROßER, K.; AYMAZ, I.; GEPPERT, H.; JÜRJENS, J., 2023. *Enhanced abbreviation–expansion pair detection for glossary term extraction.* In: (2023) Information and Software Technology, 159, art. no. 107203, .

LIS, D.; ARBTER, M.; SPINDLER, M.; OTTO, B., 2023. *An Investigation of Antecedents for Data Governance Adoption in the Rail Industry -Findings From a Case Study at Thales.* In: (2023) IEEE Transactions on Engineering Management, 70 (7), pp. 2528-2545.

TUMA, K.; PELDSZUS, S.; STRÜBER, D.; SCANDARIATO, R.; JÜRJENS, J., 2023. *Checking security compliance between models and code.* In: (2023) Software and Systems Modeling, 22 (1), pp.273-296.

BIEHS, S.; HÖVENER, L.; SKUBOWIUS, E.; BOHLEN, M.; KOLARIK, S., 2023. *Spurring Minimum Value Collaboration: Tool-Supported Demand Alignment.* In: (2023) Logistics Journal, 2023, pp. 1-11.

HOPPE, C.; SCHMELZER, R.; MÖLLER, F.; SCHOORMANN, T., 2023. *Data spaces as enablers for sustainability.* In: (2023) Lecture Notes in Informatics (LNI), Proceedings - Series of the Gesellschaft fur Informatik (GI), P-337, pp. 1325-1336.

SOEHNCHEN, C.; RIETZ, A.; WEIRAUCH, V.; MEISTER, S.; HENNINGSEN, M., 2023. *Creating an Intercultural User-Centric Design for a Digital Sexual Health Education App for Young Women in Resource-Poor Regions of Kenya: Qualitative Self-Extended Double Diamond Model for Requirements Engineering Analysis. In:* (2023) JMIR Formative Research, 7 (1), art. no. e50304, .

HASSO, H.; GROßER, K.; AYMAZ, I.; GEPPERT, H.; JÜRJENS, J., 2023. *ILLOD Replication Package: An Open-Source Framework for Abbreviation-Expansion Pair Detection and Term Consolidation in Requirements. In:* (2023) Proceedings of the IEEE International Conference on Requirements Engineering, 2023-September, pp. 369-370.

GROBER, K.; RUKAVITSYNA, M.; JÜRJENS, J., 2023. *A Comparative Evaluation of Requirement Template Systems.* In: (2023) Proceedings of the IEEE International Conference on Requirements Engineering, 2023-September, pp. 41-52.

TEBERNUM, D.; ALTENDEITERING, M.; HOWAR, F., 2023. *A Survey-Based Evaluation of the Data Engineering Maturity in Practice.* In: (2023) Communications in Computer and Information Science, 1860 CCIS, pp. 1-23.

QARAWLUS, H.; BIEHS, S.; SHARIATI, B.; PEDREÑO MANRESA, J.J.; BOUCHEDOUB, A.; HAßE, H.; SAFARI, P.; AUTENRIETH, A.; FISCHER, J., 2023. *Demonstration of Data-Sovereign Telemetry Broker for Open and Disaggregated Optical Networks.* In: (2023) Optical Fiber Communications Conference and Exhibition, OFC 2023 - Proceedings, art. no. M3Z.3, .

SHARIATI, B.; QARAWLUS, H.; BIEHS, S.; PEDRENO-MANRESA, J.-J.; SAFARI, P.; BALANICI, M.; BOUCHEDOUB, A.; HAßE, H.; AUTENRIETH, A.; FISCHER, J.K.; FREUND, R., 2023. *Telemetry Framework with Data Sovereignty Features.* In: (2023) Optical Fiber Communications Conference and Exhibition, OFC 2023 - Proceedings, art. no. M3G.2, .

BURMANN, A.; LANGER, H.; BOSOMPEM, J.; CLEMENS, T.; HERTEN, B.; KERSTAN, L.; LAUER, R.; NAEVE, P.; GELLER, S.; HUHNT, J.; MERKEL, S., 2023. *Governance of Digital Health Data on Cooperatively Organized Platforms - a Design Thinking Approach.* In: (2023) Proceedings of the Annual Hawaii International Conference on System Sciences, 2023-January, pp. 6250-6259.

HAßE, H.; VAN DER VALK, H., 2023. *Simple Design Approach for Shared Digital Twins.* In: (2023) Proceedings of the Annual Hawaii International Conference on System Sciences, 2023-January, pp. 6758-6767.

MÖLLER, F.; STROBEL, G.; SCHOORMANN, T.; OTTO, B., 2023. *Introduction to the Mini-Track on Designing Data Ecosystems: Values, Impacts, and Fundamentals.* In: (2023) Proceedings of the Annual Hawaii International Conference on System Sciences, 2023-January, pp. 3683-3684.

GROßER, K.; RIEDIGER, V.; JÜRJENS, J., 2023. *Requirements document relations: A reuse perspective on traceability through standards.* In: (2023) Lecture Notes in Informatics (LNI), Proceedings - Series of the Gesellschaft fur Informatik (GI), P-332, pp. 57-58.

KONERSMANN, M.; KAPLAN, A.; KÜHN, T.; HEINRICH, R.; KOZIOLEK, A.; REUSSNER, R.; JÜRJENS, J.; AL-DOORI, M.; BOLTZ, N.; EHL, M.; FUCHß, D.; GROßER, K.; HAHNER, S.; KEIM, J.; LOHR, M.; SAĞLAM, T.; SCHULZ, S.; TÖBERG, J.-P., 2023. *Evaluation Methods and Replicability of Software Architecture Research Objects.* In: (2023) Lecture Notes in Informatics (LNI), Proceedings - Series of the Gesellschaft fur Informatik (GI), P-332, pp. 75-76.

All further information on our publications and the search options in the Fraunhofer database Publica can be found at www.isst.fraunhofer.de/publica

Culture at ISST

Our Culture — #thisISSTunning

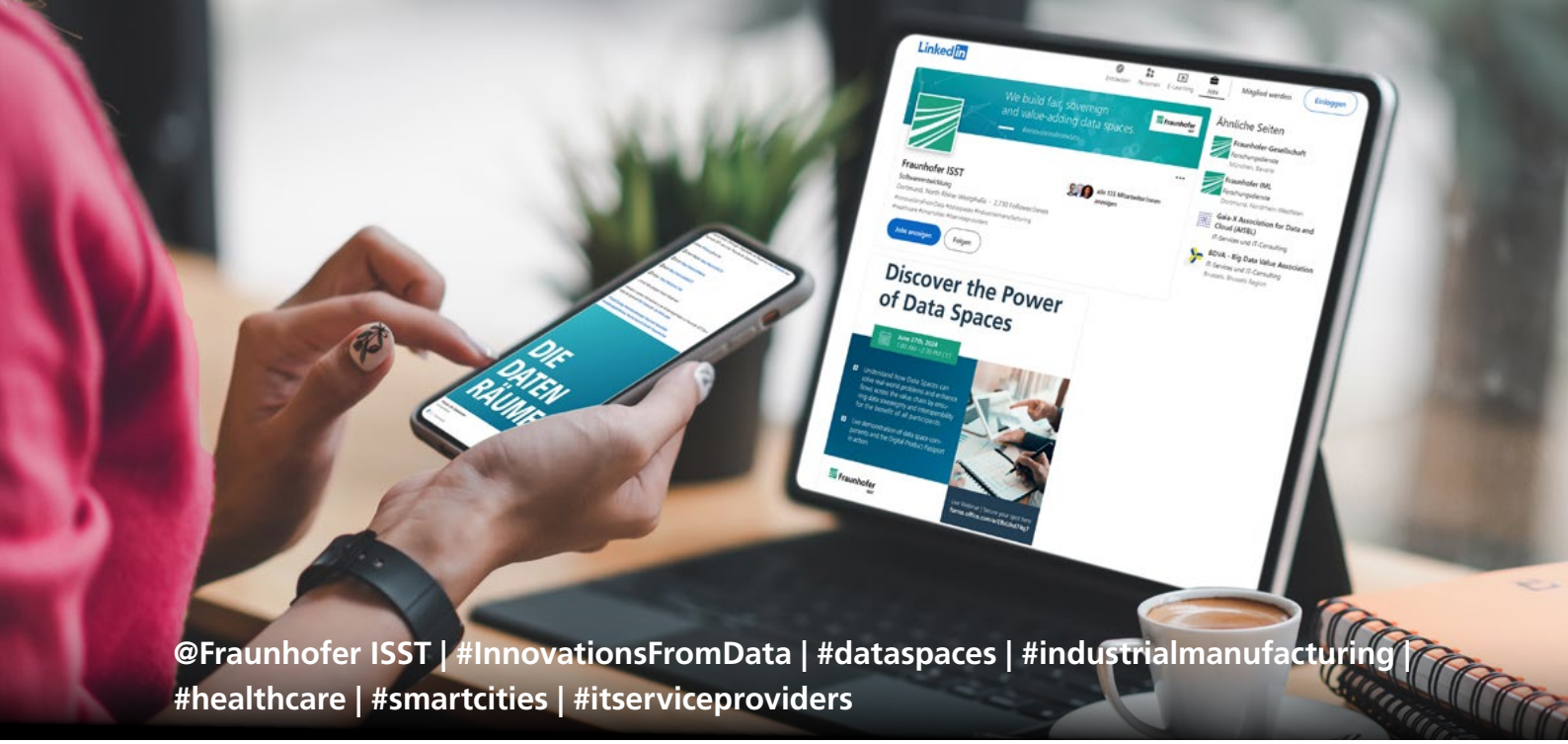
Successful research and development rely on interdisciplinary and multifaceted partnerships. As an institute of the Fraunhofer-Gesellschaft, we believe it is vitally important to establish an open culture that embodies the following:

- **Enthusiasm:** We believe in what we do. To those who think something can't be done, we say: "Yes, it can." An open atmosphere for discussion and a wide range of further training and career opportunities are important to us.
- **Freedom:** Research demands a high degree of freedom. We decide for ourselves what we are working on and ensure a good balance in our professional and private lives.
- **Responsibility:** Freedom is only possible if it is accompanied by a sense of responsibility, and we believe this is true at every single stage of a process.
- **Team:** No single person can do everything. In order to be innovative, we need to work together. As everyone has a vital role to play, we believe in flat hierarchies and interdisciplinary teams.
- **Diversity:** We don't need to know where someone comes from — we want to know where they are heading. This is why the Fraunhofer Institute for Software and Systems Engineering ISST takes a decisive stance against all forms of discrimination on the basis of origin, skin color, gender or sexual orientation.
- **Passion:** Shaping the future at Fraunhofer ISST is more than just a job. It is a deep sense of purpose.
- **Spirit of research:** You can only really change the digital world of tomorrow if you are allowed to think outside the box today. Groundbreaking ideas must be allowed to grow and mature.

Outstanding research needs outstanding employees. For many years now, the Fraunhofer-Gesellschaft has been one of the most popular workplaces among STEM graduates. And at Fraunhofer ISST, we are always on the lookout for new talent.

Change starts with us!

You can find current vacancies at www.isst.fraunhofer.de/en/jobs.html



Our Communication

As an independent research organization with a public mandate, communicating our research findings is vital to us. We are a digitalization institute that offers a variety of ways to access our projects and subject areas, particularly online.

Die Datenräumer podcast

In our podcast Die Datenräumer (The Data Space Experts), experts from the Fraunhofer Institute for Software and Systems Engineering ISST talk to business representatives about the potential held in innovative data handling. Listeners are given comprehensive insights backed by research and hear about specific examples of how companies are already using data to their advantage — and will benefit from it even more in the future.

The podcast is available at www.isst.fraunhofer.de/en/publications/podcast.html and wherever you get your podcasts.

Data Researchers video series

In Data Researchers, his personal video series, Prof. Boris Otto sheds light on some of the latest topics in digitalization in a concise, informative and well-founded way.

Boris Otto is in demand at a national and international level as a digitalization expert in the fields of data economy, data spaces and data management in industrial enterprises. In his easy-to-understand and entertaining videos, he explains the latest developments in these areas and puts them in context — from industry-oriented data spaces such as Manufacturing-X to other aspects, like user focus in data spaces and the Future Research and Innovation Strategy of the German federal government.

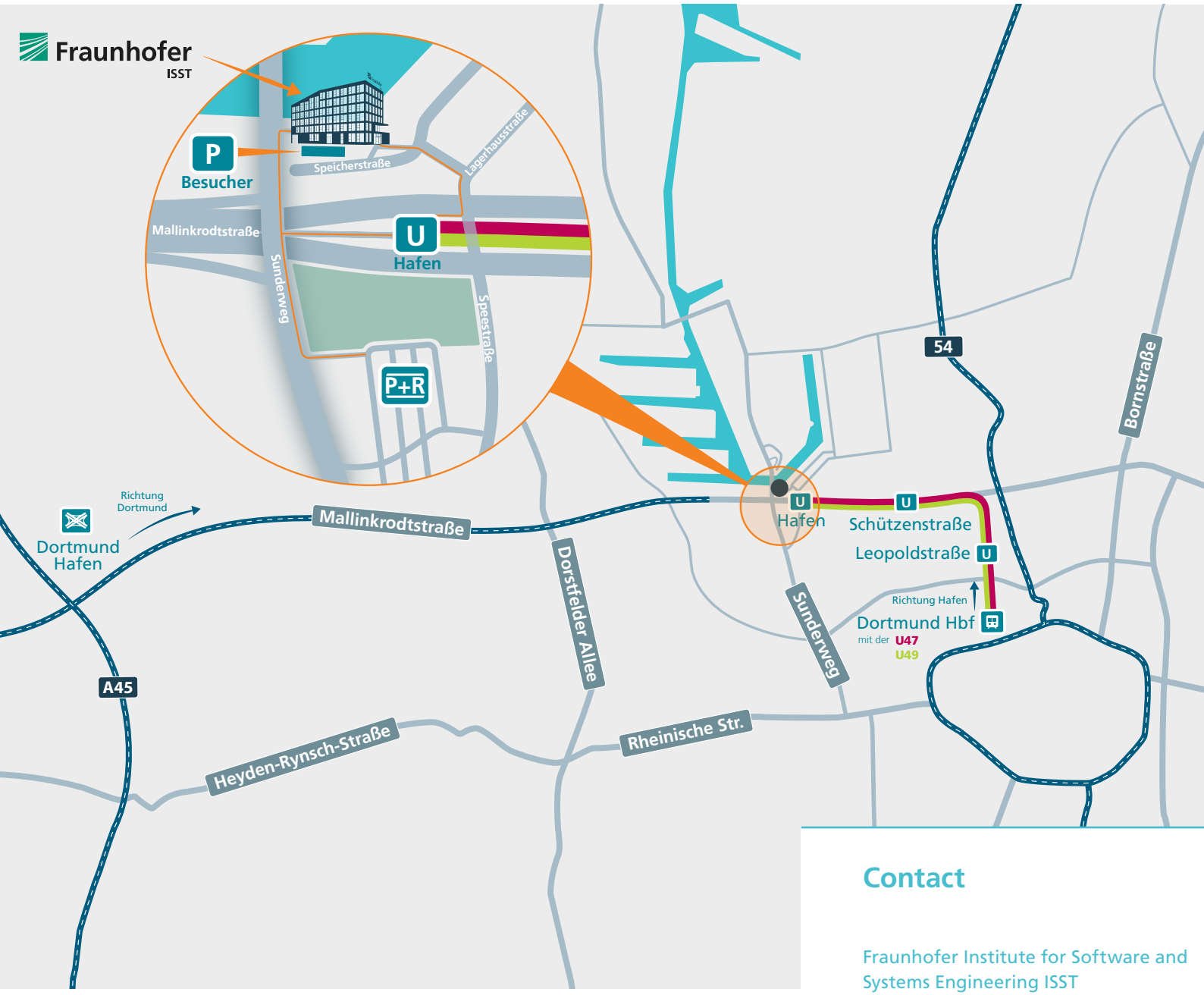
The videos are available at www.isst.fraunhofer.de/en/publications/Vlog.html and on the Fraunhofer ISST YouTube channel.

Fraunhofer online:

Contact for institute communications

Phone +49 231 97677-160
presse@isst.fraunhofer.de

Directions and Contact



Contact

Fraunhofer Institute for Software and Systems Engineering ISST

Speicherstrasse 6
44147 Dortmund, Germany

Phone +49 231 9 76 77-0
presse@isst.fraunhofer.de
www.isst.fraunhofer.de/en.html

Publishing Notes

Publisher

© Fraunhofer Institute for Software and Systems Engineering ISST

Institute Director

Prof. Boris Otto

Speicherstrasse 6
44147 Dortmund, Germany
Phone: +49 2 31 9 76 77 - 0
presse@isst.fraunhofer.de

Editorial team

Charlotte Neipperg, Britta Klocke, Fraunhofer ISST

Photo acknowledgments

Cover: ©DrHitch — AdobeStock
P. 5: ©Yingyaipumi — AdobeStock
P. 8: ©wladimir1804 — AdobeStock
P. 10: ©IDERHA
P. 14: ©安琦王 — AdobeStock
P. 16: ©kwanchaift — AdobeStock
P. 17: ©Ihor — AdobeStock
P. 19: ©Valoon / ©SIMPL
P. 21: ©Valoon
P. 24: ©metamorworks — AdobeStock
P. 25: ©Tierney — AdobeStock
P. 26: ©Tierney — AdobeStock
P. 28: ©ipopba — iStock
P. 29: ©greenbutterfly — AdobeStock
P. 30: ©Limitless Visions — AdobeStock
P. 32: ©metamorworks — AdobeStock
P. 33: ©Parradee — AdobeStock
P. 36: ©greenbutterfly — iStock
P. 37: ©ipopba — iStock
P. 38: ©vm — iStock
P. 41: ©Sergey Nivens — AdobeStock
P. 42: ©NicoElNino — iStock
P. 42: ©Skórzewiak — AdobeStock
P. 43: ©ASDF — AdobeStock
P. 44: ©Fraunhofer ISST
P. 45: ©Fraunhofer ISST
P. 47: ©Fraunhofer ISST
P. 48: ©Fraunhofer ISST
P. 51: ©Blue Planet Studio — AdobeStock
P. 52: ©Photocreo Bednarek — AdobeStock
P. 53: ©olga_demina — AdobeStock
P. 54: ©amnaj — AdobeStock

Composition/layout

Fraunhofer ISST