OUR RESEARCH SHAPES THE FUTURE

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RESEARCH

Independent. Interdisciplinary. Across Sectors.

6 Who We Are. What We Do.

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FZI
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FZI

Our Research Shapes the Future

The FZI Research Center for Information Technology is an independent non-profit foundation cooperating with partners from industry and the public sector on pioneering research projects. In the context of technology transfer, the FZI has been introducing state-of-the-art information technologies into practice for almost four decades now and providing new innovation impulses. With its research, the FZI contributes to society's welfare and addresses the central social challenges. To enable businesses and society to shape digital transformation efficiently, the FZI is not only a research and transfer institution but also an interdisciplinary training facility for academic careers and a career entry in business or self-employment. With the FZI House of Living Labs, the FZI also provides a unique research environment for applied research.

The FZI Board of Scientific Directors, consisting of 25 university professors, passes on findings and impulses from university research to industry and society via research projects. Its members advise the Executive Directors and support the interdisciplinary research groups at the FZI with their professional and scientific excellence. In these interdisciplinary groups, FZI research scientists investigate solutions for industry and public sector clients and implement the developed solutions as prototypes. The FZI is an innovation partner of the Karlsruhe Institute of Technology (KIT) in information and communication technologies. The proximity to the KIT is also reflected in the makeup of the Board of Scientific Directors: 20 members of the Board of Scientific Directors teach at the KIT in one of the four faculties of Informatics, Electrical Engineering, Mechanical Engineering, and Economics.

As a non-profit foundation under civil law, the FZI works independently for and in cooperation with companies and public institutions of all sizes: small businesses and corporations, regional administrations, federal states, the federal government, and the EU. This makes the FZI a neutral interface between science and industry, combining university research with practical application.

The FZI headquarters are located in Karlsruhe. The FZI also has a branch office in Berlin, strengthening its nationwide position and promoting direct contact with policymakers and associations at the federal level. In the state of Baden-Württemberg, the FZI assumes the function of an innovation hub in information technology.

Among other engagements, the FZI is involved nationwide as a shareholder of the Karlsruhe TechnologieRegion, the DIZ | Digital Innovation Center, the innoWerft – Technologie- und Gründerzentrum Walldorf Stiftung GmbH and the European Center for Information and Communication Technologies – EICT GmbH. The FZI is also a member of the innovation alliance innBW.

At a regional, national, and international level, the FZI is involved in initiatives, associations, committees, and networks and maintains its partnerships – a strong network for active knowledge and technology transfer to the benefit of all.
The FZI determines its research topics in a structured manner and with foresight in order to shape the future with innovative research that is not only in tune with the times but even one step ahead. This involves the methodical analysis of possible developments in business, research, politics, and civil society in the sense of long-term strategic foresight and identifying critical future topics. These form a sound basis for establishing new emerging research focuses at an early stage.

Our Fields of Application

In their research divisions, the researchers at the FZI are dedicated to eight application fields of computer science:

- Production
- Healthcare
- Supply and Disposal
- Education, Research and Administration
- Buildings and Public Space
- Services and Commerce
- Mobility, Transportation and Logistics
- Information and Communication Technology

„ The rapid development of AI technologies opens up new perspectives – not only in the industry sector but, above all, in many aspects of our social life. With its AI expertise, the FZI is ideally positioned and an outstanding technology partner, especially for small and medium-sized enterprises.“

Prof. Dr.-Ing. Dr. h. c. Stefan Jähnichen

Director at the FZI

Applied Artificial Intelligence

AI as a key technology for a sustainable society

Researching applied Artificial Intelligence (AI) is essential to shaping a sustainable society. AI offers great potential for mobility, robotics, and healthcare technology: The ability to learn from data, make predictive decisions, and generate new knowledge creates disruptive and transformative opportunities to advance these areas. The broad application range of applied AI is reflected in the interdisciplinary approach of the FZI. The scientists aim to develop innovative solutions and integrate them into various domains. In addition to information technology topics, security, ethical, and legal aspects are also considered. The FZI also supports the development life cycle of embedded AI technologies – from the initial concept phase to testing and validation.

Generative AI has received much attention due to the rapid changes in recent times. There is also a particular focus on new topics at the FZI such as the research and application of Large Language Models (LLM).

The FZI has extensive expertise in using, fine-tuning, and prompting language models. The scientists integrate structured explicit knowledge – for example, from knowledge graphs – and combine it with the implicit parametric knowledge of the LLMs. To combat so-called "hallucinations", texts freely invented by a Generative AI, and to ensure that the information is up-to-date, the FZI uses semantic information retrieval, which serves as the context basis for the LLM's Retrieval Augmented Generation (RAG). In the project Transfer Centre for Cybersecurity in SMEs, an AI-based chatbot is being developed that offers SMEs a user-centric, round-the-clock point of contact for IT security incidents. The chatbot interacts with the SME to check the request, provides an initial assessment, and forwards it to an expert network in the event of a potential IT security incident. It also supports SMEs in preventing IT security issues and ensures transparency with regard to various information services. Technologically, the chatbot combines LLM-based methods with rule-based approaches.

Generative Artificial Intelligence can also be used to generate realistic sensor data in a targeted manner, for example in automated vehicles and robotics. The FZI is investigating how generative AI can be used to generate training and test data for the development of automated vehicles. In addition to images, lidar, radar, or ultrasound signals can also be generated. This means that very rare or very dangerous traffic situations, in particular, can be investigated safely and without great effort. The project nxtAIM has been researching these approaches since the beginning of 2024.

The FZI is also investigating the use of AI in embedded and edge systems. In addition to the integration of classic neural networks into edge systems, the FZI scientists are investigating the potential of neuromorphic hardware architectures, particularly Spiking Neural Networks (SNNs). SNNs are inspired by neuronal brain structures and promise low energy consumption, which is essential in embedded systems. For example, they can process data from mobile ECGs in medical technology or data from industrial sensors for predictive maintenance. Within the project GreenEdge, the focus is on the combination with event-based cameras and the transfer to mobile platforms.

In healthcare, AI processes are used to recognize or predict people's state of health, emotions, and intentions. This makes it possible to derive health profiles and recommendations for action – the basis for personalized medicine. One focus is on recognizing processes that support the diagnosis and prediction of human behavior or technical processes in combination with humans and machines, for example in the operating theater or nursing. The FZI is involved in the development of data repositories that increase the availability of medical data in care, nursing, and research. These form the basis for the de-

velopment of AI applications. The ROUTINE real-world laboratory provides a framework for testing new developments and enabling the transfer of digital health applications and AI into practice.

Automated and connected driving benefits from AI methods in many ways, for example in individual functional components of automated driving functions, such as environment perception or prediction, and in the validation methodology itself. The project AI Data Tooling has developed a complete data solution to train and validate AI-based automated driving functions. The project just better DATA focuses on efficient and highly accurate data generation for AI applications in autonomous driving. Artificial Intelligence is also used to develop smart traffic infrastructures, such as urban environments, to support automated cars and autonomous shuttles in challenging city traffic. The real-world laboratory Test Area Autonomous Driving Baden-Württemberg (TAF BW) allows state-of-the-art algorithms to be tested in practice. The parameterization of modern control processes can also be supported and accelerated by reinforcement learning methods. Continuously learning processes can also make on-board power supply management more efficient and fail-safe, as demonstrated in the project KI4BoardNet.

AI also has a wide range of applications in robotics. Visual AI approaches enable the recognition of important objects, which the FZI is working on in numerous projects such as ROBDEKON. To enable robust, efficient autonomy, the intelliRISK2 project, which will be completed in 2023, uses AI-based risk understanding for environments and robot self-awareness. To solve complex manipulation tasks, imitation learning is used at the FZI to mimic human strategies – for example in the RackKI project. In addition, scientists in the GanResilRob project use generative AI methods to design plans for the assembly and disassembly of electronic components by robots.

AI technologies open up new opportunities for companies in terms of optimization and process efficiency. At the same time, they present companies and SMEs in particular with numerous challenges – from use cases and the provision of suitable datasets to the acceptance by customers and employees. The FZI supports companies with numerous AI consulting services and provides basic AI knowledge via a process analysis that identifies and evaluates AI solutions tailored to the respective company and supports practical implementation. In addition, the FZI also advises on strategic issues, such as the development of a data strategy to create better conditions for the implementation of AI. In interactive workshops, the FZI also provides managers and employees with practical knowledge and concrete solutions relating to the use of AI.

– The FZI sees AI as a key technology. The scientists develop, evaluate, and improve AI methods, with the aim of transferring them as tailor-made solutions into applications for FZI partners and customers.

Applied Artificial Intelligence
Selected Projects

PfleDaKi
Consolidating and efficiently using care data

Funding:
Federal Ministry of Education and Research (BMBF)

Partners:
Clinic for Geriatrics and Gerontology at Charité/Berlin, easierLife GmbH, H&R Medicare Network Beratung GmbH & Co KG, Löwenstein Medical Technology GmbH & Co KG, prenode GmbH, StatConsult IT-Service GmbH

Runtime:
03/2022 – 02/2025

Supported by:
Federal Ministry of Education and Research
on the basis of a decision by the German Bundestag

Care facilities generate large amounts of data – originating, for example, from medical technology, sensor technology, or documentation. Still, this data is rarely regarded as linked, although this approach holds enormous potential. This includes, for instance, the development of new methods for patient care and workload reduction of nursing staff.

In the PfleDaKi project, a platform is being developed to link data from various care-related sources, such as medical devices, care record systems, and electronic devices like smartwatches. The aim is to provide developers of AI applications with accessible data for research and development purposes. Here, the focus is on technical issues such as the form of data storage – centralized vs. decentralized – and the harmonization of heterogeneous data. Aspects of nursing science and ethics are also being examined, including the impact of support measures on everyday nursing care and the interaction between nursing staff and people in need of care. Common standards and well-documented interfaces facilitate the simple connection of different data sources.

More at
https://www.fzi.de/en/project/pfledaki/

Applied Artificial Intelligence
Selected Projects

KI Data Tooling
The Data Kit for Automotive AI

Funding:
Federal Ministry for Economic Affairs and Climate Action (BMWK)

Partners:
BMW Group, Robert Bosch GmbH, Continental AG, Valeo, ZF Friedrichshafen AG, Ansys, AVL LIST, dSPACE GmbH, Deutsches Zentrum für Luft- und Raumfahrt e.V., Research Institute for Automotive Engineering and Powertrain Systems Stuttgart (FKFS), University of Wuppertal, Aschaffenburg University of Applied Sciences, Technical University of Braunschweig, Technical University of Munich, University of Kassel, University of Passau

Runtime:
04/2020 – 12/2023

Supported by:
Federal Ministry for Economic Affairs and Climate Action
on the basis of a decision by the German Bundestag

Data forms the basis of AI-based and Machine Learning technologies and processes. They are used to train and test the algorithms. To implement highly complex and safety-critical functions using AI, comprehensive and high-quality data is required.

In the KI Data Tooling project, tools and methods for providing data from various sensor modalities for AI-based functions were researched holistically for the first time. The aim was to develop a complete data solution for the training and validation of AI-based automated driving functions.

Among other things, the FZI has researched the augmentation of image datasets using generative neural networks, the creation of searchable image datasets through data enrichment and neural networks, and the validation of geometric aspects of radar data. Other research areas included the development of augmentation pipelines, the semi-automatic verification of data set annotations, and the anonymization of faces in image data.

More at
https://www.fzi.de/project/ki-data-tooling/

Applied Artificial Intelligence
Selected Projects

RackKI
Automated integration of avionics racks with the help of Artificial Intelligence

Funding:
Federal Ministry for Economic Affairs and Climate Action (BMWK)

Partners:
Airbus Defence and Space GmbH,
Deutsches Zentrum für Luft- und Raumfahrt e.V.

Runtime:
12/2021 – 12/2023

Supported by:
Federal Ministry for Economic Affairs and Climate Action
on the basis of a decision by the German Bundestag

In aerospace, modularity is of great importance for cost reduction and reusability. For this reason, the CompactPCI (CPCI) standard has been developed as a new modular concept for future on-board computer architectures. ESA and manufacturers such as Airbus will use it for future missions. Components are developed as modules on a cPCI card and then integrated into a "rack" by plugging the cards into one of the standardized slots. Due to the high number of pins, the automated integration of cPCI cards requires an adaptive, force-based robotics solution that did not yet exist.

In RackKI, an automated, AI-supported AIT (Assembly, Integration and Test) cell was developed that implements a flexible handling approach with an industrial, terrestrial lightweight robot. It can carry out the AIT phase for new cards intelligently and independently. A special gripper and collision-free path planning were developed to transport the card from a storage area to the rack. A deep neural network was developed specifically for inserting the cards. It learns the human handling strategies from a simulation and uses them for adaptive handling.

More at
https://www.fzi.de/en/project/rackki/

„With my research on the challenges of automated driving at the FZI, I am contributing to a more efficient, safer, and more environmentally friendly mobility of the future – for the benefit of society.”

Sven Ochs

Research Scientist in the research division
Intelligent Systems and Production Engineering

Climate Action Innovation

Developing IT innovations for climate protection and sustainable solutions in the fields of energy, mobility, production, and logistics.

Climate change is one of the biggest social challenges of our times. IT innovations are essential to a sustainable, resilient, and climate-friendly future. In the Climate Action Innovation research focus, the FZI conducts interdisciplinary research on innovations for climate protection at the intersection of the fields of energy, mobility, supply and disposal, production, and logistics. Apart from technical innovations, a significant focus is on sustainable business models to establish innovative solutions in practice. At the same time, resource efficiency and circular economy are essential topics within the research focus. The emphasis is on both Green by IT and Green IT. Together with partners from academia and industry, the Climate Action Innovation research focus promotes practice-oriented research for a sustainable future.

Urban neighborhoods as platforms for green and sustainable IT innovations have been an exciting research subject in this focus area for several years. While past efforts primarily concentrated on optimizing supply and disposal within the neighborhood, the current focus is on opening up such districts, which requires interfaces with upstream structures. Concrete research is being conducted on how smart and networked neighborhoods can become active energy system players.

Central to our current research is the bidirectional charging of battery electric vehicles (BEVs). BEVs offer more than just climate-friendly mobility for tomorrow. Due to their relatively high storage capacity, they can also act as "rolling energy storage" for smart buildings and neighborhoods. This qualifies them as required components for a reliable, secure, and resilient energy supply. The FZI contributes significantly in this area, ranging from ICT integration and grid-supportive power grid integration to developing innovative business models and demonstrations in real-world laboratories.

In addition to smart buildings, neighborhoods, properties, and production facilities, a primary focus of research is on critical infrastructures, such as energy systems or data centers. At the intersection of Green IT (resource-efficient design of IT applications and systems) and Green by IT (sustainable solutions through digital innovations), the FZI engages in research projects on more climate-friendly data centers. Jointly with the FZI-supported start-up LIMEBIRD, solutions for distributed and networked edge data centers in wind and photovoltaic parks are being explored. The goal is to align the temporal utilization of these edge data centers with the local availability of power from renewable energy sources.

To implement intelligent energy management systems on a broad scale, concepts and algorithms are needed that require little to no manual adjustments. Therefore, scientists at the FZI are researching scalable solutions using machine learning methods. Interfaces with the Applied Artificial Intelligence research focus are being exploited in this process.

Sustainability is crucial for climate protection, particularly in the construction sector. The entire lifecycle of buildings must be considered, as CO2 emissions are generated during construction, operation, and demolition. To this aim, the FZI adapts the concept of hybrid twins to enhance energy efficiency, flexibility, and optimization throughout the lifecycle of buildings.

The FZI promotes the greening of industrial production through digitalization. Digital product passports contain information on raw materials, components, production processes, emissions, maintenance, and recycling. Within the scope of lifecycle analysis, the FZI explores AI-supported methods for cross-network determination, tracking, and root cause analysis of relevant metrics. These methods promote a circular economy and the development of new business models.

Due to the ever-growing networking and digitalization of critical infrastructures and IoT applications, IT security and resilience are becoming focal points in all application areas of this research focus. The FZI is contributing its IT security expertise accordingly.

– In the Climate Action Innovation research focus, interdisciplinary research is conducted on sustainable IT innovations for climate protection at the intersection of energy, mobility, production, and logistics.

The FZI closely cooperates with the Mittelstand-Digital Zentrum Klima.Neutral.Digital to promote knowledge and technology transfer. An essential component is the development of a virtual showroom that provides accessible knowledge on sustainability and climate neutrality. The FZI experts are also involved as climate coaches. In this role, they help SMEs develop viable sustainability strategies with concrete action plans to obtain climate neutrality step by step. The FZI experts also support SMEs with initial information, quick checks, qualification offers, and the initiation of digitalization projects.

The research results at the FZI in the Climate Action Innovation research focus have already reached a high Technology Readiness Level, particularly in the field of energy informatics. This benefits the development of effective practical solutions and the demonstration of innovative concepts and solutions in real laboratories in terms of knowledge and technology transfer. The FZI Living Lab smartEnergy at the FZI House of Living Labs (HoLL) presents a continuously growing number of demonstrators on intelligent energy management. Recently, a charging station for bidirectional charging was installed to optimize the (dis)charging of bidirectionally chargeable electric vehicles through the intelligent energy management system of the FZI HoLL. This option can contribute to the stabilization of power grids.

A digital twin of an actual production building is also being developed, integrating real-time building data (such as sensor and process data), environmental information (such as the weather), and planning data. This allows various stakeholders to conduct lifecycle-oriented analyses for more sustainability.

The research focus also promotes knowledge and technology transfer in other publicly accessible real laboratories. Examples include the Karlsruhe residential and commercial district Smart East, which focuses on innovative energy concepts at the neighborhood level, and the research project SWARM, which explores grid-supportive charging of electric vehicles. These spatially distributed labs provide ideal design and testing environments for companies to develop innovative solutions from a single source.

Start-ups like InnoCharge are crucial in implementing innovations focused on climate neutrality. We maintain close cooperation with the energy accelerator AXEL to stay in regular contact with current start-ups and support them.

Scientists of the FZI actively participate in expert committees such as the Forum Netztechnik/Netzbetrieb within VDE (Association for Electrical, Electronic & Information Technologies) to shape §14a EnWG and promote smart metering systems. By contributing to the regulatory framework, the FZI plays a crucial role in setting the stage for the energy transition's success in Germany. Through its involvement in EU projects, the FZI promotes innovative research for climate action beyond national borders.

Climate Action Innovation
Selected Projects

WeForming
Buildings as efficient and interoperable components of future energy systems

Funding:
European Union

Partners:
European Dynamics, Luxembourg Institute of Science and Technology (LIST), Regulatory Assistance Project (RAP), F6S Innovation, Hardware and Software Engineering, HOLISTIC, IKO Real Estate, Sudstroum, Circu Li-ion, Q Energy, GenCell Energy, Builtrix, MOVIDA, R&D Nester, Grid ONE, Smart Island Krk, University of Zagreb – Faculty of Electrical Engineering and Computing, Wingest, Flexide Energy, University of Liège, Cuerva, Schneider Electric, Aggregering, Vergy, AIR Institute, University of Málaga, Karlsruhe Institute of Technology (KIT), Stadtwerke Karlsruhe, BES - Badische Energie-Servicegesellschaft mbH

Runtime:
10/2023 – 09/2026

WeForming is a pioneering project that turns buildings into active players of the electricity grid as a way to stabilize the latter. For that purpose, a European reference architecture for smart buildings is being developed, which is demonstrated and evaluated in six pilots across Europe. One is the Smart East residential and commercial quarter in Karlsruhe, where the FZI House of Living Labs is also integrated. The intelligent energy management systems optimize the use of solar power and charging processes, integrate electric vehicles as storage units, reduce CO2 emissions, and, at the same time, improve the cost balance. The FZI develops algorithms that enable optimal schedules for regenerative electric vehicles and batteries in the quarter. The FZI also contributes to developing the European reference architecture for intelligent buildings. By putting innovative and smart building energy management into practice in a scalable manner, the project significantly contributes to the energy transition.

Founded by the European Union

More at
http://weforming.eu/

Climate Action Innovation
Selected Projects

FlexBlue
Flexible refrigeration systems against the background of increased decarbonization

Funding:
Federal Ministry for Economic Affairs and Climate Action

Partners:
Fraunhofer Institute for Environmental, Safety and Energy Technology UMSICHT, Karlsruhe Institute for Technology – Institute for Automation and Applied Informatics (IAI), SK Verbundenergie AG, Rütgers GmbH & Co. KG, kraftboxx GmbH, Technische Hochschule Ingolstadt

Runtime:
01/2024 – 12/2026

Supported by:
Federal Ministry for Economic Affairs and Climate Action
on the basis of a decision by the German Bundestag

In the FlexBlue project, established companies and researchers cooperate to make the heating and refrigeration supply of functional buildings ready for the energy transition. The aim is to develop a solution that makes operating heat pumps and chillers more efficient and flexible. To this end, a system consisting of an innovative cold/heat storage unit with an AI-based control process is being developed, with testing and evaluation at two locations.

The FZI is developing generic algorithms for an optimized system control based on machine learning concepts. The project also focuses on the identification and design of the interfaces of the actors involved as well as on knowledge transfer and participation aspects. The aim is to ensure that after the project's termination, the developed algorithms, in combination with the storage system, can be retrofitted as a plug-and-play solution in many buildings. This will reduce the operating costs of buildings and, at the same time, contribute to the success of the energy transition in Germany.

More at
https://www.fzi.de/en/project/flexblue/

Climate Action Innovation
Selected Projects

Hybrenergy
Hybrid building twins for increased energy efficiency

Funding:
Federal Ministry for Economic Affairs and Climate Action

Partners:
Karlsruhe Institute of Technology – Institute for Information Management in Engineering (IMI), Schneider Electric GmbH, RWTH Aachen University - Chair for Energy Efficiency and Sustainable Building represented by the Rector, Lumoview Building Analytics GmbH, Actimage GmbH, archis Architekten und Ingenieure GmbH

Runtime:
10/2023 – 09/2026

Supported by:
Federal Ministry for Economic Affairs and Climate Action
on the basis of a decision by the German Bundestag

Hybrenergy focuses on sustainable construction process engineering via digital building twins. Apart from building information models and traditional construction plans, the project integrates as-built scans (for example, precise laser scans of existing rooms and buildings), control data from the building services equipment (BSE), and sensor and environmental data. These data are merged into a common hybrid twin model spanning all lifecycle phases of the building and used for energy simulations, BSE optimizations, and collaborative visualizations in virtual reality. The aim is to evaluate what-if scenarios for CO_2-reducing construction and refurbishment measures in new buildings and, even more importantly, in existing buildings, and translate them into specific investment recommendations.

Hence, the project directly supports the energy transition in the building sector. Within the project's scope, the FZI is developing the holistic data model for the hybrid twin of a real building as well as processing and merging high volumes of heterogeneous data for use in simulations and visualizations.

More at
https://www.fzi.de/en/project/hybrenergy/

"Whoever controls training data and processes determines the cultural identity of the AI models and ultimately of those who use them. In democracies, these models should be a public good. Society should have control over the data maintenance and the methods and guidelines for training the models."

Prof. Dr. Achim Rettinger

Director at the FZI

Digital Democracy and Participation

Overcoming the challenges of digital democracy with participatory approaches

The consequences of the pandemic, the climate crisis, inflation, the Russian war of aggression against Ukraine, the Hamas attack on Israel, and the rise of right-wing extremism, including visible antisemitism, are keeping politics and society in a state of emergency. Crises require practicable answers to new and highly complex questions. The digital space plays an ambivalent role in this regard: On the one hand, it has simplified social interaction and enabled digital commerce as well as new forms of knowledge dissemination. On the other hand, technologies and digital platforms can also be used to damage democracies.

Given the threats to democracies, it is of utmost importance to enable both the political sphere and civil society to use and develop their own tools for digital participation. At the same time, it is important to explore how technologies in the digital space can impact democracies. Therefore, a critical examination of mechanisms that drive social polarization in the digital space is just as urgently needed as research into how these polarization tendencies, in turn, affect social realities. Democracy and digital society have a design problem because they do not meet the requirements of today's complexity. Design problems often require customized solutions to identify and fix them.

With the FZI House of Participation – in short, HoP – the FZI researches and develops possible solutions. The HoP is a competence center dealing with all challenges relating to digital democracy. Its areas of activity include analyzing social polarization trends, researching and combating disinformation, and developing platform solutions for participation projects. At the same time, the HoP advises inside and outside the FZI on participatory technology development, as the needs of all stakeholders must always be considered when designing user-centered digital platforms.

(Digital) citizen participation in cities and municipalities also offers many advantages: early identification of problems, conflict avoidance, and increased social acceptance of political action. In cooperation with partners such as Liquid Democracy and Zebralog, the FZI researches and promotes such digital participation processes. The FZI's work is not only aimed at citizens and potential users but also strengthens companies and administrations of cities and municipalities through research cooperation. At the same time, digital participation offers the opportunity to shape work processes together with the employees concerned. The FZI investigates innovative participation and collaboration formats, considers technical, organizational, and ethical issues, and involves employees in the development process.

Another field of research is digital citizen science. Participatory approaches enable citizens to take part in research and help shape it – for example, by contributing data, questions, and hypotheses. How do such approaches relate to CrowdX approaches in the private sector and political citizen participation? In 2023, the HoP developed an interactive taxonomy to help differentiate between various digital participation methods and thus provide concrete assistance to practitioners from various fields.

The COVID-19 pandemic and the Russian war of aggression against Ukraine have made it particularly clear what a major challenge manipulated information poses for democracy. The FZI is dedicated to identifying and combating misinformation and focuses on strengthening society's media literacy with the help of innovative technological solutions such as explainable AI components. For populist movements, especially those of the extreme right, social media have become powerful tools for self-organization, as demonstrated by the attack on the German Bundestag (2020), the storming of the US Capitol (2021), and the attack on the Brazilian seat of government (2023). The spread of conspiracy myths and manipulated information has a real impact on societies. This is why the FZI is working intensively on the mechanisms that drive social polarization in the digital space and is researching the effects of such polarization tendencies on social realities.

The FZI House of Participation is a competence and consulting center. As a contact point for decision-makers from politics, society, business, and science, the HoP aims to ensure an intensive exchange on the pressing issues of our times and to explore possible solutions. In addition to its podcast – the HoPcast – a roundtable event is organized at the FZI branch office in Berlin, and a conference is held in Karlsruhe. In this way, the HoP enters into an intensive dialog on the research topics and obtains feedback and suggestions for its work from politics, industry, civil society, and academia. In May 2024, the SOSEC project was presented along with the first results at the FZI Spring Festival in Berlin.

– Overcoming the challenges of digital democracy with participatory approaches.

Spotify

Apple Podcast

Digital Democracy and Participation
Selected Projects

SOSEC
Innovative research design for resilient democracies

Funding:
Alfred Landecker Foundation

Partners:
Karlsruhe Institute of Technology (KIT)

Runtime:
01/2024 – 12/2025

What are the prevailing sentiments within our societies? What are the drivers of polarization? Where are the dividing lines?

An innovative research design makes it possible to capture the sentiments of a society and anticipate potentially negative tipping points. Initially, the consortium's research focused primarily on the energy crisis and the effects of the war of aggression on Ukraine. In the meantime, the focus has been expanded, and research is now also concentrating on attitudes towards group-focused enmities such as antisemitism.

The research project aims to identify and predict possible developments and threats to democracy in our society. As a result, effective countermeasures for future crises can be developed. With the help of representative panel surveys and agent-based models of opinion dynamics, SOSEC continuously tracks and evaluates how social sentiment develops in crises. This is a new type of quantitative social sentiment study. Since November 2022, the representative sample (1,500 participants each in Germany and the USA) has been asked the same questions once a week in a very simple and accessible manner. The panel data is subsequently matched with other events through news event monitoring and social media monitoring.

More at
https://www.socialsentiment.org

Digital Democracy and Participation
Selected Projects

DeFaktS
Addressing Disinformation Campaigns by Revealing Factors and Techniques

Funding:
Federal Ministry of Education and Research (BMBF)

Partners:
Murmuras GmbH, Liquid Democracy e.V., University of Marburg

Runtime:
01/2022 – 12/2024

Supported by:
Federal Ministry of Education and Research
on the basis of a decision by the German Bundestag

The DeFaktS project (Addressing Disinformation Campaigns by Revealing Factors and Techniques) pursues a comprehensive approach to researching and combating disinformation. The aim is to develop a universal solution that provides automated, transparent feedback on the potential occurrence of disinformation across various platforms. Politics, print media, online news, social media platforms, and debate and participation tools are all exposed to the problem of false information and could benefit from such a solution. The application also has a positive impact on users' media literacy. These effects are being investigated in the project as well. As this approach is being developed and researched for the first time for the German-speaking area, the endeavor offers significant added value for the local society. The FZI is the consortium leader of the project. It focuses on project management and public relations in addition to development and research.

More at
https://www.twon-project.eu/

Digital Democracy and Participation
Selected Projects

TWON
Twin of Online Social Networks

Funding:
EU funding program Horizon 2020 (European Commission)

Partners:
University of Amsterdam, Jožef Stefan Institute, Karlsruhe Institute of Technology (KIT), Robert Koch Institute, Slovenska Tiskovna Agencija (STA), University of Belgrade, Trier University, DialoguePerspectives e.V.

Runtime:
04/2023 – 03/2026

Founded by the European Union

In the EU-funded project TWON (Twin of Online Social Networks), the consortium investigates the effects of Online Social Networks (OSN) on democratic debate culture. Through the design of their internal mechanisms, such as algorithmic ranking, OSNs influence the dissemination of news and the behavior of users. These design choices are often driven by the economic interests of the platform operators. This has led to calls for more moderation on platforms to protect democratic debates. However, there is no standardized method for estimating the effects of a change in algorithmic parameters.

In particular, the complexity of such systems makes it difficult to translate the results of isolated experiments into an estimate of the overall impact. The overall goal of the research project is to use a digital twin to identify the impact of social media platform mechanisms, such as content filtering or personalization, on democratic debates. On the one hand, this is intended to identify metrics that promote democracy and, on the other, to create a discussion basis independent of politics, civil society, and platform operators for possible regulatory measures or even design recommendations for platform operators.

More at
https://www.twon-project.eu/

"I am proud that our research at the FZI pushes forward the digital transformation. We support pioneering developments that benefit the common good and economy in a wide range of application areas."

Jana Deckers

Department Manager in the research division
Intelligent Systems and Production Engineering

Intelligent Transportation Systems and Logistics
Research for the mobility of the future

The FZI researches integrated mobility systems for the mobility of the future – from vehicle automation to methods and platforms for the safe implementation of AI in traffic systems to the design of inner-city mobility and logistics. The FZI covers the entire design and processing chain of networked, automated mobility and logistics systems. Thanks to the excellent equipment with real laboratories and test vehicles, participatory and comprehensive research is carried out on safe concepts for intelligent and networked future cities. Through cooperation with companies, the FZI closes the gap between basic research and practical application and, as an interface between science and business, contributes to implementing tailor-made solutions for SMEs, industry, and society.

In logistics, the FZI focuses on the planning and controlling of logistics systems, particularly for intralogistics and last-mile logistics, and their implementation in technical systems and applications. The application fields here range from retail to industry and healthcare. The FZI successfully completed the BMWK-funded FLOOW project in 2023. In the final demonstration, the deployment of a fleet of different types of transport robots for intralogistics was exemplified. A unique feature of the project was the localization in the transition between outdoor and indoor areas. The HELIOS project funded by the BMDV was also successfully completed. Here, the symbiotic movement between mail carriers and automated cargo bikes was the central object of investigation. Symbiotic mobility aims to enable machines to navigate in crowded areas in a socially acceptable manner, and it is currently being further investigated. With the Medicar4.0 research project, the FZI is focusing on digitalizing and automating hospital logistics to reduce the workload of hospital staff. As part of the BMWK-funded LieferBotNet project, legal recommendations for crowdsourcing in networked and urban delivery traffic were developed jointly with stakeholders, and data protection and liability issues relating to the use of crowdworkers and possible operator platforms were addressed.

The KI-Wissen project, completed in 2023, targeted critical problems on the road to autonomous driving: increasing functional quality, data efficiency, plausibility checks, and validating AI-supported functions. These goals were achieved by integrating different types of knowledge into machine learning. In the jbDATA and nxtAIM projects, the FZI focuses on the intelligent and efficient collection of data, which is to be used to train foundation models for the transport sector.

In 2023, the FZI researched the validation of automated driving functions in several industry projects. Among other things, a goal-conditioned reinforcement learning approach was developed for exploratory scenario generation. A self-supervised validation concept for perception functions based on vehicle measurement data was also developed.

In the MINGA project, the FZI is responsible for conceiving a holistic validation methodology for an SAE Level 4 bus platform. In the RepliCar project, the focus is on validating perception systems. The FZI is developing a systematic procedure for testing sensors and perception algorithms. A multimodal sensor test bench is also being set up at the FZI.

Complex calculations and large amounts of data must be mastered in future transportation systems. To this end, the FZI is researching scalable and secure hardware and software architectures. Innovative hardware architectures are required for real-time and energy-efficient execution of complex AI-based algorithms, such as deep learning-based semantic segmentation. The FZI is researching accelerator-based SoC architectures for RISC-V and has extended a toolchain for the automated mapping of neural network architectures to an FPGA-based accelerator platform.

In 2023, the CeCaS project was launched as part of the BMBF project family MANNHEIM. In this project, the FZI researches mechanisms for intelligent load balancing, real-time capable execution of AI models, the energy-efficient acceleration of radar data processing, and the isolated execution of applications on mixed-criticality hardware platforms. This research also builds a bridge to the activities in Software-Defined Vehicles (SDV) from the perspective of microelectronics. The FZI is a partner in the European project FEDERATE. FEDERATE is developing a strategic roadmap for SDV in Europe. The project supports the initiation and implementation of SDV projects through consolidated requirements and best practices, supports networking between projects, and promotes standardization.

The FZI also explored several application-oriented methods in automotive cybersecurity. In the KASTEL-MOBILITY project, systematic test processes for connected driving were developed, and state-of-the-art threat modeling was applied to future sustainable mobility scenarios. To analyze the interfaces of modern vehicle components, the SofDCar project researched AI-based fuzzing techniques that enable an efficient localization of vulnerabilities. Work was also carried out to evaluate the security properties of over-the-air updates for vehicles. In the BMWK-funded TASTE project, the FZI communicates the latest research findings to small and medium-sized companies active in the automotive software sector.

– Research and transfer for safe and sustainable mobility

In 2023, work on setting up the CoCar NextGen test vehicle was completed. After the final integration phase, the promising sensors with perception methods were put into operation. Finally, in September, the test vehicle was presented to the scientific community with a demo of its sensory capabilities at the IEEE International Conference on Intelligent Transportation Systems (ITSC).

Due to the tremendous success of the Test Area Autonomous Driving Baden-Württemberg (TAF BW), an extension of the operating contract was agreed with the operator KVV. TAF BW is thus entering a second operation phase, allowing scientific institutions and industry to research new mobility concepts together. In the meantime, the GOFFI project (health optimization of pedestrian and bicycle infrastructure to reduce particulate matter pollution in metropolitan areas) has also been launched. Together with research partners, the FZI is investigating the exposure of pedestrians and cyclists to particulate matter in urban areas. To this end, the FZI is developing a mobile app to determine individual particulate matter intake, contributing to the FZI research focus Climate Action Innovation. Potential improvements to the cycling infrastructure in urban areas are also being identified.

Intelligent Transportation Systems and Logistics
Selected Projects

LogIKTram
Innovative and environmentally friendly logistics concept to reduce road traffic

Funding:
Federal Ministry for Economic Affairs and Climate Action

Partners:
Alb Valley Transport Company (AVG), Offenburg University of Applied Sciences, INIT GmbH, Karlsruhe Institute of Technology (KIT), Marlo Consultants GmbH, SimPlan AG, Thales Germany, DB Engineering & Consulting GmbH

Runtime:
03/2021 - 06/2024

The LogIKTram project rethinks urban freight and goods transport. This innovative logistics concept uses the existing tram and train infrastructure of the "Karlsruhe Model" to enable the combined transport of people and goods, promoting more environmentally friendly logistics. A key component is the LogIKTram ICT platform. It orchestrates the logistics process from the regional logistics hub by tram to the urban logistics hub. A semi-automated bicycle trailer serves as a load carrier. An essential part of the platform is the FZI tracking component. It consolidates status messages from the subsystems and implements detailed shipment tracking in public transport. The partners in last-mile logistics always stay informed about the current shipment status and can adjust their planning accordingly.

Supported by:
Federal Ministry for Economic Affairs and Climate Action
on the basis of a decision by the German Bundestag

More at
https://logiktram.de/en/logiktram-the-freight-tram/

Intelligent Transportation Systems and Logistics
Selected Projects

SofDCar
Paving the way for the software-defined vehicle

Funding:
Federal Ministry for Economic Affairs and Climate Action (BMWK), EU program NextGenerationEU (European Union)

Partners:
Boole Works GmbH, ETAS GmbH, Research Institute for Automotive Engineering and Powertrain Systems Stuttgart, Karlsruhe Institute of Technology (KIT), Mercedes-Benz AG, Robert Bosch GmbH, P3 group GmbH, T-Systems International GmbH, University of Stuttgart, Vector Informatik GmbH, ZF Friedrichshafen AG, e-mobil BW GmbH

Runtime:
08/2021 - 07/2024

The partners in the SofDCar consortium are developing new methods for the car of the future and their efficient data use. The vehicle is understood as part of a networked system environment integrated by a “Data Loop” and based on a new type of “Digital Twin”. The goal is to achieve digital sustainability of existing and future vehicle generations, efficient data use, and innovative use cases over the entire life cycle of the vehicle (re-deployment).
The FZI is contributing its software engineering and mobility research expertise to the project. The main focus is on the safeguarding and evolution of variants and functionality and on quality-assured application processes across vehicle boundaries. Besides challenges concerning software over-the-air updates (OTA), safeguarding, and robustness enhancements, the FZI is researching IT security methods using AI and practical testing.

Founded by the European Union
NextGenerationEU

Supported by:
Federal Ministry for Economic Affairs and Climate Action
on the basis of a decision by the German Bundestag

More at
https://sofdcar.de/

Intelligent Transportation Systems and Logistics
Selected Projects

CeCaS
CentralCarServer – the supercomputing platform for Highly Automated Vehicles

Funding:
Federal Ministry of Education and Research

Runtime:
12/2022 – 11/2025

Partners:
Ambrosys GmbH, AVL Software and Functions GmbH, Berliner Nanotest und Design GmbH, Continental Automotive Technologies GmbH, Emmtrix Technologies, Fraunhofer Institutes for Electronic Nanosystems (ENAS), Microstructure of Materials and Systems (IMWS), Photonic Microsystems (IPMS), Reliability and Microintegration (IZM), Glück Engineering GmbH, Hella GmbH & Co. KGaA, Hochschule München University of Applied Sciences, INCHRON AG, Infineon Technologies AG, Infineon Technologies Semiconductor GmbH, Karlsruhe Institute of Technology (KIT), Kernkonzept GmbH, Missing Link Electronics GmbH, Robert Bosch GmbH, Steinbeis Transfer Center Heat Management in Electronics (ZFW), STTech GmbH, Swissbit Germany AG, University of Technology Chemnitz, Technical University of Munich, Universität zu Lübeck, ZF Friedrichshafen AG

The CeCaS (CentralCarServer) project, as part of the BMBF project family MANNHEIM, brings together key German partners from industry and science to research central supercomputing platforms in the automotive sector. The demands placed on connected and automated driving are constantly rising, as is the need for a powerful computing platform suitable for automobiles. The project explores innovative approaches in automotive microelectronics with FinFET technology and computing and software architectures to maintain flexibility and efficiency. In addition, the electronic architecture will move from a domain-based hierarchy to a zonal and redundant high-availability architecture. In CeCaS, the FZI explores new hardware accelerator architectures for the energy-efficient processing of sensor data, among others, with its partner Infineon Dresden. Also, scheduling and compiler mechanisms for the secure real-time execution of applications in high-performance processors are being investigated.

Supported by:
Federal Ministry of Education and Research
on the basis of a decision by the German Bundestag

More at
https://www.mannheim-cecas.de/home-2

"I am convinced that the digital transformation can help to change our society for the better of everyone. To make this a success, we need secure information technology that also respects privacy. The FZI is the link between secure methods and their correct implementation."

Dr. rer. nat. Dirk Achenbach

Division Manager in the research division
Cybersecurity and Law

Safety, Security and the Law
Designing secure digitalization

For a secure digitalization in all application fields of the FZI, the research focus Safety, Security and the Law is dedicated to the scientifically consolidated, application-oriented investigation and communication of innovative concepts, methods, and the legal framework. It pursues a cross-system approach that ensures a holistic view of security, spanning from hardware level to software level and networked systems. A particular focus is on the applicability of new technologies (such as quantum computing or AI) and the involved security challenges. The research work is being conducted in laboratory environments with outstanding equipment.

"Ticket, please!" In many processes of the digital and physical world, evidence must be provided to authorities or companies. Whether it is age verification, registration certificates, donation receipts, access to mobility platforms, or shopping profiles – digital identities and evidence enable a trustworthy interaction and personalization of processes. In research projects such as SDIKA and SDI4ECom, solutions are being developed that focus on individuals and their self-determination while strengthening the sovereignty of organizations and the state. Trust is also a prerequisite for the data trade and can be ensured through data trustees or shared data platforms like the KI-Allianz Baden-Württemberg. Sensitive personal data must be handled with caution. We explore data anonymization methods – as in the field of mobility – while also questioning the remaining usability of the data. Where surveillance occurs, such as in public spaces, personnel management ("people analytics"), or correctional facilities, technology potentially jeopardizes personal rights. We explore the framework and related consequences and examine the economic, ethical, and legal aspects.

In the research focus Safety, Security and the Law, we regard applied cryptology as essential for securing systems. Specifically, we support companies with the application of new cryptographic methods in their products, addressing the growing need for protection caused by increasing threats. The ongoing development of quantum computers accelerates innovations in cryptology. With the standardization of post-quantum cryptography by the National Institute of Standards and Technology (NIST), the transition becomes inevitable. We assist companies and institutions with all migration-related questions. The relevance of privacy has also intensified in recent years, as evidenced by end-to-end encryption in messaging services. With our expertise, we help clients ensure data privacy and security, particularly in the fields of anonymization and data/people analytics.

The FZI contributes to research in information security across a wide range of topics, from incident response over IoT and hardware security to theoretical modeling. Irrespective of the concrete application, we research theoretical and practical concepts that can be employed for enhanced IT security. On the other hand, we develop new methods and tools for testing the IT security of systems and devices. We apply these in practical safety investigations across various scenarios, at present often focusing on IoT devices. In this process, we extract generalizable insights into security vulnerabilities and investigate potential causes for their occurrence. We also contribute significantly to research into existing and new security concepts in specific domains and maintain an intensive exchange with other FZI research focuses. Through transfer projects like InnoSecBW and the Transfer Centre for Cybersecurity in SMEs, we offer businesses low-threshold support formats to safeguard products and IT infrastructure based on the latest technological developments.

In the context of safety and security, the FZI researches hardware/software platforms for secure, distributed data processing in embedded and edge systems. This includes approaches for the isolated execution of first- and third-party applications on a mixed-criticality hardware platform, mechanisms for continuous monitoring of hardware platforms, and hardware accelerators for sensor-near processing. These technologies are widely used in medical wearables, industrial IoT pump applications, and automotive functions within centralized computer architectures for connected and autonomous driving. The FZI is developing model-based methods for integrating functional hardware and security architectures to protect hardware architectures in terms of functional safety. The aim is to separate functional hardware architecture and security architecture, allowing for the tool-supported exploration of various security architectures for RISC-V systems. Combined with approaches for securing software, this results in a comprehensive tool suite for protecting hardware/software edge systems.

Just like information security, the research and support on and for legal issues of IT is a cross-sectional area of application-oriented IT research. This already becomes evident during the conception of solutions for secure digitalization. Therefore, the FZI scientists accompany research projects right from the start, especially in data protection, IT security law, and AI law, providing legal assessments, accompanying research, and developing recommended actions and workshops for the researching industrial partners and politics. This involves drawing up recommended actions for existing and new regulations and providing expert opinions identifying the need for legal training. More than that, the domain of law by itself is also seen as a field of application for technical innovations and research. In legal informatics, the FZI investigates the deployment of AI-supported systems to formalize standards and automate legal activities. This includes the analysis of primary and secondary literature, legal texts, private law standardization, and applying legal methodologies.

– By adopting a cross-system perspective, we enable secure digitalization in all application fields of the FZI

Safety, Security and the Law
Selected Projects

Transfer Centre for Cybersecurity in SMEs
Prevention, detection, and response to cyberattacks

CYBERsicher Transferstelle. Cybersicherheit. Mittelstand.

Funding:
Federal Ministry for Economic Affairs and Climate Action (BMWK)

Partners:
Der Mittelstand. BVMW e.V., Leibniz University Hannover – Institute of Vocational Education and Adult Education, tti Technologietransfer und Innovationsförderung Magdeburg GmbH

Runtime:
07/2023 – 06/2027

Supported by: Federal Ministry for Economic Affairs and Climate Action on the basis of a decision by the German Bundestag

The Transfer Centre for Cybersecurity in SMEs supports small and medium-sized enterprises, craft businesses and start-ups free of charge in preventing, detecting and responding to cyberattacks. To this end, the Transfer Centre provides information and qualification formats, a detection and response platform for cyberattacks, and a broad network of partners throughout Germany. The Transfer Centre is implemented by four project partners and funded by the Federal Ministry for Economic Affairs and Climate Action (BMWK).

With the expertise gained in previous projects – such as the Cyberwehr Baden-Württemberg – the FZI, as a specialist partner, is developing target group-oriented information content and is building up an emergency aid platform for IT security incidents. The aim is to help companies to better prepare for IT security threats. Companies shall also be able to react in the best possible way in case of an emergency and to find the necessary support to keep damage to a minimum.

More at
https://transferstelle-cybersicherheit.de/

Safety, Security and the Law
Selected Projects

InnoSecBW
Innovation and Security

Funding:
Ministry of Economic Affairs, Labour and Tourism of Baden-Württemberg

Runtime:
12/2022 – 06/2024

Baden-Württemberg
MINISTERIUM FÜR WIRTSCHAFT, ARBEIT UND TOURISMUS

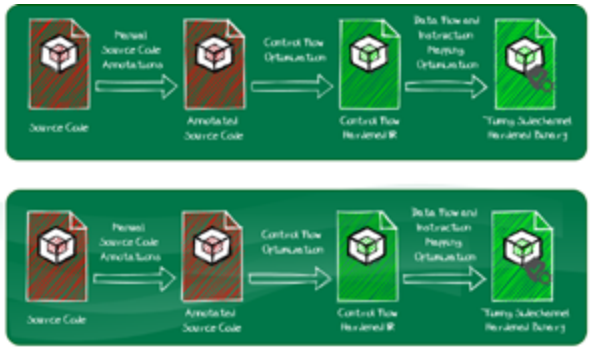
Cybersecurity for small and medium-sized enterprises will fundamentally change over the next few years. Significant progress is expected in applying Artificial Intelligence (AI) methods for spotting attacks and the automated detection of security vulnerabilities. At the same time, attacks on AI create new risks for companies wishing to use this essential technology in their products. On top of that, groundbreaking progress in quantum computing poses an entirely new threat scenario to the security of businesses. Over the next few years, many of the current cryptographic methods will be replaced by new post-quantum-safe methods to ensure data safety.

As part of the InnoSecBW project, we support companies from Baden-Württemberg with the offering formats Cybersecurity-Checkup and Cybersecurity-Booster. We point out IT infrastructure risks and help identify innovative technologies for data protection.

More at
https://innosecbw.de

Safety, Security and the Law
Selected Projects

FreeSBee
Side-channel-free software for embedded systems



Funding:
Federal Ministry of Education and Research (BMBF)

Partners:
AbsInt GmbH, Kasper & Oswald GmbH

Runtime:
02/2023 – 02/2026

Supported by:
Federal Ministry of Education and Research
on the basis of a decision by the German Bundestag

The project FreeSBee (side-channel-free software for embedded systems) develops a tool-based methodology for (partially) automated detection and elimination of security vulnerabilities based on timing attacks. Timing attacks make it possible to infer confidential information, such as secret keys, by observing variations in software runtime.

Based on the Astrée tool by project partner AbsInt, an approach was developed that uses annotations of confidential information in the source code to automatically detect all potential code sections that may cause control-flow-based runtime variations subject to confidential information and to display these for the user in the source code. The subsequent compilation process was extended by one step to automatically eliminate these potential control-flow-based runtime variations through code transformations. These tools allow the protection of software against control-flow-based timing attacks with just a few annotations.

In the further course of the project, approaches for the elimination of microarchitecture-related runtime variations are investigated. The focus here is on hardware architectures for the RISC-V instruction set.

More at
https://www.freesbee.de/

"Innovations can only have an impact if they reach the economy and society. This is why we support the entire innovation process at the FZI by taking up impulses from business, politics, and society, conducting interdisciplinary research at the human-technology interface, and actively involving users in research through participatory transfer formats."

Natalja Kleiner

Department Manager in the research division
Innovation, Strategy and Transfer

Transfer

Practical. Methodical. Competent.

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42 Supply and Disposal

Silke Mülherr
Co-CEO der Alfred Landecker Foundation
Prof. Dr. Christof Weinhardt
Professor am Karlsruher Institut für Technologie und Direktor am FZI
Uschi Jonas
Team-Leiterin CORRECTIV.Faktencheck
Dr. Jonas Fegert
Abteilungsleiter am FZI und Leiter des House of Participation
Eine Veranstaltung des FZI Forschungszentrum Informatik

Our Offer

Driving forward the energy transition, protecting critical infrastructure from attacks, optimizing processes while at the same time conserving resources, making mobility safe and environmentally friendly, and implementing AI systems in a compliant and ethical manner. As diverse as the current challenges are, they have one thing in common: They can only be overcome through collaboration and cutting-edge research. We rely on trust-based cooperation in research and development. Together with our partners, we develop software and system solutions and concepts jointly or on a direct contract basis and implement these in innovations and services. In 2023, around 185 projects were carried out at the FZI for and together with companies. This excellence, however, can only be achieved thanks to outstanding employees who bring their expertise acquired at the FZI to companies and public institutions after completing their qualification – or even found start-ups themselves.

Contract research for companies

In contract research, our researchers develop a goal-oriented scientific solution – usually for a concrete application problem – in close consultation and collaborative exchange. In this way, they help the client to achieve innovative solutions that put the latest scientific findings into practice.

Doing so, they help the client find innovative solutions that successfully put the latest scientific findings into practice. Technology consulting, feasibility studies, and training for new technologies are other short-term forms of contract with which we support entrepreneurial innovation processes and contribute to a sustainable transfer of technology and knowledge.

Research in collaboration

In collaborative research projects, a group of partners from various fields works on a defined research task. Here, knowledge transfer does not occur exclusively from the research partner to the commissioning party, but all project partners support each other with their competencies to achieve an overarching research goal. Even before the actual project begins – in the application phase – the participants work out a shared vision for the innovation being developed in the research project. Once the research funding has been approved, this transfer of knowledge and technology, which began in the application phase, continues along the lines of the actual research question being addressed. New collaborations and ideas for future innovative projects often arise from the joint work in this research network.

Sponsored SME research

To support small and medium-sized enterprises' innovative capacity and growth orientation, funding programs at European, federal, and state levels promote the commissioning of research institutions to research and develop new products and services. The projects carried out at the FZI within this framework are tailored to the risky innovation needs of the industrial partners, who contribute their share of the project costs.

Our Offer

Knowledge transfer via minds

The FZI sees itself as a qualification center for outstanding experts who acquire in-depth and, at the same time, practical knowledge in the ICT field as part of their project work, doctorate, thesis, or scientific or student assistant work and transfer this knowledge to companies and public institutions as specialists and managers after their work at the FZI. This exchange is bi-directional, however: To this end, the FZI maintains a close relationship with its alumni and decision-makers from industry and the public sector and always integrates these impulses from its environment into its current research orientation, guided by target group-specific transfer formats. This is how the transfer of knowledge succeeds.

Utilizing innovations in spin-offs and start-ups

With the development of new, innovative technologies, there are always opportunities to bring these into application via spin-offs. The FZI Research Center for Information Technology actively supports its employees in implementing their ideas and, at the same time, actively involves newly founded start-ups in research and development projects. These benefit from the often flexible and agile teams, which, thanks to their compact size, can contribute innovative impulses directly from the application to higher-level projects and, at the same time, test research results directly on the market.

FZI House of Living Labs – participatory and collaborative innovation

The FZI House of Living Labs, a new type of research environment especially for small and medium-sized enterprises, is available for research and development across all industries and fields of application. With its seven location-based FZI Living Labs and the two decentralized real laboratories, it supports the collaborative development and testing of future-oriented innovations under real conditions. It provides excellent technical equipment and research infrastructure for this purpose. This ranges from demonstrators for inspiration and knowledge transfer to the Test Area Autonomous Driving Baden-Württemberg with its mapped and sensor-equipped roads over 200 kilometers long to the SmartEast district in the eastern part of Karlsruhe, which has digitalized existing buildings with smart meters and connected them in a district energy management system.

Our Fields of Application

The basic idea and goal of our research is to prepare technology transfer with foresight and thereby trigger innovative impulses. For almost 40 years, we have supported companies and public institutions in their effort to transfer new information technology findings in computer science, engineering, and economics into cutting-edge products, services, business and production processes. Our research is dedicated to eight application fields of informatics; our work is always characterized by a pragmatical, interdisciplinary, methodical, competent, and cross-sector approach.

Education, Research and Administration

Services and Commerce

Buildings and Public Space

Healthcare

Information and Communication Technology

Mobility, Transportation and Logistics

Production

Supply and Disposal

The joint work within the research network also creates new collaborations and ideas for innovations.

People

Conviction. Responsibility. Sustainability.

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Was wir tun: Informatik-Anwendungsforschung
und Technologietransfer
FZI
UNSERE
FORSCHU
GESTALTE
ZUKUNFT

Our Values

Shaping the future requires clear orientation. We are guided by clear values and convictions in our daily collaboration – with each other and our partners.

Shaping the future with responsibility

What unites us at the FZI is joint research for the benefit of society. The Code of Ethics developed jointly by the Board of Executive Directors, the Board of Scientific Directors, and the employees summarizes the values the FZI stands for. We live and protect these values daily – today and in the future. These values guide our daily cooperation – with each other and our partners – and create a reliable basis of trust.

More about our guiding principles at
https://www.fzi.de/en/the-fzi/guiding-principles/

Research for the common good

What unites us at the FZI is joint research for the benefit of society. The Code of Ethics developed jointly by the Board of Executive Directors, the Board of Scientific Directors, and the employees summarizes the values the FZI stands for. We live and protect these values daily – today and in the future. These values guide our daily cooperation – with each other and our partners – and create a reliable basis of trust.

Professional excellence, interdisciplinarity, creativity

Solving problems is our passion. We shape tomorrow's digital world and build bridges between science, business, politics, administration, and the public. The highest scientific standards and interdisciplinarity and diversity are the basis of our innovation and performance. When realizing creative ideas, we use the latest methods and technologies. Besides laboratories and test fields at the highest technical level, we benefit from a network of innovative partner facilities for testing. In this research and working environment, our employees enjoy ideal conditions for a career in specialist and management positions or their start-up company.

Independence, initiative, responsibility

As a non-profit foundation under civil law, we are committed to the common good. We maintain our legal, economic, and moral independence and rely on the initiative and integrity of all members of the FZI team. We embrace our responsibility: We proactively shape debates on the opportunities and risks of technological innovations and put our words into action.

Transparency, openness, trust

We communicate amongst ourselves and with our partner companies on an equal footing, focusing on openness and readily accepting constructive feedback. For us, transparency means that decisions are accountable. Cooperation at the FZI is characterized by trust, commitment, and mutual support and is geared towards clearly defined goals. We actively embrace a team spirit – we can rely on each other and stand up for each other.

Appreciation, respect, fairness

We treat all FZI team members, partners, and clients with equal respect and appreciation and are guided by equal opportunities and fairness principles. Our enthusiasm for the digital technologies of the future unites us. We rely on a flexible and family-friendly working environment for individual professional and personal development.

Our Team

For almost four decades, we have recruited most of our team members during their student days or shortly after graduation. Within the scope of their work, our research scientists are given the opportunity, supported by the Board of Scientific Directors, to conduct research for their scientific careers and to pursue a doctorate at the faculties of the professors engaged at the FZI.

The successful realization of research projects in close cooperation with public clients, other research institutions, and companies in the private sector requires a high degree of independence, a sense of responsibility, and specialist knowledge from the research scientists. Our management structures are consistently geared towards providing them with the necessary support and structure for excellent research. At the same time, they allow space for the development of individual scientific, professional, and organizational skills.

We see ourselves as a training center for experts who combine scientific issues with real-world practice. We focus just as much on the continuing education and further qualification of our research scientists as we do on excellence in research, which is ensured by our proximity to outstanding research partners and universities, such as the Karlsruhe Institute of Technology (KIT). With modern, extensive laboratory equipment and the FZI House of Living Labs as a unique research environment, researchers at the FZI can develop and thoroughly test new technologies. They usually work with partner companies of all sizes, other research institutions or associations, and public administration.

At the FZI, you will encounter an intercultural and motivated team. A flexible, family-friendly work culture is just as much a matter of course for us as participation in international conferences and competitions or the promotion of individual further education and training for our team members.

FZI alumnus Dr. Manuel Lösch
presents his spinoff InnoCharge in
his FZI Open House lecture

Work, research for your doctorate, build a start-up – all at the same time? No problem at the FZI.

Research scientists at the FZI have many opportunities at their disposal. Instead of limiting themselves to just one aspect of their career, they can pursue several goals simultaneously.

– The unique thing about FZI projects is that specialists from computer science, electrical engineering, mechanical engineering, economics, mathematics, psychology, law, and many other areas work closely together on an interdisciplinary basis.

The highest scientific aspirations and practical relevance go hand in hand at the FZI. Whether through scientific publications and participation in conferences or through close contact with the members of the Board of Scientific Directors and their partner chairs, our research scientists are firmly integrated into the university research community. At the same time, they develop IT solutions for practice at the FZI at a high scientific level – in cooperation with users and our partners from industry and associations. While still at the FZI, our research scientists make valuable contacts with exciting employers for their future careers.

They can also gain management experience as project, department, or division managers. We support our employees with onboarding training and a wide range of further education and training offers.
The FZI-wide "Senior Expert" role also offers an exciting career option. It strengthens the scientific excellence of the FZI by opening up a primarily discipline-oriented career path.

Promoting IT innovations via startups

New and exciting technologies and business models are constantly developing; it is worth exploring them. To bring these IT innovations to society, we support our researchers in the spin-off process –among other things, in the domains of coaching, marketing, financing, and by transferring rights to research results.

The FZI also supports research scientists who want to set up companies with flexible employment models. These offer a secure foothold during the start-up phase. We provide employees with the premises and infrastructure they need during this time. This also includes our laboratory environment in the FZI House of Living Labs. The FZI Scientific Directors advise employees interested in founding a company or provide valuable contacts to established companies that also began as start-ups at the FZI. In this way, we have already accompanied the founding of over 60 start-ups.

Sharing Knowledge

We specifically prepare our scientific employees for a job in academia or the private sector. By qualifying the experts and leaders of tomorrow, we shape the knowledge transfer from research into practice, politics, and society.

We pass on the knowledge generated at the FZI to our scientists and students. In 2023, a team of 273 employees worked across disciplines on 185 national and international research and industry projects, supported by over 172 assistants.

Our contract research and development constantly receives new impulses from our student assistants, interns, Bachelor and Master students, and doctoral candidates from various disciplines. The result is the development of cutting-edge concepts, software, hardware and system solutions.

Thanks to application-oriented research and close cooperation with partner institutions, the scientific staff at the FZI gains valuable experience for future research, development, and management tasks. We support competence building and personal and professional development with customized offerings for continuing education and in-house training.

We also pass on our expertise to our partners from science, business, and society and offer them qualifications through workshops and training courses.

Besides science, business also benefits from the FZI's interdisciplinary research work. Many FZI employees continue their professional careers at companies they came into contact with as part of an FZI research project.

– Innovation and transfer are our core tasks addressed in each of our research projects and through numerous events and activities. In addition, it is essential to pass on the knowledge gained – within the FZI, but also to existing and new partners from science, business, politics, and civil society.

"Software doesn‘t have to be as bad as it currently is in many cases. This is why I work on methods, techniques, and tools for the constructive development of reliable and secure software."

Prof. Dr.-Ing. Ina Schaefer

Director at the FZI

Things to Know

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FZI
UNSERE
FORSCHUNG
GESTALTET
ZUKUNFT
FZI FORSCHUNGSZENTRUM INFORMATIK

The FZI in Figures

Scientific Achievements

12 Dissertations

10 Magazine/ Newspaper Articles

119 Conference Contributions

3 Books

2 Book Contributions

20 Technical Reports

3 Popular Science Publications

10 Training Courses and Workshops

Economic Achievements

185
Projects in Total

78 Direct Orders

107 Publicly Funded Projects

Range of FZI Revenues from Projects

€2.500 – €3.689.703

Range of Project Runtimes

1 – 63
Day Months

Total Sales Revenue 2023

€30,5
Million

Staff

273
Employees in Total

172 (Research) Assistants

5 Interns

Changes in Full-Time Staff

49 New Colleagues

24 New Alumni

Full-Time Staff

30 % Female Employees

70 % Male Employees

2023

The FZI in Figures

Organization

Board of Executive Directors

The FZI is managed by the Board of Executive Directors consisting of three members: two professors from the FZI Board of Scientific Directors – who perform their duties on a part-time basis – and one full-time board member.

– Prof. Dr.-Ing. J. Marius Zöllner

Karlsruhe Institute of Technology, Institute of Applied Informatics and Formal Description Methods, Applied Technical-Cognitive Systems

– Prof. Dr. Stefan Nickel

Karlsruhe Institute of Technology, Institute for Operations Research, Discrete Optimization and Logistics

– Jan Wiesenberger

Full-time member of the FZI Board of Executive Directors

Divisions

COM
Communications

CSL
Cybersecurity and Law

ESS
Embedded Systems and Sensors Engineering

IPE
Information Process Engineering

IST
Innovation, Strategy and Transfer

ISPE
Intelligent Systems and Production Engineering

RAD
Research Administration

SE
Software Engineering

TIS
Technology and Infrastructure Services

The research divisions Cybersecurity and Law, Embedded Systems and Sensors Engineering, Information Process Engineering, Innovation, Strategy and Transfer, Intelligent Systems and Production Engineering, and Software Engineering cover informatics application research across the entire innovation cycle. The central divisions Communications, Research Administration and Technology and Infrastructure Services and their organizational units create the framework for efficient and effective research at the FZI.

Board of Scientific Directors

With their technical and scientific excellence, the directors – coming from the academic disciplines of computer science, economics, electrical engineering, mechanical engineering, and law – support our research groups, organized in six research divisions, each led by division managers.

The Board of Scientific Directors advises the Board of Executive Directors on the essentials of internal scientific and research policy, on research, expansion and financial planning, and on all issues related to the seamless cooperation and effective support of the research divisions.

– Prof. Dr.-Ing. Dr. h. c. Jürgen Becker

Embedded Systems and Sensors Engineering (ESS)

Karlsruhe Institute of Technology, ITIV Institute (Institut für Technik der Informationsverarbeitung)

– Prof. Dr. Bernhard Beckert

Software Engineering (SE)

Karlsruhe Institute of Technology, KASTEL – Institute of Information Security and Dependability

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University of Tübingen, Wilhelm Schickard Institute – Technical Computer Science/ Embedded Systems

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Christof Weinhardt

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Karlsruhe Institute of Technology, Institute of Information Systems and Marketing (IISM)

– Prof. Dr.-Ing.
J. Marius Zöllner

Intelligent Systems and Production Engineering (ISPE)

Karlsruhe Institute of Technology, Institute of Applied Informatics and Formal Description Methods (AIFB)

"The FZI is in direct exchange with federal policymakers, the federal administration, and relevant associations. We provide neutral and independent advice on research and digital policy issues."

Ada Streb

Director of the FZI Capital Office in Berlin

Board of Trustees

The Board of Trustees of the FZI currently comprises 20 experts from public administration, business, and science. As part of their voluntary work, they define the principles for the activities of the FZI and advise the FZI on its long-term strategic orientation, the effective design of technology transfer, and the safeguarding of scientific excellence.

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