# aifb

# ANNUAL REPORT

CRITICAL
INFORMATION
INFRASTRUCTURES
RESEARCH GROUP

**KIT**
Karlsruhe Institute of Technology

# 2023

**ANNUAL REPORT 2023**

Research Group Critical Information Infrastructures

# PREFACE

Dear Friends,

the year 2023 was not an easy one but it was good ! Last year marked a significant milestone for the cii research group, as we made great contributions to research, teaching, and innovation. Our academic aims persist in maintaining a harmonious balance between theoretical exploration and its applicability at the intersection of information systems and computer science.

We published several research papers that were very well received by the academic community. We presented and discussed our research at leading scientific conferences, like the International Conference on Information Systems (ICIS), the International Conference on Wirtschaftsinformatik (WI), the Conference on Human Factors in Computing Systems (ACM CHI), and the Hawaii International Conference on System Sciences (HICSS).

Among the publication highlights were definitely that we received accepts for publication in the prestigious journal Information Systems Research (ISR) for two of our articles and that Dr. Scott Thiebes was awarded two respected awards for his dissertation—the dissertation award by the German Association for Data Protection and Data Security (GDD) and the Science Award for Computer Science from the KIT Department of Economics and Management.

Once again this year, we took the opportunity to host our doctoral seminar in the Black Forest, away from our everyday working lives, to deepen our focus on "The PhD Journey". The three-day retreat was held at the Haus der Kirche Evangelische Akademie Baden, Bad Herrenalb. The seminar was characterized by having great discussions both in professional and personal matters and manners.

In 2023, we again offered numerous multi-faceted lectures, seminars, programming courses, and hackathons. In this year's cii "Applied Informatics — Internet Computing" Guest Speaker Series, three guest speakers provided their insights on current industry trends. The different perspectives on the latest internet computing topics and issues included: System integration, DevOps & Kubernetes, and AI solutions for digital transformation. We are already looking forward to the numerous final theses in the coming year and will continue to provide up-to-date topics from research and practice in our courses in 2024.

# PREFACE

Regarding innovation, I would like to highlight the completion of the research projects ReDiBlock, PANDIA, NephroCAGE, and FLAIROP. The project "Ressourcenschonung durch Distributed-Ledgers- und BlockchainTechnologie für die industrielle Produktion und Kreislaufwirtschaft" (ReDiBlock) was funded by the Ministry of the Environment, Climate Protection and the Energy Sector Baden- Württemberg. The BMBF-funded project "Platform for the Analysis of Privacy Notices of Interactive Assistance Systems in the Health Care Domain—Consumer-centered Privacy Communication" (PANDIA) developed a platform that enables consumers and companies to automatically check information processing in interactive assistance systems. The projects "Nephrology Disease Cooperation between Canada and Germany for Applied AI" (NephroCAGE) and "Federated Learning for Robotic Picking" (FLAIROP) were both cooperation projects between Canada and Germany funded by the German Federal Ministry for Economic Affairs and Climate Action.

Last but most importantly, I am pleased to have welcomed five new PhD students in my research group in 2023—Mansur Aliyu Masama, Long Hoang Nguyen, Yannick Erb, Guangyu Du, and Gabriela Ciolacu. Welcome again and great to have you on board! I would also like to congratulate Dr. Manuel Schmidt-Kraepelin and Dr. Konstantin Pandl, who successfully finished their PhD in 2023. I am honestly proud of you, guys.

Much more information regarding our team, research projects, talks, teaching activities, publications, industry-related activities, and community services can be found in this annual report of the research group critical information infrastructures. I hope you will enjoy reading the report and gain some interesting insights into our highlights of 2023.
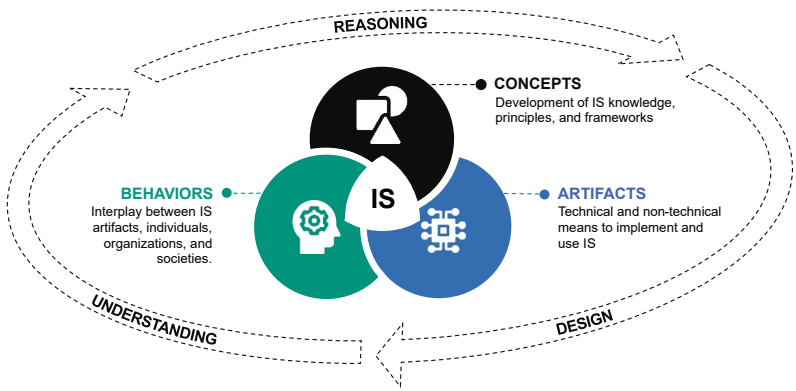
I am looking forward to the year 2024 !

Very Best

Ali Sunyaev

# INTRODUCTION

Critical information infrastructures are sociotechnical systems comprising essential software components and information systems with pivotal impact on individuals, organizations, governments, economies, and society. We work on research challenges concerned with the design, development, and evaluation of reliable and de:centralized information systems. Our research features a strong domain focus, in particular, on internet, mobility, and health care industries as well as on the industry-specific application of secure and trustworthy AI models. The principal goal of our research is theorizing on and designing the applications and methods required for creation and innovation of sociotechnical systems with auspicious value propositions. In our studies, we rigorously employ a variety of interdisciplinary methods and build on theories from information systems and related disciplines. Our work accounts for the multifaceted use contexts of information and communication technologies with research on human behavior affecting critical information infrastructures and vice versa. This enables us to rigorously generate strong theoretical insights while simultaneously producing research outputs of relevance to practical audiences.



REASONING

CONCEPTS
Development of IS knowledge, principles, and frameworks

BEHAVIORS
Interplay between IS artifacts, individuals, organizations, and societies.

IS

ARTIFACTS
Technical and non-technical means to implement and use IS

UNDERSTANDING

DESIGN

# WE ARE PART OF



KIT
Karlsruhe Institute of Technology

gaia-x

## WIWI

aifb

DdA Digitalisierung der Arbeitswelten

HiDSS 4HEALTH | HELMHOLTZ INFORMATION & DATA SCIENCE SCHOOL FOR HEALTH

KIT
Karlsruhe Institute of Technology
Center Information Systems Technologies

KIT
Karlsruhe Institute of Technology
**HealthTech**

KASTEL

Digitalisierung im Dialog

# TABLE
# OF
# CONTENTS

# TEAM

**01.**

# TEAM



## PROF. DR. ALI SUNYAEV

**Professor**

Phone: +49 721 608-46037
E-Mail: sunyaev@kit.edu

## ELISABETH LIEDER

**Secretary**

Phone: +49 721 608-43679
E-Mail: elisabeth.lieder@kit.edu





## DR. TOBIAS DEHLING

**Research Associate**

Phone: +49 721 608-44967
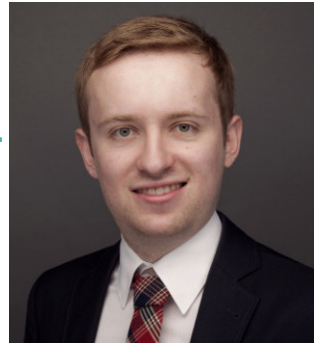E-Mail: dehling@kit.edu

## DR. SEBASTIAN LINS

**Research Associate**

Phone: +49 721 608-42819
E-Mail: sebastian.lins@kit.edu

## DR. KONSTANTIN PANDL

**Research Associate**

E-Mail: konstantin.pandl@kit.edu

## DR. MANUEL SCHMIDT-KRAEPELIN

**Research  Associate**

Phone: +49 721 608-4406
E-Mail: manuel.schmidt-kraepelin@kit edu

# TEAM

## DR. BENJAMIN STURM

**Research Associate**

Phone: +49 721 608-46586
E-Mail: benjamin.sturm@kit.edu

## DR. SCOTT THIEBES

**Research Associate**

Phone: +49 721 608-45393
E-Mail: scott.thiebes@kit.edu

## JAN BARTSCH

**PhD Student**

Phone: +49 721 608-44754
E-Mail: jan.bartsch@kit.edu

# TEAM

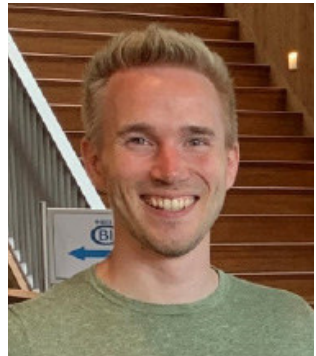## MIKAEL BEYENE

**PhD Student**

Phone: +49 721 608-46039
E-Mail: mikael.beyene@kit.edu

## MAXIMILIAN BLUME

**PhD Student**

Phone: +49 721 608-43679
E-Mail: maximilian.blume@partner.kit.edu

## KATHRIN BRECKER

**PhD Student**

Phone: +49 721 608-43678
E-Mail: kathrin.brecker@kit.edu

# TEAM

## GABRIELA CIOLACU

**PhD Student**

E-Mail: gabriela.ciolacu@kit.edu

## PHILIPP LUKAS DANYLAK

**PhD Student**

Phone: +49 721 608-43922
E-Mail: philipp.danylak@kit.edu

## GUANGYU DU

**PhD Student**

E-Mail: guangyu.du@kit.edu

# TEAM

## YANNICK ERB

**PhD Student**

E-Mail: yannick.erb@kit.edu

## MANDY GORAM

**PhD Student**

Phone: +49 721 608-43711
E-Mail: mandy.goram@kit.edu

## RICHARD GUSE

**PhD Student**

Phone: +49 721 608-43679
E-Mail: richard.guse@kit.edu

# TEAM

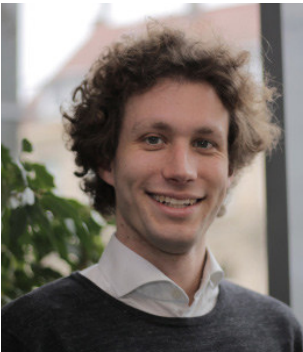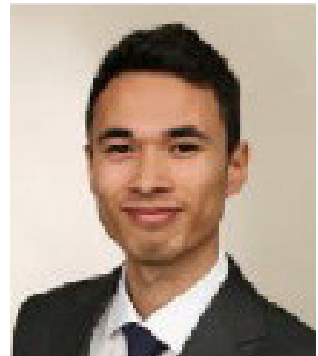## SHANSHAN HU

**PhD Student**

Phone: +49 721 608-43679
E-Mail: shanshan.hu@kit.edu

## DAVID JIN

**PhD Student**

Phone: +49 721 608-43679
E-Mail: david.jin@kit.edu

## NICLAS KANNENGIESSER

**PhD Student**

Phone: +49 721 608-45779
E-Mail: niclas.kannengiesser@kit.edu

# TEAM

## DANIEL KIRSTE

**PhD Student**
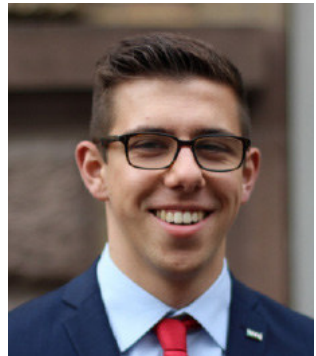
Phone: +49 721 608-43679
E-Mail: daniel.kirste@partner.kit.edu

## FLORIAN LEISER

**PhD Student**

Phone: +49 721 608-47680
E-Mail: florian.leiser@kit.edu

## MANSUR ALIYU MASAMA

**PhD Student**

E-Mail: mansur.masama@partner.kit.edu

# TEAM

## LONG HOANG NGUYEN

### PhD Student

E-Mail: long.nguyen@kit.edu

## SASCHA RANK

**PhD Student**

Phone: +49 721 608-43679
E-Mail: sascha.rank@kit.edu

## MAXIMILIAN RENNER

**PhD Student**

Phone: +49 721 608-46554
E-Mail: maximilian.renner@kit.edu

# TEAM

## VALERIA SMOLENSKAYA

PhD Student

Phone: +49 721 608-43679
E-Mail: valeria.smolenskaya@kit.edu

## EVA SPÄTHE

PhD Student

Phone: +49 721 608-44513
E-Mail: eva.spaethe@kit.edu

## HEINER TEIGELER

PhD Student

Phone: +49 721 608-47946
E-Mail: heiner.teigeler@kit.edu

# TEAM



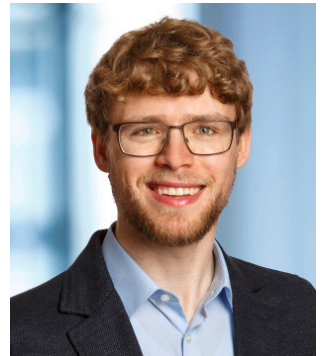## PHILIPP TOUSSAINT

PhD Student

Phone: +49 721 608-44752
E-Mail: philipp.toussaint@kit.edu

## SIMON WARSINSKY



**PhD Student**

Phone: +49 721 608-46036
E-Mail: simon.warsinsky@kit.edu



## NORA ALMASI

**Student Assistent**

E-Mail: nora.almasi@kit.edu
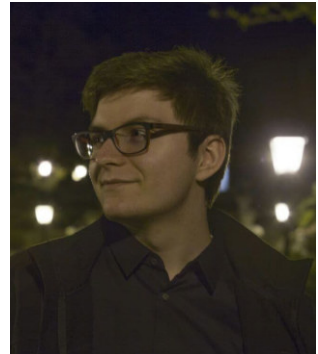
## AMANDA ISABEL JIMÉNEZ BERMÚDEZ

**Student Assistent**

E-Mail: amanda.bermudez@kit.edu

## NIKOLAI BETZ



**Student Assistent**

E-Mail: nikolai.betz@kit.edu



## ARI NUBAR BOYACIOĞLU

**Student Assistent**

E-Mail: ari.boyacioglu@kit.edu

# TEAM



## KAI YEN CHANG

**Student Assistent**

E-Mail: kai.chang@kit.edu

## JIANYANG DOU



**Student Assistent**

E-Mail: jianyang.dou@kit.edu



## ELENA FANTINO

**Student Assistent**

E-Mail: elena.fantino@kit.edu

# TEAM

## NICK HENZE

**Student Assistent**

E-Mail: nick.henze@partner.kit.edu
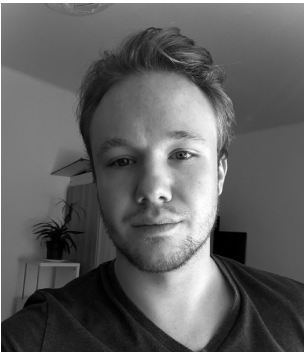
## NIKOLAS KIEFER

**Student Assistent**

E-Mail: nikolas.kiefer@kit.edu

## ROBIN LINK

**Student Assistent**

Email: robin.link@kit.edu

# TEAM



## FELIX LINNEMANN

**Student Assistent**

E-Mail: felix.linnemann@kit.edu



## STEFAN LÖFFELHOLZ

**Student Assistent**

Email: stefan.loeffelholz@kit.edu



## PETER MAIER

**Student Assistent**

Email: peter.maier@kit.edu

## GOKUL MURAL

**Student Assistent**

E-Mail: gokul.mural@kit.edu

## ALEKSANDRA ALICJA PAWELEK

**Student Assistent**

Email: aleksandra.pawelek@kit.edu

## ZHOU SHA

**Student Assistent**

Email: zhou.sha@kit.edu

# TEAM

## MAYA STAUSS

**Student Assistent**

Email: maya.stauss@kit.edu

## MARKO STEIN

**Student Assistent**

Email: marko.stein@kit.edu

## AYLIN USTA

**Student Assistent**

Email: aylin.usta@kit.edu

# TEAM



## PHILIPP WINTERHOFF

**Student Assistent**

Email: philipp.winterhoff@kit.edu

## DANIEL WÜSTEFELD



**Student Assistent**

Email: daniel.wuestefeld@kit.edu



## VASILEIOS XANTHAKIS

**Student Assistent**

E-Mail: vasileios.xanthakis@kit.edu

# TEAM

## JULIAN ZINGLER

**Student Assistent**

Email: julian.zingler@kit.edu

# RESEARCH —

# — PROJECTS

**02.**

# Accountable Artificial Intelligence-based Systems

Developments in Artificial Intelligence (AI) offer new innovative ways to contribute to the well-being and progress of individuals and society. However, due to a multitude of incidents with AI (e.g., discrimination through AI predictions), the accountability of AI becomes more and more important. In general, accountability means that actions performed can be clearly assigned to a person. Applied to AI, accountable AI-based information systems (AAIS) refer to a socio-technical set of relationships consisting of humans interacting with AI technologies to perform certain tasks, where the actions taken in the course of the interaction can be uniquely attributed to a person. AAIS is intended to ensure that someone can be held legally responsible if the AI-based IS fails.

While calls to develop and embed mechanisms to create accountability

Project Title: Accountable Artificial Intelligence-based Systems: A Multi-Perspective Analyses

Contact Person: Prof. Dr. Ali Sunyaev, Dr. Sebastian Lins

Funded by: German Research Foundation

Project Partner: Prof. Dr. Alexander Benlian, Technische Universität Darmstadt

Website: -

# AUDITOR

The objective of the research project European Cloud Service Data Protection Certification (AUDITOR) is the conception, exemplary implementation and testing of an enduring EU-wide data protection certification for cloud services. The certification in accordance with the EU General Data Protection Regulation (GDPR) is in the interests of everyone involved: the cloud customers, who are only permitted to work with cloud providers that can guarantee a sufficient level of data protection, the cloud providers, who can offer just this security with such a certification, the auditing and certification bodies, for whose business area the GDPR stipulates strict laws, and the end-user, potentially affected by the data usage, the protection of whose personal data is in the focus of certifications of cloud services. The highly political project is led by our research group and already enjoys highest attention internationally. AUDITOR is carried out in cooperation with numerous partners from large, medium-sized and small companies (e.g. IBM, Salesforce, Microsoft, Fujitsu, Deutsche Telekom, and SAP), several major ministries and authorities (e.g. the Deutsche Akkreditierungsstelle), and a large number of German data protection authorities.

Project Title: European Cloud Service Data Protection Certification (AUDITOR)

Contact Person: Dr. Sebastian Lins, Heiner Teigeler, Prof. Dr. Ali Sunyaev

Funded by: Federal Ministry for Economic Affairs and Climate Action

Project Partner: CLOUD&HEAT Technologies GmbH; datenschutz cert GmbH; DIN-Normenausschuss Informationstechnik und Anwendungen (NIA), DIN e.V.; ecsec GmbH; EuroCloud Deutschland_eco e.V., eco — Verband der Internetwirtschaft; University of Kassel

Website: www.auditor-cert.eu

# BISE Student

The BISE Student project develops an innovative open-access platform for publishing excellent student dissertations, like Bachelor, Master, and Diploma theses. Typically, after a thesis has been handed in and graded, it simply disappears into a non-public university archive or desk drawer, never to be seen again. However, many of these theses are being carried out with great thoroughness and present results of high practical and scientific value for other students, researchers, and practitioners. Following the open knowledge idea, which is to allow anyone to freely access, use, modify, and share knowledge, BISE Student makes the publication of excellent student theses much easier for students and universities as well as provides an open and highly visible platform revealing the real worth of Bachelor, Master, and Diploma theses. BISE Student utilizes the innovative potential of distributed ledger technology to archive the system's three primary design goals: ease of use, openness, and content excellence. The entire submission process is transparently documented and safeguarded by the bloxberg blockchain (https://bloxberg.org). In order to create a truly open publication platform, BISE Student stores the theses and accompanying research data (e.g., interview transcripts, statistical data, program code) using a public decentralized storage solution - the InterPlanetary File System (IPFS).

Project Title: BISE Student — An Open Access Dissertation Library

Contact Persons: Benjamin Sturm, Ali Sunyaev

Funded by: -

Project Partners: BISE Journal (https://bise-journal.com)
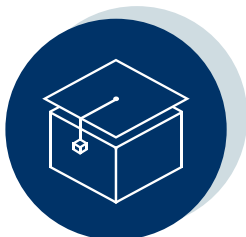


**BISE** Student



MAX-PLANCK-GESELLSCHAFT



BISE

# BloG3

Members of the BloG3 project intent to design, develop, and evaluate a blockchain-based system for the management of health data. The system enables oncology patients leaving the Charité hospital in Berlin to manage access rights to their data. This allows patients to grant data access to other doctors, hospitals, and nursing services in the context of follow-up care conveniently via a smartphone app. In order to consolidate scattered records, form different institutions, the blockchain-based system integrates different health information systems and builds a bridge between different electronic data sources.

The project consortium comprises partners from IT services, healthcare, and computer science research. The main objective of this project is to investigate tangible benefits of blockchain technology for the German healthcare system from a technical, economic and social perspective. Within this project, KIT particularly works on the design of the system architecture, the perception of the system by different user groups, and the development of incentive mechanisms for the continuous use of the platform.

---

Project Title: BloG3 - Blockchain-basiertes Gesundheitsdatenmanagement für gesamtheitliche Gesundheitsprofile

Contact Person: Shanshan Hu, Dr. Scott Thiebes, Prof. Dr. Ali Sunyaev

Funded by: : Federal Ministry of Education and Research

Project Partner: Forschungszentrum Informatik, FU Berlin, Charité Berlin, Pflegewerk Berlin, C&S Computer und Software GmbH, nubedian GmbH, easierLife GmbH, CircularTree GmbH, ITK Engineering AG

Website: www.blog3.de

---

# COOLedger

Over the past decade, various application areas have been identified for the use of Distributed Ledger Technology (DLT), including concepts such as blockchains. These application areas have specific requirements for DLT characteristics (e.g., fast consistency or high availability). However, trade-offs between these characteristics prevent the development of universally applicable distributed ledgers that can simultaneously address all requirements. Instead, a large number of distributed ledgers exist (e.g., Bitcoin, Ethereum, or IOTA), each optimized to meet requirements of a specific application area. Since the retroactive switch out an underlying DLT design is hardly possible, developers need to ponder suitability of DLT designs for their use cases before implementing.

In order to support the selection and configuration of a suitable distributed ledger, the COOLedger research project develops a model that identifies the dependencies between DLT characteristics and presents them in an understandable way. The model will be embedded in a process and implemented as software, which facilitates finding the optimal configuration of distributed ledgers for specific applications.

Project Title: COOLedger

Contact Person: Niclas Kannengießer, Dr. Benjamin Sturm, Prof. Dr. Ali Sunyaev

Funded by: Helmholtz Association

Project Partner: -

Website: -

**HELMHOLTZ** RESEARCH FOR GRAND CHALLENGES

**RSF** Russian Science Foundation

NATIONAL RESEARCH UNIVERSITY

# DaWID

Information is a fundamental component of services, platforms, and new business models in today's IT landscape. Consequently, digital service providers collect data on a large scale whenever someone uses their applications. This has led to a situation where citizens seized to be the sovereigns of their data.

The DaWID project aims to develop a metaplatform that makes it possible for citizens to ensure their data sovereignty on the one hand and creates cross-platform mechanisms to link previously siloed services and platforms on the other hand. As a result, data can be collected and refined by an orchestrated sequence of IT services in a data-driven value chain.

The DaWID consortium consists of industry and research partners who investigate economic, ethical, and sociotechnical issues in data-driven value chains. The cii group focuses on the development of methods and mechanisms for (re-)establishing citizens' data sovereignty. We will enable citizens' to trace and influence the flow of their data across the platforms involved. Citizens' preferences for data usage will be stored in a machine-readable manner, matched with the respective data flows, and made enforceable across all platforms.

The DaWID project started in February 2020 and ran until April 2023.

---

Project Title: DaWID: Data-Centered Value Creation

Contact Persons: Jan Bartsch, Dr. Tobias Dehling, Prof. Dr. Ali Sunyaev

Funded by: Federal Ministry of Education and Research

Project Partner: Fraunhofer Institute for Software and Systems Engineering (ISST), Institute for Digital Transformation in Healthcare (idigiT), Fraunhofer Center for International Management and Knowledge Economy (IMW), T-Systems International GmbH - IoT Data Analytics

Websites: https://www.dawid-projekt.de/

---



Datenzentrierte Wertschöpfungsplattform für Interaktive, assistierende Dienstleistungssysteme

VDI|VDE|IT

Supported by:

Federal Ministry for Economic Affairs and Climate Action

on the basis of a decision by the German Bundestag

Institute for Digital Transformation in Healthcare

Fraunhofer ISST

Fraunhofer IMW

# Digitale Transformation in Healthcare

One of the most striking examples of digital transformation, with supposedly profound societal and organizational impacts, is the field of personalized medicine. The impact of new technology is huge in healthcare, for example, because genomic data will certainly reach the clinical routine and thus make personalized medicine available for everybody. However, digitization does not only have the potential to offer benefits. For example, the changing care model due to personalized medicine is also expected to dramatically change the work practices and the economics of healthcare professionals. Entire medical professions may become obsolete or see their work practices turned upside- down. Even though we are facing striking and massive changes in healthcare due to digital transformation, we currently lack theories to guide us and help us to understand, describe, explain, and predict this phenomenon. The project Digital Health Work investigates how the digitization shapes work in the healthcare sector. To do so, we draw on the Theory of the Smart Machine, seeking to test the theory within the healthcare domain. Moreover, we develop a new explanatory theory for the phenomenon of digital transformation in healthcare by means of a qualitative research design.

---

Project Title: Digital Transformation in Healthcare: Theoretical Perspectives and Conceptualization of Digitization Effects on Human Work in Healthcare

Contact Person: Prof. Dr. Ali Sunyaev, Dr. Scott Thiebes

Funded by: German Research Foundation (DFG)

Project Partner: University of Cologne, University Hospital Cologne

Website: https://digitalisierung-der-arbeitswelten.de/

---

# DIRECTIONS

The research project Data Protection Certification for Educational Information Systems („DIRECTIONS") aims to design, implement, and test a sustainable data protection certification for educational information systems. Two stages of DIRECTIONS are planned to achieve the project goal: First, a quality seal will be designed and tested. Second, the quality seal will be further developed to become an approved and recognized data protection certification. By developing a quality seal in the first stage, DIRECTIONS provides a short-term means for providers of educational information systems to communicate their data protection practices. This can create transparency and comparability on the market at an early stage and reduce potential uncertainties. However, a quality seal is insufficient to demonstrate compliance with the GDPR. Therefore, it is planned in the second stage to develop the quality seal into a data protection certification in accordance with Art. 42 of the GDPR and to have it formally approved. DIRECTIONS is supported by over 40 associated partners from the educational sector and funded with more than 6 million euros.

Project Title: DIRECTIONS — Data Protection Certification for Educational Information System

Contact Person:  Dr. Sebastian Lins, Prof. Dr. Ali Sunyaev

Funded by: German Federal Ministry for Education and Research

Project Partner: Prof. Dr. Gerrit Hornung, University of Kassel; Dr. Sönke Maseberg und Dr. Irene Karper, datenschutz cert GmbH

Website: https://directions-cert.de



Supported by:

Federal Ministry for Economic Affairs and Climate Action

on the basis of a decision by the German Bundestag

datenschutz cert

UNIKASSEL VERSITÄT

# DLT4Life

Modern life sciences with their highly sensitive omics data sets face several challenges with regard to data storage and sharing. On the one hand data must be protected in order to preserve the privacy of those individuals who contributed their data to research. On the other hand, the true value of omics data can only be realized if shared with as many researchers as possible. In an ideal world, data subjects (i.e., patients) should be able to control access to their data directly. However, granting and revoking access to data is a slow and tedious

DLT within the life sciences promise to enable data subjects granting and revoking access rights flexibly, independent of intermediaries, and on an individual basis, giving way for data subjects' direct control over who may access their data for what purposes.

Project Title: Distributed Ledger Technology for Life Sciences

Contact Person: Mikael Beyene, Dr. Scott Thiebes, Prof. Dr. Ali Sunyaev

Funded by: Helmholtz Association, Helmholtz Information and Data Science School for Health

Project Partner: German Cancer Research Center (DKFZ, Deutsches Krebsforschungszentrum)

Website: https://www.hidss4health.de/

OLTZ
MATION & DATA SCIENCE
L FOR HEALTH

party trust enforcement. Applications of

dlt4life.

# FLAIROP

Artificial Intelligence (AI) has proven to enable large economic efficiency gains in the context of the recent digital revolution. AI-based systems typically need large amounts of data to provide good results. As many industrial manufacturing companies are small or medium-sized, picking items are highly individual. This results in a small amount of data for a specific task. Sharing data across factories and companies could help in gaining more data for industrial use cases but has proven to be challenging in real-world applications as companies refrain from exchanging their critical production data. Federated learning is an emerging approach toward distributed, privacy-preserving machine learning. The training of AI-based systems is executed locally and only AI model parameters are uploaded to a central cloud server which is shared by multiple companies. The central server then aggregates all local models into an updated AI model which is distributed to all companies, while ensuring confidentiality of the participating companies' data. In this project, we aim to develop an international federated learning system in the domain of robotic picking and placing of unknown objects. The goal is to boost current AI solutions with more data while preserving privacy regulations.

Project Title: FLAIROP

Contact Person: Sascha Rank, Florian Leiser, Dr. Scott Thiebes, Prof. Dr. Ali Sunyaev

Funded by: German Federal Ministry for Economic Affairs and Energy

Project Partner: KIT IFL, University of Waterloo, Festo SE & Co. KG, Darwin AI

Website: https://www.flairop.com

# GAIA-X 4 ICM

Digital solutions play a central role in the Innovation Campus Mobility of the Future (ICM), and Gaia X is seen as a potential enabler for a variety of research activities. The goal of this project is to make Gaia-X usable for production, to realize a concrete instance for this purpose, to enable coupling with production systems, and thus to create the basis for a strongly scaling innovation platform for the ICM, but also beyond that for research and industry. The identification of open research questions, a reflection of the findings in the Gaia-X initiative, and knowledge transfer are the focus. The research group supports the project GAIA-X 4 ICM by identifying requirements to set up an ecosystem compliant with the GAIA-X principles and foundations. Together with the project partners, the research group will conceptualize and prototypically implement an ecosystem for production systems.

Project Title: GAIA-X4ICM

Contact Person: Dr. Sebastian Lins, Yannick Erb, Heiner Teigeler, Prof. Dr. Ali Sunyaev

Funded by: Ministry of Science, Research and Arts Baden-Württemberg

Project Partner: University of Stuttgart

Website: http://gaia-x4icm.de/



Ministerium für Wissenschaft, Forschung und Kunst Baden-Württemberg

Universität Stuttgart

# GaMeIT

Cognitive surgical assistance systems, such as surgical robots require image-based scene understanding to perceive the surgery context, comprehend the surgery procedure, and eventually generate safe trajectories to assist during the surgery. To achieve such scene understanding, recognition and semantic segmentation of different surgery aspects are necessary pre-conditions. Machine Learning (ML) approaches are a promising technology for semantic segmentation of images. To train robots with ML methods, annotated image data (e.g. in the form of videos) is required. Image annotation of surgical images and videos is often manually conducted by healthcare professionals. The process of manual annotation is prone to human errors since it can be tedious, monotonous, and exhausting. As a consequence, poor label quality is a common problem. However, for surgical robots to improve surgical procedures, sufficient data quality of annotated images is a decisive factor. If ML models for surgical robots are trained based on poorly labeled image data, this may negatively influence patients' health since the robots cannot be utilized to their full potential. In this project, we address the problem of poor label quality of surgical image data by augmenting the annotation process with persuasive technology.

Project Title: Data-driven Gamification to Improve Quality in Medical Image Annotation Tasks (GaMeIT)

Contact Person: Simon Warsinsky, Dr. Manuel Schmidt-Kraepelin, Dr. Scott Thiebes, Prof. Dr. Ali Sunyaev

Funded by: Helmholtz Association, Helmholtz Information and Data Science School for Health

Project Partner: University Hospital Heidelberg

Website: https://www.hidss4health.de/#projects

# Intelligent Security Handwerk

The digital transformation of German small and medium sized craft businesses is creating IT security challenges. The project Intelligent Security Handwerk as part of the BMWi initiative "IT-Sicherheit in der Wirtschaft" will address those challenges by sensitizing SME craft businesses for IT security and technically and organizationally enabling businesses to improve their IT security.

To this end, the cii research group led by Prof. Dr. Ali Sunyaev will develop and test an intelligent IT security assistant for German craft businesses. The assistant will capture the business IT infrastructure and IT security preferences to recommend an individual course of actions. This will enable SME craft businesses to make competent and independent IT security decisions. An interactive application will allow for an easy and intuitive usage which will be tested and evaluated in multiple lab and field studies.

The project consortium consists of the University of Kassel, the Berufsförderungswerk des Handwerk, and the KIT.

The project started in August 2021 and will run until July 2024.

Project Title: Intelligent Security Handwerk

Contact Persons: Dr. Benjamin Sturm, Mikael Beyene, Dr. Tobias Dehling, Prof. Dr. Ali Sunyaev

Funded by: Federal Ministry of Economic Affairs and Energy

Project Partners: University of Kassel, Berufsförderungswerk des Handwerk (BFH)

Websites: https://intelligent-security-handwerk.de

Supported by:

Federal Ministry for Economic Affairs and Climate Action

on the basis of a decision by the German Bundestag

INTELLIGENT SECURITY HANDWERK

UNIKASSEL VERSITÄT

BFH
Berufsförderungswerk des Handwerks gemeinnützige GmbH

# KASTEL

Within KASTEL Engineering Secure Systems, the research group cii focuses on the design of secure decentralized information systems (IS). In the application context of networked mobility, we focus on implications for consumers emanating from different degrees of decentralization of IS. Decentralization of IS can increase data sovereignty for users in IS but requires also that users take on new tasks and roles when processing information. For example, users of decentralized IS need to make efforts to operate their data repositories. Moreover, the degree of decentralization of an IS is not a constant property but changes over time due to economic, political, social, and technical dynamics. These dynamics make it difficult to design decentralized IS in such a way that they continue to meet user needs while allowing them to harness the benefits of decentralized IS (e.g., increased data sovereignty). To better understand the design of decentralized IS, the research group cii focuses in particular on the following research topics: 1. Dynamics influencing decentralization of IS 2. Choosing appropriate degrees of decentralization to meet application-specific requirements of IS 3. Implications of different degrees of decentralization for users of IS

# NephroCAGE

The NephroCAGE consortium applies the latest advances of learning systems to address a multi-national healthcare challenge in nephrology. We aim to combine medical and technical innovations to build and evaluate a real-world demonstrator incorporating the expertise of two leading nations in the fields: Canada and Germany. Combining clinical data from both nations through a secure blockchain-based federated learning platform enables access to a unique multi-national pool of clinical nephrology data for the first time. This clinical data pool forms the foundation for applying selected machine learning (ML) methods to train models, which help to predict the probability for selected clinical outcomes (i.e., kidney transplant success rates). However, the use of ML methods requires access to clinical data, which are highly protected through data protection regulations like GDPR. Especially multinational projects are hindered due to different data protection regulations and data formats at each site. Therefore, we propose the use of a federated learning infrastructure, where data resides at their original locations and ML algorithms are exchanged instead of raw data. If the consortium outcomes prove to be successful, the developed platform and methods will be applicable to address additional medical indications and chronic diseases.

Project Title: NEPHROCAGE

Contact Person: Florian Leiser, Dr. Konstantin Pandl, Dr. Scott Thiebes, Prof. Dr. Ali Sunyaev

Funded by: German Federal Ministry for Economic Affairs and Energy (BMWi)

Project Partner: Hasso Plattner Institute, Charité, University of British Columbia, Centre hospitalier de l'Université de Montréal, McGill University, Pirche AG

Website: https://www.nephrocage. org

# PANDIA

Today's privacy notices of interactive assistance systems in the health care domain are usually too long and not informative for lay users due to their legal jargon. As a consequence, consumers remain unaware of the specific terms of use and how their information is used.

The PANDIA project aims to develop a platform and innovative tools that enable consumers and companies in the health care domain to automatically check and understand information processing in interactive assistance systems (e.g., electronic health records, mHealth apps). By applying natural language processing (NLP) algorithms, the information essential for consumers will be extracted from privacy notices. Legal and complicated formulations will be simplified, enriched with visualizations, and communicated in an informative way. How consumers' information is used in the health care domain will be abstracted from various sources (e.g., apps, websites). Within the scope of PANDIA, the cii research group develops personalized solutions that inform all interested stakeholders about what information is stored, transmitted, or processed, in which way, by whom, and for what purposes in interactive assistance systems.

The PANDIA project runs from March 2020 to November 2023.

Project Title: PANDIA: Platform for the Analysis of Privacy Notices of Interactive Assistance Systems in the Health Care Domain—Consumer-centered Privacy Communication

Contact Persons: Mandy Goram, Dr. Tobias Dehling, Prof. Dr. Ali Sunyaev

Funded by: Federal Ministry of Education and Research

Project Partner: Snoopmedia GmbH, Ascora GmbH, elevait GmbH & Co. KG, OFFIS e.V. Institut für Informatik, FIZ Karlsruhe Leibniz Institut für Informationsinfrastruktur

Website: www.pandia-projekt.de

# ReDiBlock

The data generated along the product life cycle serves as basis for many decisions. Both the upstream areas of production and distribution and the downstream areas of collection, reuse and recycling could benefit from this information. An information exchange forms the basis for effective design and control of resource-efficient recycling management and economy. Flows of materials and goods must be analyzed over the entire product life cycle so that it can be controlled from each phase. Since this is not (or partially) the case in practice, the approach of a Distributed Ledger Technology (DLT) platform offers the possibility to improve the data basis for all actors in value-added and recycling management networks. Sharing access to this information would significantly increase the effectiveness and efficiency of the entire system. This information is indispensable in the course of societal expectations of climate protection and in the course of a sustainable industrial society with efficient, environmentally compatible flows of energy and materials. The project's goal is to clarify technical approaches and prerequisites, analyze correctness guarantees of transfers of real data into the digital system, develop a DLT system concept, as well as build and test a platform with real data from participating companies.

.

---

Project Title: ReDiBlocK

Contact Person: Mikael Beyene, Dr. Scott Thiebes, Prof. Dr. Ali Sunyaev

Funded by: Ministry of Environment, Climate Protection and the Energy Sector Baden-Württemberg

Project Partner: Institut für Angewandte Geowissenschaften (AGW), Institut für Industrial Ecology (INEC), iPoint-systems GmbH

---

# SDM4FZI

The challenge in the vehicle and supplier industry today is to produce economically despite highly volatile markets and under dynamic conditions. The decisive competitive factor here is the adaptability of production systems. In order to achieve maximum adaptability, a strict separation must be created between the hardware of the production systems and the controlling software. The SDM4FZI project therefore deals with the new method: software-defined manufacturing (SDM). Analogous to solutions from information and communication technology, non-predefined functions are also to be realised by automatically generated software. The basic prerequisite is the abstraction of the existing hardware through digital twins with the help of which the software can be automatically derived and distributed. For this purpose, the existing production OT (Operational Technology) must be rethought in order to make the control and communication infrastructure SDM-capable. SDM creates the basis for innovative applications and business models that use digital twins as their core to optimise adaptable production systems.
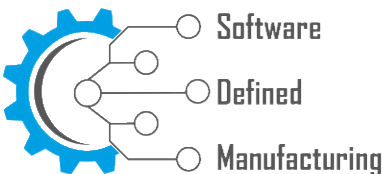
Project Title:  SDM4FZI - Software-defined Manufacturing for the vehicle and supplier industry

Contact Person: Dr. Sebastian Lins, Heiner Teigeler, Prof. Dr. Ali Sunyaev

Funded by: Federal Ministry for Economic Affairs and Climate Action

Project Partner: ABB, Audi, Bosch, HOMAG, University of Stuttgart, and many more

Website: https://www.sdm4fzi.de/

# SPECK

Agriculture, and particularly animal husbandry, is currently facing major challenges, such as ensuring food quality and creating sustainable value chains. Regional and global food security, animal welfare, efficient use of raw materials, climate and environmental protection, and their interactions play a prominent role in addressing these challenges.

To address the challenges regarding food quality and sustainable value chains, the digitization of food supply chains seems necessary in order to generate and analyze associated data. Digitization harnesses the potential of novel technologies, such as Artificial Intelligence and Distributed Ledger Technology (DLT), to improve the productivity, quality, and sustainability of food supply chains. For example, DLT has the potential to increase productivity and ensure quality by improving food traceability. The research project SPECK (Systemic optimization of the meat value chain using the example of pig farming through the development and embedding of digital tools), aims to improve the meat value chain by developing and embedding digital tools (e.g., DLT) and developing a digital application for optimized, animal-specific traceability and for continuous process diagnostics and process control

Project Title: SPECK

Contact Person: David Jin, Prof. Dr. Ali Sunyaev

Funded by: Federal Office for Agriculture and Food

Project Partner: University of Kassel, Chair of Agricultural and Biosystems Engineering, Karlsruhe Institute of Technology, Institute for Industrial Production
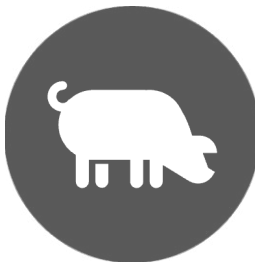
# Toward better Development of Applications on DLT

During the emergence of Distributed Ledger Technology (DLT) over the past decade, various applications on DLT have been proposed, implemented, and even patented. In the course of the development of such applications, new challenges arose from the inapplicability of extant programming paradigms to application development on DLT. Since these new challenges have not been fully identified and only barely solved, various incidents have already shown how devastating the effects of faulty applications on DLT can be (e.g. the loss of 50 million US dollars in The DAO Hack). The research project has not only synthesized existing development challenges related to smart contracts but has also provided solutions and software design patterns that help developers making DLT applications perform, secure, and maintainable. Results of the research project have been recently published at the prestigious journal IEEE Transaction on Software Engineering.

Project Title: Toward better Smart Contract Development

Contact Person: Niclas Kannengießer, Dr. Benjamin Sturm, Mikael Beyene, Prof. Dr. Ali Sunyaev

Funded by: EnBW

Project Partner: EnBW

# Unblackboxing IT Certifications

This research projects examines when and why information system certifications are effective in electronic markets. We explain how factors in the certification ecosystem can influence consumers' and platform providers' perceptions of IS certifications. Specifically in electronic markets, such as online platforms in e-commerce, two factors are of the utmost importance in the certification ecosystem: first, an independent third party as a certification authority, and second, competing for information signals on an online marketplace. Moreover, prior studies have not explored how customers perceive IS certifications in the long term. Thus, this research project next seeks answers to the following questions: (1) how does a certification authority as an independent third-party impact the perception of IS certifications, (2) which effects have different information signals on the perception of IS certifications and (3) what are the long-term effects of IS certifications (if customers interact several times with a certified online platform).

Project Title: Unblackboxing IT Certifications

Contact Person: Dr. Sebastian Lins, Maximilian Renner, Prof. Dr. Ali Sunyaev

Funded by: German Research Foundation

Project Partner: Prof. Dr. Alexander Benlian, Technische Universität Darmstadt

Website: -





Deutsche Forschungsgemeinschaft
German Research Foundation

TECHNISCHE UNIVERSITÄT DARMSTADT

# XAIOmics

As it is becoming progressively challenging to wholly analyze the ever-increasing amounts of generated biomedical data (e.g., CT scans, X-ray images, omics data) by means of conventional analysis techniques, researchers and practitioners are turning to artificial intelligence (AI) approaches to analyze their data. Extant AI approaches are often inaccessible and non-transparent to humans, thus limiting us in fully understanding and therefore trusting the produced outputs. Explainable AI (XAI) addresses this opacity issue by producing (more) interpretable AI models whilst maintaining high levels of performance and accuracy. The objective of XAIOmics is to design, develop, and evaluate XAI approaches to biomedical (i.e., omics) data. In particular, we will identify biomedical use cases and current, viable approaches in the domain of XAI and apply and adapt them to the identified use cases. With regards to the highly interdisciplinary field, a central research hurdle will be the development of an understanding for the different kinds of biomedical data and the subsequent feature enginee-ring in the context of the design of the AI algorithms. In doing so, this project will not only aid researchers and physicians in obtaining a better understanding of the outputs of contemporary AI approaches for biomedical data but also create more transparency.

Project Title: Explainable Artificial Intelligence in Life Science: An Application to Omics Data

Contact Person: Philipp Toussaint, Dr. Scott Thiebes, Prof. Dr. Ali Sunyaev

Funded by: Helmholtz Association, Helmholtz Information and Data Science School for Health

Project Partner: German Cancer Research Center (DKFZ, Deutsches Krebsforschungszentrum)

Website: https://www.hidss4health.de/

# TALKS &
## HIGHLIGHTS

**03.**

### Papers Presented at the Hawaii International Conference on System Sciences (HICSS'23)



Kathrin Brecker, Shanshan Hu, Florian Leiser, and Maximilian Renner from the cii research group presented papers at the Hawaii International Conference on System Sciences (HICSS). The conference took place in Maui, Hawaii, from January 04 - 06, 2023.

### Prof. Dr. Ali Sunyaev elected as jury member for the KI Newcomers 2023



Every year, the KI-Camp of the Federal Ministry of Education and Research (BMBF) and the German Informatics Society (Gesellschaft für Informatik e.V.) select ten AI newcomers from Germany. For the KI Newcomers 2023, Prof. Dr. Ali Sunyaev was invited as a jury member.

### Anton Fink Science Prize for Artificial Intelligence Awarded to KIT Master Graduate



KIT master's graduate, M. Sc. Tim Rädsch, was awarded for his master's thesis titled „The Quest for High Quality Annotations. Quantifying the Impact of Labeling Instructions on Real-World Data" with the Anton Fink Science Award for Artificial Intelligence. The prize is endowed with 10,000 euros. The master thesis is the result of a cooperation between the critical information infrastructures (cii) research group of the Institute for Applied Informatics and Formal Description Methods (AIFB) at KIT and the Department of Intelligent Medical Systems (IMSY) at the German Cancer Research Center (DKFZ) in Heidelberg. The supervision from KIT side was done by Dr. Konstantin Pandl and Prof. Dr. Ali Sunyaev, from DKFZ side by M.Sc. Annika Reinke, Prof. Dr. Lena Maier-Hein and Prof. Dr. Annette Kopp-Schneider (Department of Biostatistics at DKFZ).

## ReDiBlock Research Project Successfully Develops Blockchain-based Prototype for Circular Economy



The ReDiBlock research project, which involves KIT AIFB, KIT Thinktank, INEC, and ipoint-systems GmbH, has successfully developed a prototype application supporting circular economy using Blockchain technology. The project's use case is focused on gold recycling, with two industry partners, C. Hafner and egf, providing valuable insights and help in refining the concept behind the prototype. The internal project closing meeting, hosted by INEC at Pforzheim University, was attended by the project partners and marked the successful completion of the project.

## Final results of the digilog@bw "Blockchain for Open Knowledge" project presented



Concluding the three-year research project digilog@bw, a selected number of research outcomes have now been presented in a compact video format. The cii research group, represented by Dr. Benjamin Sturm, showcased the results of a subproject that aimed at better understanding the design of blockchain-based systems to support the open knowledge dissemination.

## Prof. Dr. Ali Sunyaev was interviewed in the journal „Management & Krankenhaus"



In the April 2023 issue of the journal „Management & Krankenhaus", in an interview Prof. Dr. Ali Sunyaev explains the current state of IT security of networked devices in medical technology in the article titled „Security is not a checkbox that can be ticked off". How can a future-proof security architecture for medical devices be created? In the interview, current security-relevant topics of interconnected medical technology systems are discussed. Among other things, terms frequently used in conjunction with secure IT and indirect medical technology such as „confidential computing" and „security by design" are explained in more detail.

## Girls' Day - Future Prospects for Girls: Become a Scientist and Shape the Future



In contribution to this year's nationwide "Girls' Day - Future Prospects for Girls" on the April 27, 2023, the cii research group conducted the workshop 'Become a Scientist and Shape the Future — An Introduction to our Research Projects & Your Opportunities' - "Als Wissenschaftlerin die Zukunft gestalten — Wir zeigen dir unsere Forschungsprojekte & deine Möglichkeiten" as a part of the overall KIT program. The workshop provided students with an introduction to our research group and insights into our research objectives and potential paths towards becoming a scientist. This year, Kathrin Brecker from the cii research group was invited to present her work as PhD student at the AIFB and her research topic "Artificial Intelligence Assessment" at the KIT Girls' Day introductory event to the more than 500 participating girls.

## Late-Breaking Work Presented at the ACM CHI Conference on Human Factors in Computing Systems (CHI 2023)



Manuel Schmidt-Kraepelin presented the Late-Breaking Work paper „Narrative Transportation in Gamified Information Systems: The Role of Narrative-Task Congruence" at the ACM CHI Conference on Human Factors in Computing Systems (CHI 2023). The conference took place in Hamburg, Germany, from April 23 — 29, 2023.

**Congratulations to Manuel Schmidt-Kraepelin for his successful doctoral examination**





On May 03, 2023, Manuel Schmidt-Kraepelin successfully defended his Ph.D. thesis. His dissertation is entitled "Gamified Information Systems for Health Behavior Change". During his doctoral studies, Manuel has published several papers in the proceedings of leading IS, medical informatics, and human-computer interaction journals and conferences.

**Research Project DIRECTIONS' Expert Advisory Board Meeting at the Federal Ministry of Education and Research (BMBF) in Berlin**
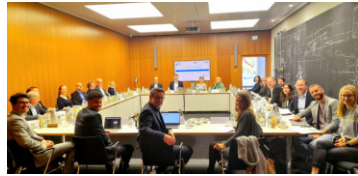




The DIRECTIONS (Data Protection Certification for Educational Information Systems) expert advisory board meeting was held at the Federal Ministry of Education and Research (BMBF) in Berlin on May 10, 2023. The projects' current status as well as next steps for the piloting phase were discussed. https://cii.aifb.kit.edu/img/News/2023/

## cii Summer Excursion 2023





This year's summer excursion of the cii research group went under blue sky and sunshine on May 04, 2023 to a guided tour and wine tasting to the state winery Kalrsruhe-Durlach followed by a common dinner. In the early afternoon, the cii staff, led by Prof. Dr. Sunyaev, set off for the State Winery Karlsruhe-Durlach. Under a bright sun and blue sky, the cii research group arrived at the State Winery, where they were warmly welcomed by the winery staff. After a short but informative tour through the winery and the wine terraces, they were given insights into Karlsruhe wine production and the work at the State Winery. There, they tasted a selection of the wines and subsequently together went for dinner at the Borsalino restaurant in Durlach.

## Dr. Scott Thiebes was awarded this year's science award for computer science from the KIT Department of Economics and Management



Scott was awarded this year's science award for computer science from the KIT Department of Economics and Management for his outstanding dissertation on "A Socio-Technical Analysis of Genetic Privacy and its Role in Genetic Data Sharing", which he completed at KIT last year.

## BloG3 Final Event 2023



At the end of the BloG3 project, all consortium partners came together once again for the hybrid (partial) final event at the FZI in the House of Living Labs. For the successful conclusion the results of all work packages of the individual consortium partners were presented.

## Data Platforms and Ecosystems in Healthcare Minitrack @ HICSS-57



Together with Prof. Dr. Daniel Fürstenau (IT University of Copenhagen) and Dr. Katarina Braune (Charité Universitätsmedizin Berlin), Prof. Dr. Ali Sunyaev and Dr. Scott Thiebes, for the second time, co-chair the Data Platforms and Ecosystems in Healthcare minitrack at the 57th Hawaii International Conference on System Sciences (HICSS), which takes place from January 3-6, 2024.

## cii Doctoral Seminar 2023 — Bad Herrenalb



Like every year, the cii research group held a doctoral seminar in 2023. The three-day retreat was held at the Haus der Kirche Evangelische Akademie Baden, Bad Herrenalb, from June 28 through June 30, 2023. This year's lectures and workshops took place under the seminar theme "The PhD Journey". The research group around Prof. Dr. Ali Sunyaev organized several sessions and workshops on planning and finishing the PhD, research paradigms, research methods, and reviews and revisions.

## Industry Insights from Esteemed Guest Speakers in this Year's Course „Angewandte Informatik - Internet Computing"



In this year's cii "Angewandte Informatik - Internet Computing" Guest Speaker Series, three Guest Speakers provided their insights on current industry trends. The different perspectives on latest internet computing topics and issues included: System Integration, DevOps & Kubernetes, and AI solutions for digital transformation. The first talk was given by Sebastian Esch who is Senior Solution Architect for the SAP Business Technology Platform at IBsolution GmbH. He presented how integration in hybrid system landscapes works and provided examples from SAP practice. Vincent Welker and Tobias Manske from ATIX AG were the next to share their knowledge on DevOps and how to implement highly-scalable Kubernetes solutions. In the last guest lecture, Senior Director of Strategic Solutions EMEAI at C3.ai Dr. Matthias Pfaff introduced the students to the latest trends in how to integrate AI solutions in large enterprises and organizations to achieve cost-efficiency and increase productivity.

## Final event of the PANDIA project in Oldenburg



From July 18 - 19, 2023, the final event of our PANDIA project took place at OFFIS in Oldenburg, attended by representatives of all consortium partners and the project execution agency VDI/VDE. Together we looked back on more than three exciting and challenging years of research and development and presented and discussed the most important results and findings. The goal of the project was to provide consumers with privacy information from various providers in a simple, clear and understandable way. What sounds simple was a great challenge for the interdisciplinary consortium. Despite or perhaps because of this, we were able to overcome the challenges and successfully look forward to promising results and findings through the PANDIA project.

## Prof. Dr. Ali Sunyaev Held a Keynote at the Evening Event of the Summer School #Data2Health in Koblenz



On July 19, 2023 Prof. Dr. Ali Sunyaev held a keynote speech titled "Unleashing the Power of Medical Expertise for Machine Learning in Healthcare" at the Evening Event of the Summer School #Data2Health in Koblenz. In his keynote speech Prof. Dr. Ali Sunyaev talked about the ongoing fusion of medicine and technology. In addition, the dedicated PhD students of the College presented their exciting PhD projects. What a great opportunity to gain insight into ongoing research.

## Final Event of NephroCAGE project in Montreal



On August 01 and 02, 2023, we concluded the NephroCAGE project in Montreal, Canada hosted by our project partners at the McGill University Health Center (MUHC) and Le Centre Hospita-
lier de l'Université de Montréal (CHUM). On the first day, hosted by CHUM we discussed the project partners' efforts of the last project year and used the rare occasion to discuss the remaining challenges in person. The cii research group presented their efforts toward developing a decentralized federated learning infrastructure in this transatlantic consortium. After a joint conference dinner, we held the 3rd international NephroCAGE symposium at MUHC the following day. At this symposium, project partners as well as associated partners, and the German and Canadian funding agencies presented the insights gained in this project.

## Final Event of FLAIROP Project in Esslingen



On July 27, 2023, we held the final presentation for the FLAIROP project in Esslingen at the site of Festo SE. In the presence of the German funding agency, the German-Canadian project collaborators demonstrated the benefits of federated learning in robot bin picking cells.

## DFG approves follow-up proposal for our project „Accountable Artificial Intelligence-based Systems"
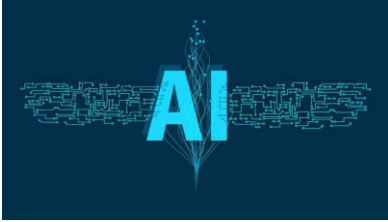


The German Research Foundation (DFG) has approved our follow-up proposal to continue joint research with Prof. Alexander Benlian in the topic area of Accountable AI for another 24 months.

## New article presented at Mensch und Computer Conference and published in the Proceedings



At the largest European human-computer-interaction conference, Florian Leiser presented our paper "From ChatGPT to FactGPT: A Participatory Design Study to Mitigate the Effects of Large Language Model Hallucinations on Users" in Rapperswil, Switzerland.

## Paper Presentation and Participation at 18. Internationale Tagung Wirtschaftsinformatik in Paderborn



This year's „Internationale Tagung Wirtschaftsinformatik" took place from September 18-21, 2023 in Paderborn, Germany. During the conference, Prof. Dr. Ali Sunyaev enacted his role as spokesperson of the Department of Information Systems of the German Informatics Society and organized several meetings within the department and across department boundaries. Florian Leiser presented the joint work of Mattis Bodynek, Florian Leiser, Scott Thiebes, and Ali Sunyaev on "Aggregating Random Forests in Federated Learning: A Synthesis of Aggregation Techniques" which stems from a successful bachelor thesis that was submitted as a paper to the conference's student track.

**Meeting of TU Darmstadt & KIT for the DFG project on „Accountable Artificial Intelligence-based Systems"**



On September 25, 2023, we welcomed our guests from TU Darmstadt in Karlsruhe to discuss the current status and future directions of the joint DFG project on "Accountable Artificial Intelligence-based Systems". Following a short welcome, we had a project meeting at KIT where each team presented their current works. TU Darmstadt's recent works revolve around the effects of accountability incongruence on AI developers, while KIT is currently examining accountable AI dimensions and user´s perception of Accountability in AI. We are thankful for the fruitful discussions and look forward to great future collaborations.

**Congratulations to Konstantin Pandl for his successful doctoral examination**



On October 10, 2023, Konstantin Pandl successfully defended his Ph.D. thesis! His dissertation is entitled "Trustworthy Decentralized Machine Learning Systems". During his doctoral studies, Konstantin has published several papers in the proceedings of leading computer science, medical informatics, and IS journals and conferences.

**Prof. Dr. Sunyaev gave a Talk on Informed Machine Learning during the KIT Welcome Week 2023**



On October 16, 2023, the welcome week of the KIT department of economics and management took place. As always, Prof. Dr. Ali Sunyaev had the chance to welcome the approximately 600 new first-year students of the industrial engineering and management study program at KIT. On this occasion and to get the students familiar with their new life at the university, Prof. Dr. Ali Sunyaev provided first-hand insights into the daily routine of teaching and studying by holding a lecture on the topic of informed machine learning in the context of digital health.

## Dr. Sebastian Lins started his visiting professorship at the University of Kassel



Sebastian is coming back to the University Kassel, holding a visiting professor for the winter semester 2023/2024. He is a substitute for Prof. Dr. Matthias Söllner, heading the chair 'Information Systems and Systems Development' at the University of Kassel. Sebastian particularly took over the lecture "Information Systems Analysis and Design", providing students in Kassel with basic information on information systems, system architectures, and human-computer-interaction!

## Best Paper Nomination @ HICSS-57



The paper „Designing Gamification Concepts for Expert Explainable Artificial Intelligence Evaluation Tasks: A Problem Space Exploration" by Philipp Toussaint, Simon Warsinsky, Manuel Schmidt-Kraepelin, Scott Thiebes, & Ali Sunyaev has been nominated for the Best Paper Award at HICSS-57.

## Prof. Kalle Lyytinen visits KIT



Prof. Kalle Lyytinen from Case Western Reserve University in Cleveland, Ohio, USA visited the cii research group at KIT for a two-day research seminar with doctoral students from October 19-20. Prof. Lyytinen had been a regular guest at the cii research group prior to the pandemic. We are happy to have Kalle back at KIT, after a brief hiatus due to the pandemic.

## Best Paper Nomination @ International Conference on Information Systems (ICIS) 2023



The paper "Artificial Intelligence as a Service: Trade-Offs Impacting Service Design and Selection" by Kathrin Brecker, Sebastian Lins, Manuel Trenz, & Ali Sunyaev has been nominated for the Best Paper Award at the International Conference on Information Systems

**(ICIS) 2023. Dr. Scott Thiebes was awarded this year's dissertation award by the German Association for Data Protection and Data Security (GDD)**

Scott was awarded this year's dissertation award in the area IT security by the German Association for Data Protection and Data Security (GDD) for his outstanding dissertation on "A Socio-Technical Analysis of Genetic Privacy and its Role in Genetic Data Sharing", which he completed at KIT last year. The award ceremony took place during GDD's 46th Data Privacy Conference (DAFTA), this November in Cologne.



**Fujitsu NEXT „IT Innovation" Award 2023 for an Outstanding Master's Thesis Awarded to KIT Master Graduate and cii Research Group Member Yannick Erb**

KIT master's graduate and current Ph.D. candidate, Yannick Erb, was awarded the Fujitsu NEXT "IT Innovation" Award 2023 for his master's thesis titled "From Affordances to Business Value — How Can Organizations Use Fog Computing to Create Business Value?". The prize was endowed with 3,000 euros. The supervision for

Erb's master's thesis was provided by Dr. Sebastian Lins and Prof. Dr. Ali Sunyaev.



**Papers Presented at the International Conference on Information Systems (ICIS) 2023 and Workshop on Information Technologies and Systems (WITS) 2023**

Kathrin Brecker from the cii research group presented papers at the International Conference on Information Systems (ICIS) 2023 and Workshop on Information Technologies and Systems (WITS) 2023. The conferences took place in Hyderabad, India, from December 10-15, 2023.
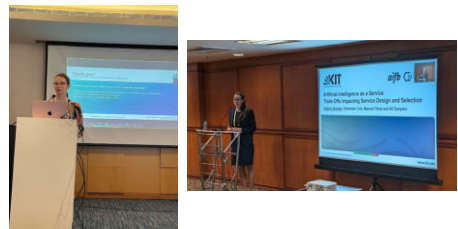
## cii Christmas Celebration 2023

For this year's Christmas celebration the cii research group went to Badisch Brauhaus Karlsruhe to have dinner together. After a brief joint activity of decorating Christmas cookies, the cii research group went to the Christmas market and parted ways as the day drew to a close.











## Cii's Genetic Privacy Research Featured on Heise Online

Our news article on "Genetic Data: Why sharing is such a dilemma" by Scott Thiebes and Ali Sunyaev has been published by Heise Online. With more than 20 million monthly readers, Heise Online is one of Germany's leading tech news websites.

# TEACHING&
## RESEARCH

**04.**

# LECTURES

### Applied Informatics - Internet Computing (Bachelor)
The lecture Applied Informatics — Internet Computing provides insights into fundamental concepts and future technologies of distributed systems and Internet computing. Students should be able to select, design and apply the presented concepts and technologies. The course first introduces basic concepts of distributed systems (e.g., design of architectures for distributed systems, internet architectures, web services, middleware). In the second part of the course, emerging technologies of Internet computing will be examined in depth. These include, among others: cloud computing, fog computing, internet of things, blockchain, artificial intelligence. Practical topics are discussed in tutorials.

### Critical Information Infrastructures (Master)
The course critical information infrastructures introduces students to the world of complex sociotechnical systems that permeate societies on a global scale. Students learn to handle the complexities involved in the design, development, operation, and evaluation of critical information infrastructures. In the beginning of the lecture, critical information infrastructures are introduced on a general level. The following sessions focus on an in-depth exploration of selected cases that represent current challenges in research and practice.

### Digital Health (Master)
The course Digital Health introduces master students to the subject of digitization in health care. Students learn about the theoretical foundations and practical implications of various topics surrounding the digitization in health care, including health information systems, telematics, big health care data, and patient-centered health care. After an introduction to the challenge of digitization in health care, the following sessions focus on an in-depth exploration of selected cases that represent current challenges in research and practice. Students work (in a group of 3-4) on a selected topic and have to write a course paper. Students can choose a topic from a variety of topics. To answer the research questions, students use literature reviews but also interviews, surveys, programming tasks, and other research methods.

### Trustworthy Emerging Technologies (Master)
The novel course Trustworthy Emerging Technologies provides insights into emerging and disruptive technologies and resulting information systems. Students write a scientific paper on topics such as generative AI, metaverse, and fog computing. Throughout the course, students develop a learning portfolio to get immediate feedback on their way to solving a real-world problem. They apply diverse research methods to solve identified problems, including literature reviews, interviews, and surveys. The course is supported by an online learning module teaching the basics

# SEMINARS

### Seminar Emerging Trends in Digital Health (Bachelor/Master)
The seminar aims at providing insights into current topics in the field of Information Systems with a focus on innovative digital healthcare systems. There are short introductions and corresponding seminar paper topics for different topics around the lectures and research topics of Prof. Sunyaev's research group "Critical Information Infrastructures" including genomics, distributed ledger technologies (e.g. blockchain), artificial intelligence, and gamification in healthcare. Students can also propose their own topics within the framework of the given topic areas. The seminar aims to provide insights into current topics in the field of digital health and to offer students the opportunity to write a scientific paper in a group of students for the first time.

### Seminar Selected Issues in Critical Information Infrastructures (Master)
The seminar aims at introducing master students to innovative, digital and scientifically based teaching concepts. In groups of up to five, they independently develop and analyze a teaching concept for KIT courses. Existing teaching units (e.g. basic lectures, seminars, or ILIAS learning modules) are used as examples and prototypically reviewed. Modern teaching concepts, such as interactive learning modules, gamification, serious gaming, or flipped classrooms, are examined and critically discussed with regard to their applicability and usefulness. Furthermore, students have the opportunity to integrate their own ideas and concepts based on current scientific knowledge. In a final session, the teaching concepts will be applied as examples and discussed within the group.

### Research Seminar: Critical Information Infrastructures (PhD Students)
The cii research seminar, aims to strengthen rigor and relevance of the research conducted in the cii research group. In weekly sessions, PhD students present their ideas for and challenges with their current research to the entire research group to obtain feedback. The cii research seminar fosters the exchange of ideas and knowledge within the research group, enables the effective mastering of arising challenges, and improves the overall quality of the research conducted in the cii research group.

# PRACTICAL COURSES

### Practical Course Blockchain Hackathon (Bachelor/Master)

The practical course "Blockchain Hackathon" aims to teach students the basics of developing sociotechnical information systems in the context of blockchain or distributed ledger technology (DLT) in a practical way. To this end, students are introduced to DLT and the development of DLT applications in a kick-off event. Subsequently, students work in groups to implement a software artifact (e.g., desktop application, mobile app, or web application) that solves a given problem. The practical course is held in the form of a 1-week hackathon. The hackathon also focuses on quality assurance (e.g. by implementing tests) and documentation of the implemented software artifact.

### Practical Course Sociotechnical Information Systems Development (Bachelor/Master)

The goal of the practical course is to understand the fundamentals of developing sociotechnical information systems for different application areas. Within the scope of the course, students learn to identify a suitable solution strategy for a given problem, define requirements and implement them in form of a working software product (e.g., web platforms, mobile apps, desktop applications). Students also learn to test the quality of the developed sociotechnical system and document it in accordance with established standards.

# TEAM PROJECTS

### Team Project Economy and Technology (Bachelor)

The team project course "Economics and Technology" is conducted in cooperation with colleagues from the Institute of Information Systems and Marketing (IISM). It aims to prepare students for working in heterogeneous teams. The course implements the concept of research-oriented teaching and fosters students' problem-solving competences. In teams of 4-5, students work on defined interdisciplinary problems at the intersection of economics and technology. Potential results of the projects include artifacts, such as methods, algorithms, models, software or components. Each team writes a final report and presents their findings to their supervisors and fellow students. Each semester, our research group offers interesting topics in the areas of digital health and information privacy.

# SELECTED
## PUBLICATIONS

**05.**

# SELECTED

# PUBLICATIONS

**Sunyaev, A.; Dehling, T.; Strahringer, S.; Da Xu, L.; Heinig, M.; Perscheid, M.; Alt, R.; Rossi, M. (2023)**
The Future of Enterprise Information Systems
Business & Information Systems Engineering (65), 731-751.
doi:10.1007/s12599-023-00839-2

**Sunyaev, A.; M. Renner, P. A.; Toussaint, S.; Thiebes & S.; Lins, Eds. (2023)**
**cii Student Papers — 2023**
Karlsruher Institut für Technologie (KIT)
doi: 10.5445/IR/1000162178

**Adam, M.; Lins, S.; Sunyaev, A.; Benlian, A. (2023)**
The Contingent Effects of IS Certifications on a Website's Trustworthiness
Journal of the Association for Information Systems, accepted manuscript
doi: 10.17705/1jais.00836

**Dehling, T.; Sunyaev, A. (2023)**
A Design Theory for Transparency of Information Privacy Practices
Information Systems Research, ePub ahead of print August 8, 1—22.
doi: 10.1287/isre.2019.0239

**Greulich, M.; Lins, S.; Pienta, D.; Thatcher, J.; Sunyaev, A. (2023)**
Exploring Contrasting Effects of Trust in Organizational Security Practices and Protective Structures on Employees' Security-Related Precaution Taking
Information Systems Research, accepted manuscript, 1—23.

**Thiebes, S.; Gao, F.; Briggs, R. O.; Schmidt-Kraepelin, M.; Sunyaev, A. (2023)**
Design Concerns for Multiorganizational, Multistakeholder Collaboration: A Study in the Healthcare Industry
Journal of Management Information Systems, 40 (1), 239—270.
doi: 10.1080/07421222.2023.2172771

**Goram, M.; Dehling, T.; Morsbach, F.; Sunyaev, A. (2023)**
Human-Centered Design for Data-Sparse Tailored Privacy Information Provision Human Factors in Privacy Research.
In: Gerber, N., Stöver, A., Marky, K. (eds) Human Factors in Privacy Research. Springer, Cham, 283-298.
doi: 10.1007/978-3-031-28643-8_14

**Erler, C.; Hu, S.; Danelski, A.; Stork, W.; Sunyaev, A.; Gersch, M. (2023)**
Threat Modeling to Design a Decentralized Health Data Management Application.
In: Rocha, Á., Ferrás, C., Ibarra, W. (eds) Information Technology and Systems. ICITS 2023. Lecture Notes in Networks and Systems, vol 692. Springer, Cham.
doi: 10.1007/978-3-031-33261-6_38

**Leinweber, M,; Kannengießer, N.; Hartenstein, H.; Sunyaev, A. (2023)**
Leveraging Distributed Ledger Technology for Decentralized Mobility-as-a-Service Ticket Systems.
In: Proff, H. (eds) Towards the New Normal in Mobility. Springer Gabler, Wiesbaden.
doi: 10.1007/978-3-658-39438-7_32

**Pandl, K. D. (2023)**
Trustworthy Decentralized Machine Learning Systems
Karlsruher Institut für Technologie (KIT)

**Schmidt-Kraepelin, M. (2023)**
Gamified Information Systems for Health Behavior Change
Karlsruher Institut für Technologie (KIT)

**Blume, M.; Lins, S.; Sunyaev, A. (2023)**
Uncovering Effective Roles and Tasks for Fog Systems
Proceedings of the 10th European Conference on Service-Oriented and Cloud Computing (ESOCC).
doi: 10.1007/978-3-031-46235-1_8

**Bodynek, M.; Leiser, F.; Thiebes, S.; Sunyaev, A. (2023)**
Applying Random Forests in Federated Learning: A Synthesis of Aggregation Techniques
Wirtschaftsinformatik 2023 Proceedings

**Brecker, K.; Lins, S.; Sunyaev, A. (2023)**
Why it Remains Challenging to Assess Artificial Intelligence
Proceedings of the 56th Annual Hawaii International Conference on System Sciences (HICSS), Hawaii, January 3-6, 2023, 5242—5251.

**Brecker, K.; Lins, S.; Sunyaev, A. (2023)**
Artificial Intelligence Systems' Impermanence: A Showstopper for Sustainable Assessment?
Workshop on Information Technologies and Systems (WITS)
Hyderabad, India, December 13-15, 2023.

**Brecker, K.; Lins, S.; Trenz, M.; Sunyaev, A. (2023)**
Artificial Intelligence as a Service: Trade-Offs Impacting Service Design and Selection
Proceedings of the 44th International Conference on Information Systems (ICIS), Hyderabad, India, December 10-13, 2023.

**Fürstenau, D.; Thiebes, S.; Witte, A.-K.; Sunyaev, A. (2023)**
Data Platforms and Ecosystems in Healthcare
Proceedings of the 56th Annual Hawaii International Conference on System Sciences (HICSS), Hawaii, January 3-6, 2023, 2797—2798.

**Hu, S.; Usta, A.; Schmidt-Kraepelin, M.; Warsinsky, S.; Thiebes, S.; Sunyaev, A. (2023)**
Be Mindful of User Preferences: An Explorative Study on Game Design Elements in Mindfulness Applications
Proceedings of the 56th Annual Hawaii International Conference on System Sciences (HICSS), Hawaii, January 3-6, 2023, 1116—1125.

**Leiser, F.; Eckhardt, S.; Knaeble, M.; Mädche, A.; Schwabe, G.; Sunyaev, A. (2023)**
From ChatGPT to FactGPT: A Participatory Design Study to Mitigate the Effects of Large Language Model Hallucinations on Users
Mensch und Computer 2023, 81—90, Association for Computing Machinery (ACM)

**Leiser, F.; Rank, S.; Schmidt-Kraepelin, M.; Thiebes, S.; Sunyaev, A. (2023)**
Medical Informed Machine Learning: A Scoping Review and Future Research Directions
Artificial Intelligence in Medicine
doi: 10.1016/j.artmed.2023.102676

**Leiser, F.; Warsinsky, S.; Daum, M.; Schmidt-Kraepelin, M.; Thiebes, S.; Wagner, M.; Sunyaev, A. (2023)**
Understanding the Role of Expert Intuition in Medical Image Annotation: A Cognitive Task Analysis Approach
Proceedings of the 56th Annual Hawaii International Conference on System Sciences (HICSS), Hawaii, January 3-6, 2023, 2850—2859.

**Leiser, F.; Warsinsky, S. L.; Schmidt-Kraepelin, M.; Thiebes, S.; Sunyaev, A. (2023)** How Experts Rely on Intuition in Medical Image Annotation — A Study Proposal
Proceedings NeuroIS Retreat 2023 Vienna, Austria, May 30 - June 1, 245—253.

**Renner, M.; Lins, S.; Söllner, M.; Jarvenpaa, S. L.; Sunyaev, A. (2023)**
Artificial Intelligence-Driven Convergence and its Moderating Effect on Multi-Source Trust Transfer
Proceedings of the 56th Annual Hawaii International Conference on System Sciences (HICSS), Hawaii, January 3-6, 2023, 5208—5217.

**Schmidt-Kraepelin, M.; Thiebes, S.; Warsinsky, S. L.; Petter, S.; Sunyaev, A. (2023)**
Narrative Transportation in Gamified Information Systems: The Role of Narrative-Task Congruence
Extended Abstracts of the 2023 CHI Conference on Human Factors in Computing Systems, 1—9, Association for Computing Machinery (ACM).
doi: 10.1145/3544549.3585595

**Späthe, E.; Lins, S.; Sunyaev, A. (2023)**
Large Language Models (LLM) in der Bildung — Über Chancen und Risiken von ChatGPT® an der (Hoch)Schule
Proceedings of the 9. Zukunftsforum Bildungsforschung, Ludwigsburg, November 23-24, 2023.
doi: 10.5445/IR/1000165279

# COMMITTEES AND MEMBERSHIPS

**06.**

# COMMITTEES AND MEMBERSHIPS

Prof. Ali Sunyaev is assigned to specific committees and is a member of various associations.

Gesellschaft für Informatik (GI)

Spokesperson of Department of Information Systems of the German Informatics Society (GI)

Association for Information Systems (AIS)

Deutsche Gesellschaft für Medizinische Informatik, Biometrie und Epidemiologie e.V. (GMDS)

Editorial Board Journal of the Association for Informtion Systems (JAIS)

Editorial Board Journal of Information Technology (JIT)

Editorial Board Electronic Markets (EM)

Member of the Scientific Advisory Coucil of the Anwenderverein Fujitsu NEXT e.V. („Network of Experts")

Verband der Hochschullehrer für Betriebswirtschaft (VHB)

Founder and Spokesperson of the "Digital Health" section in the German Informatics Society (GI)

Chairman of the examination board for the course of studies "Information Systems" at the KIT

Board Member of the KIT Division II — Informatics, Economics, and Society

Advisory council at the Fraunhofer Blockchain Center

AIS Distinguished Member - Cum Laude

Committee Member, Council for Research and Promotion of Young Scientists (CRYS), KIT

Scientific Committee Member, ETH Library Lab, ETH Zurich

Chairman of the examination board for the course of studies "Informa-

# IMPRINT

**07.**