KSRI is a hub for service research, with a worldwide network of partners from industry and academia. If you are interested in co-operating with KSRI, please do not hesitate to contact us.

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KSRI – An Overview and selected Research Projects

KSRI - KARLSRUHE SERVICE RESEARCH INSTITUTE

KIT - University of the State of Baden-Wuerttemberg and
National Research Center of the Helmholtz Association

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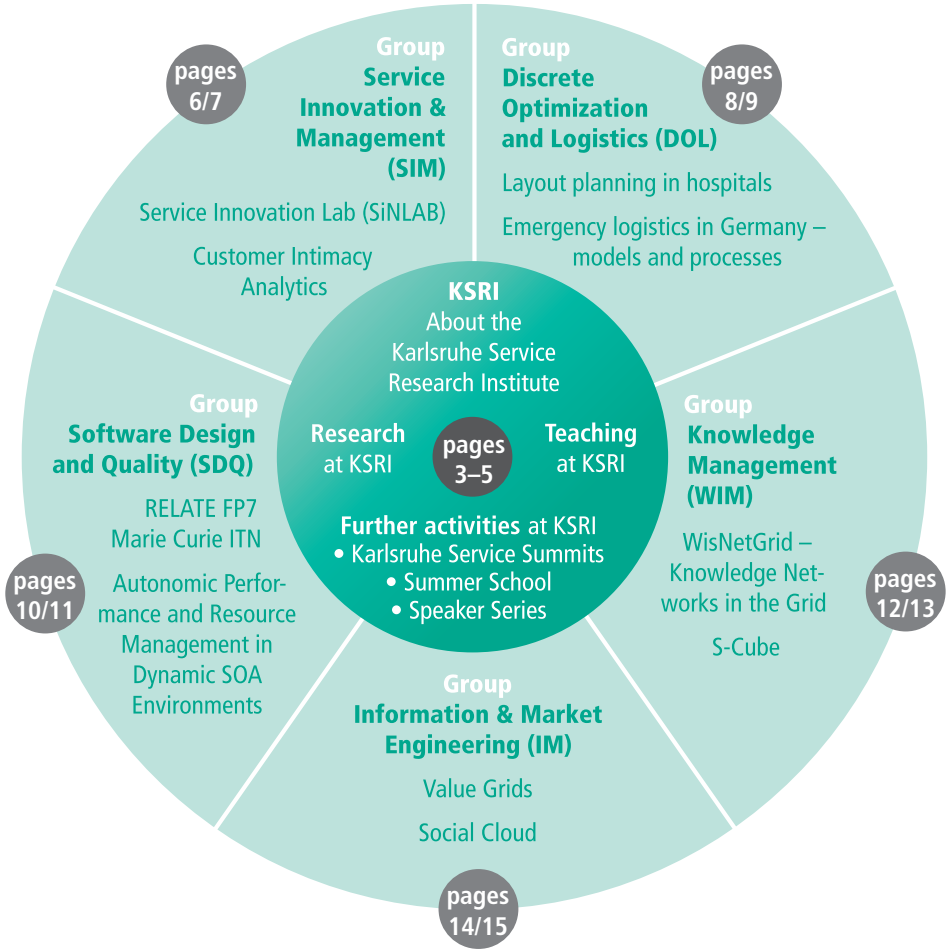
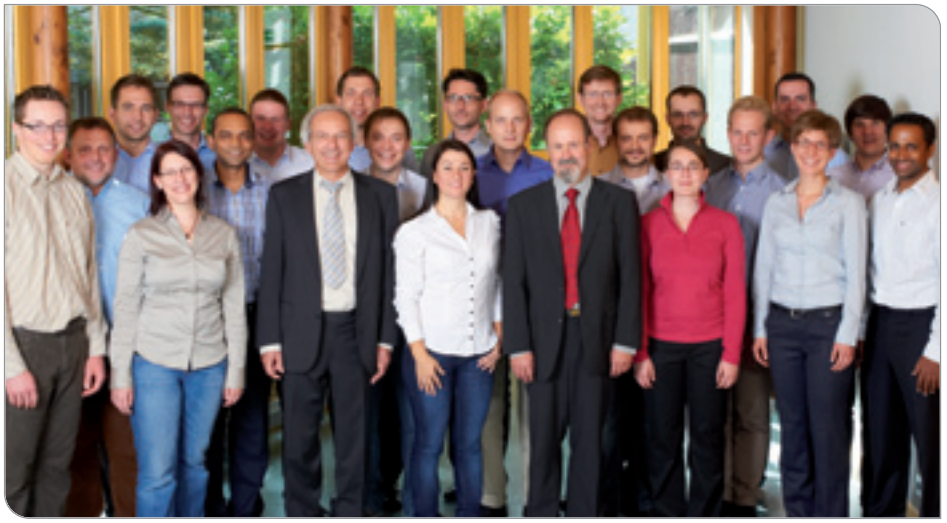
Content



KSRI Profile

ABOUT THE KARLSRUHE SERVICE RESEARCH INSTITUTE (KSRI)



The Karlsruhe Service Research Institute (KSRI) is part of the Karlsruhe Institute of Technology (KIT) which is among the leading engineering research institutions worldwide. As a member of the Helmholtz Association, the largest science organization in Germany, the institution makes major contributions to top national and international research.

Founded in 2008, KSRI is an innovative public-private-partnership of IBM and the KIT. Experts from IBM and the KIT jointly conduct research projects and offer an academic curriculum focusing on services. As an interdepartmental institute, KSRI brings together key research areas, in particular computer science, economics, and operations research. A further core activity is driving service innovation.

The academic field of Service Research, also referred to as Service Science, Management and Engineering (SSME), aims at a holistic understanding of complex service systems that can be found everywhere in today's digital society. Such service systems are characterized by the co-creation of economic value, multiple independent parties and enabled by the systematic use of information and communication technologies. In this context, KSRI develops concepts, methods and technologies for innovators and decision-makers to foster the joint value creation in an IT-based and service-oriented economy. Research questions are considered from different perspectives like service engineering, semantic technologies, market engineering, and service management and innovation.

KSRI Profile

RESEARCH AT KSRI

In interdisciplinary research teams, KSRI works on public and industry funded projects. The focus of these projects is to analyze complex service systems from different perspectives. Important domains such as ICT, health care, logistics and industrial services provide striking challenges for service research. These challenges are scrutinized by applying research methods from areas like supply chain management, market pricing, data or knowledge management, autonomic computing and service innovation.

Since 2010, the institute also offers the interdisciplinary graduate program "Service Research" with focus on Service Value Networks. In close collaboration with associated industry partners, the graduate program investigates research questions arising from complex service systems in industry, energy, healthcare, logistics, and information and communication technology.
The Karlsruhe Service Research Institute is organized in five distinct research groups led by experts from industry and academia:

Service Innovation & Management	(Prof. Dr. Hansjörg Fromm)
Discrete Optimization and Logistics	(Prof. Dr. Stefan Nickel)
Software Design and Quality	(Prof. Dr. Ralf Reussner)
Knowledge Management	(Prof. Dr. Rudi Studer)
Information & Market Engineering	(Prof. Dr. Christof Weinhardt)

TEACHING AT KSRI

Professional and leadership positions in industry and academia increasingly require an integrated interdisciplinary profile. KSRI offers a focused education, thereby providing a unique profile. Gaining practical experience in collaboration with industry partners is a central aspect of this market-oriented education. KSRI addresses this prerequisite within various BSc and MSc programs at KIT, such as Business Engineering, Information Engineering and Management, and Economics Engineering. KSRI lectures regularly occupy top ranked positions among all lectures at the department of economics.

FURTHER ACTIVITIES AT KSRI

KSRI has established several formats, which serve as forums to foster interdisciplinary discussions among international researchers and practitioners from industry.

- **Karlsruhe Service Summits**

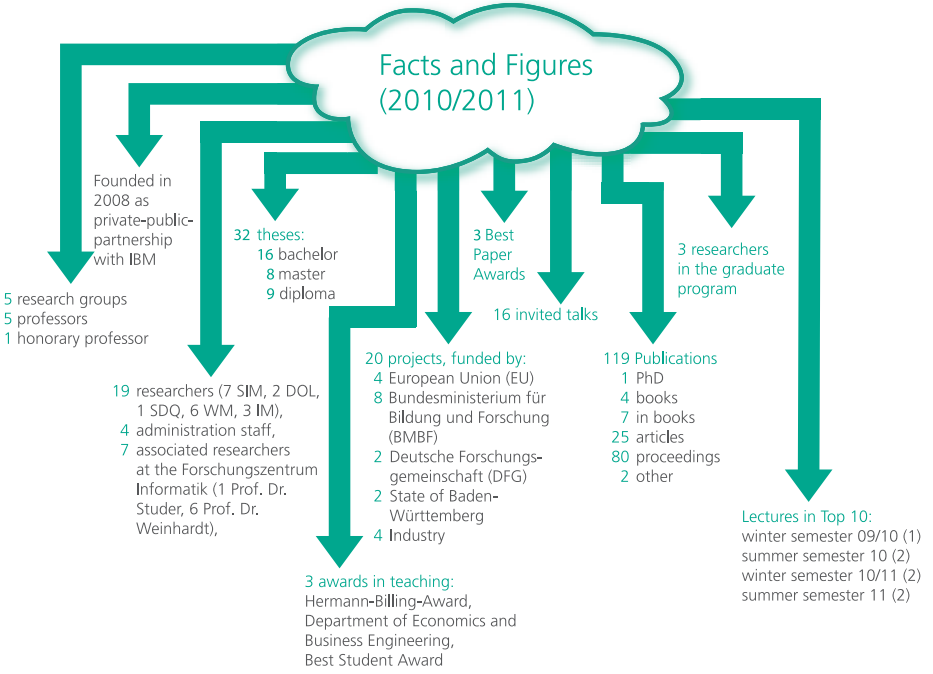
Karlsruhe Service Summits bring together experts from industry and academia to discuss the next steps into a service-led economy. The Service Summits address the latest topics in Service Research, presented by renowned speakers. In accordance with the interdisciplinary approach of KSRI, the whole-day events focus on the multiple fields within Service Research. Participants have the opportunity to experience a multilateral program which is covered by two sessions, each comprising several talks and a panel discussion. The sessions are complemented by keynotes from industry and academia.

- **Summer School**

Internationally renowned experts in the field Service Research exchange their experience with PhD students, young scientists and practitioners from industry. Through lectures, tutorials and social events, the Summer School provides a forum for participants to discuss and learn about Service Research.

- **Speaker Series**

In winter semester 2009/2010 KSRI started its interdisciplinary speaker series. Each semester the institute welcomes international speakers from industry and academia who shed light on selected topics in Service Research.



Research Groups

SERVICE INNOVATION & MANAGEMENT (SIM)

Head:
Prof. Dr. Hansjörg Fromm

Group description

The research focus of the group "Service Innovation & Management" (SIM) is the development and introduction of new forms of services, which gain an important role in a future, increasingly service-oriented economy. The research group sees the unique potential of services in the co-creation of value among partners. This is based on the conviction that economic value – driven by the rapid development of information and communication technology – is increasingly created and managed in value networks. Companies collaborate with customers and partners in order to jointly develop and offer services.

Three research topics enable the "service-oriented transformation" of companies:

Service Innovation and Transformation: Methods to capture new sources of value, in projects on methods and barriers for service innovation, customer integration and service design, on the impact of joint value creation on forms of work and business models, and transformation of companies from products to services.

Service Relationships: Management and engineering of complex service systems, with projects on decision support and coordination, on the design of interaction and communication, on key performance indicators, as well as on the measurement and management of productivity.

Service Analytics: Development of business analytics and optimization methods and tools tailored to the specific characteristics of services- led business models. Focus on the identification, analysis and interpretation of patterns in service value networks and service encounters.

Research projects

Service Innovation Lab (SiNLAB)

The Service Innovation Lab (SiNLAB) was initiated as a platform for joint research between industry and academia on disruptive innovation of services and business models. As innovation processes in a service context differ from established models, and many service-specific challenges have not yet been answered by research, the research group follows Lewin's "Action Research" approach to examine service innovation in tion with industry partners.

Since understanding service-specific innovation mechanisms is essential for the successful introduction of new, competitive services (see BMBF project "Service Innovation and Methods"), the SiNLAB ventures to explore and provide practical insights and solutions.

The Service Innovation Lab provides a "shared space" for the exchange of knowledge between practitioners, students and researchers from which all participants can benefit. Introducing the research results into the business environment of the project partners enables us to derive new insights and methods with direct practical impact. Through this approach, companies receive valuable innovation impulses, students gain practical experience in the adaptation and application of innovation methods, and relevant research topics can be examined from economic, organizational, technical, and human behavior perspectives. In addition to the research projects, the SiNLAB also offers customized trainings and workshops to industry.
Further information: http://sinlab.ksri.kit.edu

Customer Intimacy Analytics

The ability to capture customer needs and to tailor the provided solutions accordingly, also defined as customer intimacy, has become a significant success factor in the Business-to-Business space - in particular for increasingly "servitizing" businesses. Providers aim at achieving competitive advantages by leveraging customer relationships and customer knowledge. However, the growing importance of customer intimacy has not been sufficiently taken into account in current IT solutions. Particularly, the management of customer intimacy lacks analytical support and, therefore, many organizations struggle with measuring and proactively managing the degree of customer intimacy established with their customers.

The research project Customer Intimacy Analytics aims to remedy this issue by providing an analytical solution to assess and monitor the achieved customer intimacy, as well as its business impact. Customer Intimacy Analytics leverages operational customer related data such as interaction, project, and revenue data to derive and visualize customer intimacy performance indicators. This approach can be used in order to assess the degree of customer intimacy established by a provider with its customers at the employee and organization levels. In addition, the approach allows a ranking and benchmarking of the different customers, thereby supporting the provider with regard to its future customer investments.

Research Groups

DISCRETE OPTIMIZATION AND LOGISTICS (DOL)

Head:
Prof. Dr. Stefan Nickel

Group description

The research group Discrete Optimization and Logistics (DOL) of Prof. Dr. Stefan Nickel focuses on the systematic conception, development and application of mathematical models for process optimization. Relevant processes can be found in different domains such as industrial logistics or healthcare. Different operations research (OR) methods exist, e.g. combinatorial or stochastic optimization approaches, which can be applied depending on the specific research question.

Healthcare logistics is the main research topic of the group at KSRI. Here, problems regarding process optimization and in-house logistics in the healthcare sector are investigated. In order to improve quality, transparency and profitability of patient services on a long-term basis processes have to be analyzed and adapted if necessary. OR offers numerous methods that may lead towards significant improvements not only in an industrial environment but also in hospitals, care or telemedicine services and healthcare networks. One characteristic of this field of application is that not only profitability but also quality of treatment and patient satisfaction have to be focused on. Different challenges comprise the planning of operating rooms, patient transportation, staffing, shift/roster design and allocation as well as layout planning, rescue service or territory planning.

Research projects

Layout planning in hospitals

The spatial organization within hospitals directly influences both the quality and effectiveness of healthcare and secondary services. A hospital layout is regarded as a long-term result and, therefore, the underlying hospital layout planning problem is classified as a resource capacity planning problem on a strategic level. Thus, in current practice static hospital layouts are developed by architects having expertise in designing healthcare facilities. They know the appropriate legal regulations and follow the instructions and requirements of the invitation to tender. Usually neither logistic experts are involved nor quantitative methods used to achieve a systematic decision support during the planning process. This practice might have a negative impact on hospital processes after the layout is realized. To close this gap, a mathematical model is developed that uses clinical pathway data as parameter. In a first step, paths and distances that patients cover during their hospital stay are analyzed. In the second step, the aggregated data can then be used as input for the layout planning model. There, the objective is to minimize covered distances of patients. Hence, the developed layout increases the process efficiency and, consequently, the quality of care without interfering in medical decisions and operations. The dynamic healthcare environment is taken into account by a multi-period approach. Thus, for example, new treatment processes or changing demands for different sizes of patient rooms are considered.

Emergency logistics in Germany – models and processes

The German Emergency Medical Services (EMS) system is very complex. The federal states in Germany are responsible for the planning and coordination of the EMS and every state has its own law for it. Besides, the EMS system contains not only emergency rescue, but also patient transport, the coordination of the on-duty medical unit and much more.

One main planning problem is to determine the locations of ambulances together with the needed numbers. In contrast to countries like Canada for example, in Germany OR methods for determining ambulance locations are rarely used despite the large amount of literature and the positive feedback from other countries already applying them. That is why one main focus of this work lies on developing ambulance location and relocation models adapted to German regulations and requirements.

Besides, the patient transport as part of the emergency medical service might be considered as well. The analysis will be extended to the control centers and their emergency areas.

The approach is first to analyze well-known models from the literature according to their applicability for the German healthcare system. The goal is also to develop new models and to outline potential enhancements.

Research Groups

SOFTWARE DESIGN AND QUALITY (SDQ)

Head:
Prof. Dr. Ralf Reussner

Group description

The research group „Software Design and Quality“ (SDQ) of Prof. Dr. Ralf Reussner is working on an engineering approach to software design. The interdependency of software architecture, software components, model-driven development and software quality is the core competence of the research group. In particular, the group focuses on methods for systematic prediction of quality properties of software such as performance and reliability based on software architecture. Existing models like Petri nets, queuing theory and Markov models are leveraged and extended to create reliable quality prediction methods. The Emmy Noether research group "Descartes" of Dr.-Ing. Samuel Kounev which is integrated in SDQ is working on novel methods, techniques and tools for the engineering of so-called Self-Aware IT Systems and Services including among other things research questions from the area of Cloud Computing:

- Resource reservation in Cloud Computing
- SLA Management
- Benchmarking of software systems and services
- Monitoring and Analysis of software systems
- Automated model extraction, their calibration and maintenance
- Performance prediction (throughput, response time, etc.) of complex software systems
- Reconfiguration of software landscapes regarding cost- and energy optimization

Research projects

RELATE FP7 Marie Curie ITN

The FP7 Marie Curie Initial Training Network “RELATE” provides an opportunity for young researchers to study the latest technologies, platforms and tools in the area of engineering and provisioning of service-based Cloud applications. The ITN consists of seven leading European research institutes and five associated partners. Through an integrative and multidisciplinary research approach, RELATE promotes the advancement of the state-of-the-art in the related areas of model-driven development of Software-as-a-Service (SaaS) applications, formal methods, service-based mash-ups and application integration, security and performance of SaaS applications, as well as quality management and business model innovation.

Autonomic Performance and Resource Management in Dynamic Service-Oriented Environments

Modern enterprise systems based on the Service-Oriented Architecture (SOA) paradigm have dynamic architectures composed of loosely-coupled services that operate and evolve independently. Managing system resources in such environments to ensure acceptable end-to-end application performance and efficient resource utilization is a challenge because new services are composed and deployed on-the-fly subjecting the system components to unpredictable workloads. Due to the inability to keep track of dynamic changes in the system environment and predict their effect, today’s SOA systems often exhibit poor performance and resource efficiency, and have high operational costs.

The aim of the project is to develop a novel methodology for building and managing self-aware service-oriented systems. Such systems will be aware of changes that occur in their environment and will be able to predict the effect of such changes on their performance. They will automatically adapt to ensure that system resources are utilized efficiently and performance requirements are continuously satisfied. This vision is realized by means of online performance models generated dynamically from the evolving system configuration and used for autonomic performance and resource management. The project is funded by the German Research Foundation (DFG).

Research Groups

KNOWLEDGE MANAGEMENT (WIM)

Head:
Prof. Dr. Rudi Studer

Group description

The research group „Knowledge Management (WIM)" is one of the leading groups in the research area of semantic technologies worldwide. The group develops methods and tools for (1) supporting knowledge management within large enterprises, (2) creating the foundation of the Semantic Web and (3) for intelligent management and usage of Web-based services and processes.

Major research questions encompass on service-oriented information and application integration, automated deduction of new knowledge about services and processes, the seamless integration of methods of Web 2.0 as well as of the Semantic Web, and intelligent access to existing knowledge. The research activities of the research group at KSRI focus on intelligent management and exploitation of processes and services by addressing questions such as service discovery and ranking, service composition, semi-automated acquisition of service and process description, and service and data usage policies. The research results from the wide range of topics are implemented, evaluated and integrated within the suprime software framework.

Research projects

WisNetGrid – Knowledge Networks in the Grid

Current D-Grid infrastructure supports primarily the processing of data on technical level. The actual content such as documents, images, know-how and algorithms are created, managed and used only within individual communities, and are usually not available for use in cooperative and cross discipline research and business activities.

The goal of the WisNetGrid project is to create a common service layer and a common knowledge space for the D-Grid community. The service layer built on virtual technical hardware resources of the D-Grid will allow D-Grid communities, e.g. knowledge networks for environment and text grid from humanities, to use common data and service offers with the possibility to connect them to the community-specific knowledge to achieve generic and specialized service extensions as well as the use and expansion of value-added generic knowledge processing procedures. In particular, the WisNetGrid service layer will develop methods and tools for (1) provision of services for the integration and networking of data and associated metadata resources, (2) integration of data services on the technical layer of common hardware and middleware resources of the Grid, and (3) connecting the knowledge into a common "knowledge space" with opportunities for knowledge extraction, search and navigation.

S-Cube – Software Services and Systems Network

An integration of research expertise and an intense collaboration of researchers in the field of software services and systems are needed to address (1) Research fragmentation: The fragmentation of current research activities (e.g., grid computing, software engineering) leads to the problem that proposed solutions are not aligned with or influenced by activities in related research fields, and (2) Future Challenges: One of the key features of service-based systems is their adaptability to the changing environment. In order to preserve this advantage, changes need to be constantly detected and addressed.

The project S-Cube, a European Network of Excellence in software services and systems creates and establishes an integrated, multidisciplinary and active research community. S-Cube aims at revolutionizing the software services and actively shaping the development of software service based Internet, which is the basis for an interactive digital society. As concrete project objectives S-Cube pursues (1) re-shaping and integrating research agendas of key European researchers, leading to a long-lasting foundation for research and innovation at the highest level, (2) inaugurating a Europe-wide common program of education and training for researchers and industry, (3) establishing a pro-active mobility plan to enable the integration of research communities and a common software services research culture, and (4) establishing trust relationships with industry to shape European research and strengthen industrial competitiveness.

Research Groups

INFORMATION & MARKET ENGINEERING (IM)

Head: Prof. Dr.
Christof Weinhardt

Group description

The research focus of the group "Information & Market Engineering" (IM) is the co-creation and further development of the research streams information engineering, service science and market engineering. The goal of the group is to foster research in these areas and to establish these topics in the scientific community and apply them in projects with industry partners. In particular, the researchers concentrate on economic methods and concepts, which can be applied in Service Science. Methods from mechanism design, incentive engineering and decision support are harnessed and evaluated in prototypes.

Selected topics of the group are:

- Incentive design in Service Provisioning scenarios with social context
- Social Clouds: Cloud Computing in social networks
- Dynamic pricing of Cloud services in different scenarios through the application of methods from Revenue Management and Mechanism Design
- Decision support for the establishment of risk minimal Service Level Agreements
- The application of Autonomic Computing principals to Market Engineering

Research projects

ValueGrids

The ValueGrids project opens up the German Grid Initiative (D-Grid) for a new Cloud-aware scientific community, i.e. Software-/Infrastructure-as-a-Service. Today, complex offers can already be customized at the individual level to satisfy diverse requirements. However, specific requests and dynamic demands force the modularization of services from various providers and their combination in a flexible and cost-efficient manner. ValueGrids focuses on value chains which are characterized by a well-defined sequence of process steps aimed at achieving high-level value generation. In the context of increasingly dynamic business networks, the established sequences of process steps are replaced by short-lived collaborations of service providers. Thus the value chains evolve into a dynamic value network of decentralized actors.

Service Level Agreements (SLAs) represent the basis for a complete specification of services including functional, non-functional and cost aspects. Within the ValueGrids project, a decision support tool chain for the integration of networked service providers and the flexible management of value networks based on SLAs is developed to enable more informed economic decisions. Such decisions entail service quality, procurement as well as brokerage risk and the quantities of data needed for decision making.

Social Cloud

The pervasiveness of social network platforms (e.g. Facebook) has profoundly changed how humankind communicates and interacts today, e.g. in virtual platforms and communities, but also to represent, document and explore inter-personal relationships digitally. In parallel, our capabilities and resources are dramatically increasing and mean that many Internet connected users have significant resource endowments that are underutilised. Volunteering computing has taught us that at the edges of the Internet resource owners are willing to make their resources available for "good uses" altruistically. Consider that the average Facebook user has 130 friends, immediately a large connected network of resources based upon social relationships begins to present itself.

Social Clouds (resource and service sharing frameworks that utilize relationships established between members of a social network) have been defined to address these observations. They provide an environment in which (new) provisioning scenarios can be established based upon implicit levels of trust that transcend from inter-personal relationships digitally encoded within social network platforms. Their vision is motivated by the need of individuals or groups for specific resources or capabilities that could be made available by connected peers and peer groups. In simple words: Social Clouds use social networks as mechanisms for efficient collaboration, as users leverage their existing networks to share capabilities and resources. Such resources are not necessarily only computational resources, but can be any electronically consumable service, including human resources, skills and capabilities.

To address the many research challenges in this domain an interdisciplinary approach is essential. The Social Cloud research agenda therefore leverages methods and expertise in the broad areas of Computer Science, Economics and Sociology.