

Service Science, Management, Engineering and eOrganisations

KIT – Karlsruhe Institute of Technology, Universität Karlsruhe (TH)

Position Paper

Christof Weinhardt

Universität Karlsruhe (TH)
weinhardt@iism.uni-karlsruhe.de

Carsten Holtmann

FZI Research Center Information Technology
holtmann@fzi.de

Anupriya Ankolekar

Universität Karlsruhe (TH)
ankolekar@aifb.uni-karlsruhe.de

Rudi Studer

Universität Karlsruhe (TH)
studer@aifb.uni-karlsruhe.de

Björn Schnizler

Universität Karlsruhe (TH)
schnizler@iism.uni-karlsruhe.de

Nenad Stojanovic

FZI Research Center Information Technology
nstojano@fzi.de

SERVICES SCIENCE AND ENGINEERING

While the Anglo-Saxon countries are known for their well-developed services sector, continental Europe has traditionally focussed on designing and developing top-quality industrial products. However, there is reason to believe that Europe, especially Germany, can emerge as a strong force in the area of service engineering.

- i. Product engineering, and engineering in general, has always been a core research focus at most German universities. Since, a substantial number of existing (and future) services are and will continue to be closely related to physical products, service engineering for such kinds of services is a natural extension of product engineering.
- ii. Interdisciplinary work and education, as required for service engineering, is well established in German universities and research institutions, as the technology region Karlsruhe successfully illustrates. They have also been successful at transferring research knowledge into the industrial engineering of physical products.
- iii. Despite the relative emphasis on physical products, Germany already ranks second in global service quality [1]. Thus German industry is already able to deliver high quality products and services, in particular, because of the well-developed engineering

culture in companies as well as at universities.

Here, we have focussed on Germany, but much of the above also holds for other European countries. As Germany is well-known for the quality of its products, other European countries are also leaders in various aspects of engineering. For example, France and Italy are well-known for their product design and Scandinavia for its work in product quality and security.

Due to its long and rich background in product engineering, continental Europe and Germany especially can emerge as a strong force in service engineering. In particular, because much of the methods toolkit currently applied in service design and engineering builds upon traditional engineering methods. SSME only will be successful in the future if both areas are closely intertwined in interdisciplinary institutions, teams, and projects. In this position paper, we present the institutions, projects and educational structures in place at our institution, KIT in Karlsruhe, Germany, for services research.

SERVICES RESEARCH IN KARLSRUHE

KIT (Karlsruhe Institute of Technology), one of Europe's largest research institutions is the result of the integration of the Universität Karlsruhe (TH) and the Forschungszentrum

Karlsruhe (FZK), two well-known institutions combining world-class research in the area of engineering and international interdisciplinary cooperation. With 8.000 employees and a yearly turnover of about € 600 million, KIT competes with global research institutions. Research in KIT is focussed on natural and engineering sciences, as well as on interdisciplinary work with additional sciences, such as economics, sociology and law.

One of KIT's five major research areas is 'Information, Communication and Organisation' with the subfield 'Organisation and Services Engineering'. An important cadre for this research field is the scientific alliance 'eOrganisation', under whose auspices the new Karlsruhe 'Centre of eOrganisation and Service Sciences' is going to be established. A critical success factor for SSME – and simultaneously the core task for the multiple institutes involved – is understanding the nature and the embedding of services in innovative forms of organisations and networks.

In order to transfer goal-oriented fundamental research into practical application, know-how transfer between industry and research has to be accompanied by a mutual knowledge exchange process. Thus, requirements from industry have to be fed back into research, focussing on problems that are critical for improving the competitiveness of individuals and enterprises in society. Several institutions in Karlsruhe, are involved in transferring research and technology into industry, such as, e.g., the FZI Research Centre for Information Technology in the area of innovative information technology.

SERVICES SCIENCE – INTERDISCIPLINARY RESEARCH

The vision of the scientific alliance eOrganisation is that eOrganisations will play a central role in the future of any area of society. eOrganisations are organisations, where tasks, competencies and/or responsibilities are (at least) partly delegated by human beings to technical units that perform their actions through electronic media. These units are a

means to provide services for humans, but they themselves may consist of services coupled by possibly complex relationships. In order to realize eOrganisations, research on three closely related levels is required:

- the *service-driven applications level* (with corresponding knowledge of the domain and its economic models),
- the level of flexible, adaptive *services, components and models* (with high degrees of freedom with respect to their application possibilities), and
- the stable, highly-scalable, foundational level of the technical infrastructure and regulatory conditions – referred to as a *service substrate*.

The research vision is to drive services science by basic and applied research in and between all of these levels. This allows for enhanced and distributed service scenarios with autonomous, partly technical, units that share common targets but may also have potentially conflicting goals. The main concern is to enable eOrganisations to handle technical, economic and sociological challenges in spontaneous coordination and collaboration.

Related research in Karlsruhe is mainly based on a long experience in and a vast knowledge of the fields of coordination mechanisms, incentive engineering and semantic technologies, to name just a few of the technologies needed in the area. As a vivid and successful example for service engineering research, we present "computer aided market engineering", one field in Karlsruhe that exceptionally integrates those competencies [2].

Computer Aided Market Engineering

Deviating from a purely economic view, where markets are primarily conceived of as abstract mechanisms, we treat the existence of an electronic market as a result of a structured engineering process and the use of electronic markets as a complex service. The process of

consciously designing markets as services, called “market engineering”, is obviously an interdisciplinary challenge: it involves designing the market structure by providing methods and tools for all design steps, from initial economic and legal design ideas to technical implementation, testing and roll-out, as well as redesign during runtime. The integrated computer-aided market engineering (CAME) workbench, meet2trade, strives to automate and support these procedures, from the design of the market mechanism and complementary services, to the implementation[3], [4], [5].

CAME is a SSME approach and the meet2trade workbench showcases an integrated outcome of service sciences, management and engineering. CAME and meet2trade have already been applied in several well-recognized research projects:

- (i) **EFIT** (Federal Ministry for Education and Research (BMBF), 2002-2006): development of a generic market workbench,
- (ii) **STOCER** (BMBF, 2005-2007): international forecasting market for the soccer World Cup 2006,
- (iii) **SESAM** (BMBF, 2004-2007): design and development of distributed and spontaneous electricity markets, and
- (iv) **SORMA** (EU, 2006-2009): design and development of a platform for dynamic trading of ICT resources.¹

Additional SSME Research in Karlsruhe

Service Ecosystem (SE): Services ecosystems, like ecosystems in nature, are networks of co-existing elements that depend on each other for survival. The dynamic changes in business environments require efficient approaches for service integration of multiple systems. Research on SE and enabling technologies has

been performed in the scope of the project **Digital Business Ecosystems** (EU, 2003-2006) and will likely be continued in **QUAERO** (BMWI, 2007-2012).

Strategic Service Management/Planning (SSM): Our initiative sees SSM as an approach for acquisition, representation, analysis and validation of organizational strategic knowledge. SSM enables not only the vertical information integration needed for boosting innovations, but also a simplified interaction and automatic negotiation between business partners. This research has been performed in the scope of the **SAKE** project (EU, 2006-2009) that aims to develop methods for the formalization of strategic knowledge.

Service Innovation (SI): SI is a multidisciplinary approach for managing the whole innovation cycle, from generating ideas to assessing them economically. It represents a lengthy, interactive and social process embedded in the legal, economic and social environment, **QUAERO** (BMWI, 2007-2012) will fund cooperative work in this area with additional German experts.

Change Management in Services (CM): CM stands for an integrated approach for discovering, implementing and propagating changes in complex systems. CM serves as a mechanism to close the loop in the usage of a service, i.e. to support its self-adaptivity. This research is performed mainly in the scope of the following projects: (i) **OntoGov** (EU, 2003-2006), aiming at developing methods and tools for managing changes in law and regulation, (ii) **FIT** (EU, 2006-2009), for developing methods and tools to customize existing eGovernment services to user preferences by learning from usage.

EDUCATING KNOWLEDE WORKERS

The Universität Karlsruhe (TH) in KIT offers several different study programs, which address a wide area of SSME-related topics.

The first pillar of the programs are the **bachelor and master programs on 'Industrial**

¹ See also <http://www.iw.uni-karlsruhe.de/DesktopDefault.aspx/tabID/38/lang/en>

Engineering and Management’, ‘Computer Science, and ‘Information Engineering and Management’. Each of the programs has just received the top position in several university rankings once again. Within the programs, the strengths of the technical university come into play: the high experience in different kinds of engineering disciplines on a well-founded mathematical basis is combined with computer science, economics, and operational management. The courses on ‘Industrial Engineering and Management’ and ‘Computer Science’ integrate traditional engineering methodologies with economics, management and informatics. Complementary to this, the ‘Information Engineering and Management’ program focuses on an interdisciplinary view on computer science, economics, strategic and operational management, and law. The goal of this program is to organize the usage of information as an economic good and competition success factor. In particular, the program teaches students how to (i) analyze and manage internal information services in companies, (ii) establish and evaluate complex information systems, and (iii) facilitate efficient and effective user interaction with information services. The program’s graduates qualify as service scientists and engineers.

To expand the existing programs towards a more holistic view on eOrganisation and service engineering, there will be two new industry-sponsored professorships. These professorships will be dedicated to research and teaching in these new fields. Furthermore, a new cross-faculty study program on ‘Service Sciences and Engineering’ has already been requested at the regional authority.²

To complement the bachelor and master programs, an **international and interdisciplinary PhD program on**

² In Germany study programs have to be requested by the universities’ president and approved by the responsible ministry. The program is now in permission phase.

‘Information Management and Market Engineering’ is the second pillar of the SSME-related study program. This graduate school addresses topics from an interdisciplinary point-of-view, comprising computer science, law, operational research, economics, and business administration. The purpose of the school is to investigate interdisciplinary and problem-oriented approaches to all aspects of electronic markets and services, with special emphasis on the role and power of information.

Finally, the third pillar is the **Hector School of Engineering and Management, an executive master program.** The school provides technological, management, and leadership training, working closely with leading German companies. A closer cooperation with the executive master program at the Carnegie Mellon's Tepper School of Business in Pittsburgh is planned to strengthen the international study program on SSME-related topics.

IN THE YEAR 2020 ...

... our economies will have changed significantly. Currently novel phenomena will have made their way to everyday life. The amount and role of services – be they between humans, between human and technical units or only among technical units – will have increased tremendously. IT-based service design, provision, delivery, monitoring and improvement will be a necessity and SSME will have to cope with the methodological, technological and social challenges of this.

The success of SSME critically depends on how we can create and transfer new knowledge from science to industry and vice versa. And of course, although the ways we manage our knowledge will be different in the future, it will be crucial to educate people of all ages lifelong by applying new teaching and learning approaches.

Scientific institutions depend on the support of the industry: on the one hand, industry has to

support the identification of business-critical problems; on the other hand, the industry will have to provide necessary technical infrastructures and financial support for research and education. Joining forces in research and knowledge exchange centers will be the way to cope with challenges while realizing synergies for all parties.

CONCLUSIONS

SSME arises from the integration and interaction of the core disciplines of engineering, economics, management and cultural sciences, sociology, and law. Therefore, the future and success of SSME crucially depends on an integrated and interdisciplinary effort. Integrating different and complementary methodologies will enable us to further develop innovative solutions. New ways of designing and running businesses will shape the future. SSME will have to anticipate them to cope with the challenges of an IT-based services age.

KIT, the Karlsruhe Institute of Technology, has already set up organizational structures to address these challenges. Due to its solid foundation in engineering sciences, KIT, among many European institutions, is uniquely positioned to contribute to SSME.

REFERENCES

1. IMPULS (2004): Interview with R. Berger and J. Weihen, Partner for Innovation, 12/2004, p. 9.
2. Ch. Weinhardt, D. Neumann, C. Holtmann (2006), "Computer-Aided Market Engineering – A Service Engineering Approach". In: Communications of the ACM, 49/7, p. 79.
3. B. Schnizler, D. Neumann, D. Veit, Ch. Weinhardt (2006), "Trading Grid Services - A Multi-attribute Combinatorial Approach". In: European Journal of Operational Research, forthcoming
4. S. Lamparter, A. Ankolekar, D. Oberle, R. Studer, Ch. Weinhardt (2006), A Policy Framework for Trading Configurable Goods and Services in Open Electronic Markets. In: Proceedings of the 8th Int. Conference on Electronic Commerce (ICEC'06). Fredericton, New Brunswick, Canada, August 2006.
5. S. Lamparter, A. Ankolekar, R. Studer, Ch. Weinhardt (2006), "Towards a Policy Framework for Open Electronic Markets". In: Thomas Dreier, Rudi Studer and Christof Weinhardt, Information Management and Market Engineering, Volume 4 of Studies on eOrganisation and Market Engineering, pp. 11-28. Karlsruhe, 2006.