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FRAUNHOFER INSTITUTE FOR EXPERIMENTAL SOFTWARE ENGINEERING IESE

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THE FRAUNHOFER INSTITUTE FOR EXPERIMENTAL SOFTWARE ENGINEERING IESE

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Software is a part of our lives. Embedded into everyday equipment, into living and working environments or modern means of transportation, countless processors and controllers make our lives simpler, safer, and more pleasant. We help organizations to develop software systems that are reliable in every aspect, and provide empirical proof of the necessary processes, methods, and techniques, emphasizing engineering-style principles such as measurability and transparency.

Fraunhofer IESE is one of the worldwide leading research institutes in the area of software and systems development. A major portion of the products offered by our collaboration partners is defined by software. These products range from automotive and transportation systems via automation and plant engineering, information systems, health care and medical systems to software systems for the public sector. Our solutions allow flexible scaling. This makes us a competent technology partner for organizations of any size – from small companies to major corporations.

Under the leadership of Prof. Dr. Dieter Rombach and Prof. Dr.-Ing. Peter Liggesmeyer, the past decade has seen us making major contributions to strengthening the emerging IT location Kaiserslautern. In the Fraunhofer Information and Communication Technology Group, we are cooperating with other Fraunhofer institutes on developing trend-setting key technologies for the future.

Fraunhofer IESE is one of 60 institutes of the Fraunhofer-Gesellschaft. Together we have a major impact on shaping applied research in Europe and contribute to Germany's competitiveness in international markets.

Editorial Notes

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EDITORIAL

INNOVATION AND COMPETITIVENESS THROUGH DEPENDABLE SOFTWARE

Dear reader,

In all branches of industry, innovations are increasingly driven by software. If you want to stay ahead of your competitors, you will need innovative software and the leading expertise available in your domain in terms of software development. Dependable software requires professional development processes. During the course of many years, Fraunhofer IESE has established itself as a competent and reliable partner for companies from all sectors of industry regarding the subject of "Software Engineering". We offer highly innovative methods and tools for the software development of embedded systems and information systems as well as process know-how for the successful introduction of such methods and tools.

Last year, we increasingly directed our attention to the ever more important relationships between embedded systems and information systems (so-called cyber-physical systems). Examples of such systems can be found in the automotive sector, in health care, as well as in energy management. In our Living Labs you can see how future solutions are being generated for these industries.

In 2010, we drastically increased our preliminary research in embedded systems and information systems through our collaboration in the BMBF beacon projects SPES2020 and VIER-

forES (for embedded software) as well as in the project ADiWa and in the software cluster "Software Innovations for the Digital Enterprise" (for information systems). Collaboration in these projects is open to additional companies. The settlement of the European Technology and Innovation Center of the agricultural machinery manufacturer John Deere in Kaiserslautern was a highlight of our industrial collaborations. This is not only a complement for our competence, but has also led to a strategic partnership with the potential for further growth.

We are facing the future with optimism and ready for action. We have many ideas for new projects with our collaboration partners and those wanting to cooperate with us in the future. IESE enjoys an excellent reputation all over the world. This is reflected in the rising numbers of international collaborations with partners from science and industry. In the USA, Australia, and Brazil, we have already founded centers. You, too, can become a partner of IESE! Make use of our competence and benefit from our international network. We will support you on your way towards more innovation and competitiveness through dependable software!

We hope you find this report both informative and inspiring –

Dieter Rombach

Peter Liggesmeyer

Prof. Dr. Dieter Rombach   *Prof. Dr. Peter Liggesmeyer*

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PROFILE OF FRAUNHOFER IESE

HIGHLIGHTS IN 2010

INNOVATIONS IN MATHEMATICS AND COMPUTER SCIENCE IN KAISERSLAUTERN

A new "Innovation Center" in Kaiserslautern bundles the competencies of the University of Kaiserslautern (TU) and the two Fraunhofer Institutes for Experimental Software Engineering (IESE) and for Industrial Mathematics (ITWM) in applied mathematics and computer science.

This will make it even easier to work on high-quality development contracts from industry and to raise funds for outstanding research projects. Kaiserslautern will thus become even more attractive for young scientists working on innovative issues of the future that can only be answered using mathematics and computer science. Michael Ebling, State Secretary at the Ministry of Education, Science, Youth and Culture, and Professor Ulrich Buller, Senior Vice President Research Planning of the Fraunhofer-Gesellschaft, opened the new center on 19 February 2010. The state and the Fraunhofer-Gesellschaft will fund this project, which is initially planned for four years, with 6.4 million euros each.

The Innovation Center is a novel type of cooperation between the University of Kaiserslautern and the Fraunhofer institutes. "Complex issues such as those arising in mathematics and computer science particularly in the context of engineering applications can be solved best by collaborating across institutions. The Innovation Center is an ideal model for this", said Ebling, who represented science minister Doris Ahnen. A Fraunhofer section located on the campus of the TU will also be integrated into the new center. Here, experts are working on Terahertz radiation, which is used, among other things, in body scanners. "Now, all Fraunhofer institutions are combined under the umbrella of the Innovation Center on the one hand, and the integration of university basic research and optical technologies has been achieved on the other hand", underlined Ebling.

For Professor Ulrich Buller, the rapid transfer of research results into practice is most important. Overall, about 3 million euros in revenues acquired from third parties as a result of projects and industrial contracts are planned. "Especially companies will benefit from this interdisciplinary collaboration. They can use the bundled know-how of the cooperation partners in order to realize new ideas faster in their products", said Buller.

Kaiserslautern is a success story for both the state and the Fraunhofer-Gesellschaft. The achievements of the two Fraunhofer institutes ITWM and IESE, which have already received two awards in the competition "Germany – Land of Ideas", are outstanding. Both institutes together have led to the creation of almost 650 mostly highly skilled jobs in Kaiserslautern. The recent success in the Germany-wide "Spitzencluster" (cluster of excellence) competition is further evidence. The city with its two universities and seven independent research institutes is a center of science in Rhineland-Palatinate. The scientific institutions in Kaiserslautern do not only offer scientific services, problem solutions, and academic education and training, but are also the incubators for start-up businesses in the area of high-tech and cutting-edge technology.

How attractive the region is for numerous industries is exemplified by the commercial vehicle technology domain. For Dr. Thomas Engel, manager of John Deere AMS, the new Innovation Center once more confirms that his decision to come to the research hub Kaiserslautern was right. "The concept of the Innovation Center will promote the already good connections between applied research and basic research even more than before and represents an attractive collaboration offer for our company", emphasized Engel.

The importance of the Innovation Center for companies working with embedded software systems was stressed by Reinhold Achatz, Manager Corporate Research and Technologies at Siemens. "For many companies, the Innovation Center is an attractive offer in terms of research and development. This new bridge between basic research and applied research will make it possible to achieve the necessary acceleration in developing innovations", stated Achatz.

Johannes Heger, managing associate of HegerGuss GmbH from Enkenbach-Alsenborn, welcomed the bundling of activities in the new Innovation Center. "As a foundry located in Germany, we sell engineering performance every time we sell a cast part. This is our criterion for success in global competition. Engineers think in mathematical terms and talk in the language of computer science. Our eyes and our minds need visualization and success that is quickly verified by simulation", said Heger. He hopes that "the achievements of science will first manifest themselves as the success of a small or medium-sized enterprise and will then be able to guarantee secure jobs in manufacturing and production".

The State Secretary underlined the importance of science for the region: "The development of the science hub Kaiserslautern shows that investments into research and academia are investments into the future". According to Ebling, "the universities and research institutions are making invaluable contributions to the region's economic performance and especially to securing and creating high-quality jobs".

Software-Cluster

EUROPE'S LARGEST SOFTWARE CLUSTER: OVER 80 MILLION EUROS FOR RESEARCH

In January 2010, German Federal Research Minister Annette Schavan announced the winners of the second round of the "Spitzencluster" (cluster of excellence) competition. The five winners will be funded by the German Ministry of Education and Research (BMBF) with a total of up to 200 million euros over five years. The winners of the competition also include Europe's largest software cluster "Software Innovations for the Digital Enterprise".

The cluster is considered the "Silicon Valley" of Europe and extends across the centers Darmstadt, Kaiserslautern, Karlsruhe, Saarbrücken, and Walldorf. In six projects, both the cluster itself (management, networking, international presence, continuing education and training, exploitation) and the technological and methodological research and development of software solutions for the digital enterprise shall be advanced. These projects alone have a total volume of over 80 million euros. Some of the other goals include the training of 5,000 specialists within five years, the founding of 30 companies in the core area of the cluster, and the settlement of leading foreign companies in the cluster region. With this funding by the Federal Research Ministry, the partners intend to further develop Europe's largest software cluster into a technology center with global significance. This decision by the federal government will strengthen the software industry in Germany. Current studies predict 430,000 new jobs in the software industry by the year 2030. Already today, software is considered a key technology for increasing value and productivity.

Prof. Dr. Dr. h. c. Dieter Rombach as the speaker for Kaiserslautern went to Berlin to present the cluster to the "Spitzencluster" selection committee. Rombach's comment on the positive decision made by BMBF: "Once again, the IT hub Kaiserslautern is involved directly in a strategic funding project of the federal government. The fact that it was our "Spitzencluster" model that was chosen is due not least to the renowned partners from our region."

As far as the scientific side is concerned, the regional cluster does not only include Fraunhofer IESE, but also Fraunhofer ITWM, DFKI, and the Department of Computer Science at the University of Kaiserslautern. In addition, many software and user companies are involved, such as Insiders Technologies GmbH, John Deere, Netbiscuits GmbH, proALPHA Software AG, SIEDA GmbH, SmartFactory KL e.V., as well as STI e.V. Kaiserslautern. The cluster is open for additional SMEs; this network will be organized via STI e.V. Kaiserslautern. Rombach continued: "We will all profit from this decision, since this international beacon will also contribute to an increased visibility of Kaiserslautern as a science, education, and business hub."

The ministry has organized this competition in order to strengthen Germany's innovation policy. Partners from science and industry shall be empowered to realize their ideas faster in new products and services and to make better use of their existing strengths. In the software cluster, both the major German producers of enterprise software, namely IDS Scheer AG,

The winners (from left to right): Prof. Fr. Dieter Rombach (Fraunhofer IESE), Karl-Heinz Streibich (Software AG), Prof. Wolfgang Wahlster (DFKI), Prof. Dr. Lutz Heuser (SAP), Prof. Dr. Johannes Buchmann (TU Darmstadt), Thomas Feld (IDS Scheer), Michael Kleeberg (Seeburger AG)

SAP AG, and Software AG, and over 350 small and medium-sized enterprises from the enterprise software domain, such as IMC AG, Seeburger AG, proALPHA Software AG, and intelligent views gmbh are represented.

The three leading computer science research centers (DFKI, Fraunhofer, FZI) and the renowned computer science departments of TU Darmstadt – represented by the LOEWE Center CASED –, of TU Kaiserslautern, of the Karlsruhe Institute of Technology, and of Saarland University will contribute their competencies in research, development, and education to the cluster. In the long term, the "Spitzencluster" wants to become the globally leading technology center in the area of emergent software for digital enterprises. Already today, the region is known as the "Silicon Valley" of Europe.

Emergent software dynamically and flexibly combines a multitude of components from different manufacturers in order to better fulfill the highly complex requirements of globalized enterprises. This software dynamically adapts to the requirements of the market as well as those of the business environment, supports complex and dynamic enterprise networks, and enables innovative services in the future Internet. The principle of emergent software is considered a key innovation for the digital enterprise and for the Internet of the future.

The goal is to enable the transformation of companies that so far have only been using IT as a tool to support their traditional processes into completely digital enterprises. In the future, both the national economies and the prosperity in our industry- and service-oriented society will depend on how well companies can position themselves as digital enterprises.

Further Information:
www.software-cluster.org

NICTA AND FRAUNHOFER IESE WORLDWIDE LEADING RESEARCHERS COMBINE FORCES

NICTA, Australia's Information and Communications Technology (ICT) Research Centre of Excellence, has signed a five-year agreement with the Fraunhofer Institute for Experimental Software Engineering (IESE) to establish the Fraunhofer Project Center on Transport and Logistics at NICTA's Sydney laboratory.

The agreement creates an immediate framework for joint research work to solve difficult problems in areas including transport and logistics, embedded systems, and software engineering. The two organizations are committing over AUS$11m to bring together their complementary skills and world-leading expertise in these areas.

"The Fraunhofer Project Center at NICTA joins outstanding talent from our two organizations. The possibilities that this will create for NICTA and Australia are truly exciting. Australia must be part of the global innovation system to build competitive advantage in technology and the broader economy, and this is a major step in that direction," NICTA Chief Executive Officer, Dr. David Skellern says. "In addition to NICTA's contribution to the Fraunhofer Project Center, Australia's New South Wales Government is providing funds – on top of their annual $5m contribution – to support establishing industrial projects," Dr. Skellern said.

"Fraunhofer IESE is interested in advancing the level of scientific and engineering know-how by working with leading scientists around the world. Australia has world-class capabilities and we will work together to deliver greater scientific results and generate breakthrough technologies for the market," said Professor Dieter Rombach, Executive Director of the Fraunhofer Institute for Experimental Software Engineering.

NICTA Senior Researcher Mark Staples will head up the Fraunhofer Project Center at NICTA. Dr. Mark Staples has both research expertise and business experience working in software engineering, software architecture, and business technology. He is the leader of NICTA's Software Infrastructure business area, and a Conjoint Senior Lecturer at UNSW with the School of Computer Science and Engineering.

"The agreement is a formal basis for research collaboration and brings together an impressive suite of international engineering, science, and business expertise to tackle real-world problems. We will draw especially on capabilities in embedded systems, software engineering and optimization methods," Mr. Staples said.

The Fraunhofer-Gesellschaft is the largest organization for applied research in Europe with a central role in the global ICT innovation system. Establishing a project center in Australia builds on their strong international reach throughout Europe, the U.S., and Asia.

COMMERCIAL VEHICLE TECHNOLOGY SYMPOSIUM AT TU KAISERSLAUTERN

The University of Kaiserslautern organized the 1st Commercial Vehicle Technology Symposium in Rhineland-Palatinate in co-operation with the two Fraunhofer Institutes for Experimental Software Engineering IESE and Industrial Mathematics ITWM as well as the Commercial Vehicle Cluster. Under the motto "Research Meets Industry", more than 250 commercial vehicle experts met from 16 to 18 March 2010 under the patronage of Minister President Kurt Beck.

The conference was opened in the evening of 16 March by Science Minister Doris Ahnen. On 17 and 18 March, there were more than 50 professional presentations and discussions about the current state of the practice in the areas of construction, production, calculation, electrics/electronics, and software technology in the commercial vehicle industry.

This conference, which is scheduled to take place every two years, offered national and international experts from research and industry a platform for exchanging experiences in the areas of trucks and buses as well as agricultural and construction machinery.

In an accompanying technical exhibit, suppliers showed current service respectively software and hardware products. In an outdoor exhibition area, examples of modern commercial vehicles were on display: a mobile crane from the Terex company, a GPS-controlled tractor from John Deere, and a hybrid dump truck of the FAUN company, for which test drives were offered.

On 18 March, there was also a so-called "Recruitment Date", which offered the chance to get information about career opportunities in this domain.

The organizers of this event were the Center for Commercial Vehicle Technology (ZNT) at TU Kaiserslautern, the Fraunhofer Innovation Cluster Digital Commercial Vehicle Technology (DNT), and the Commercial Vehicle Cluster – Nutzfahrzeug GmbH (CVC). The goal of these three organizations is to increase the competitiveness of the commercial vehicle industry in Germany via new technologies and experience exchange in networks. Examples of successful technology transfers were also shown in the technical exhibit.

Further Information:
www.cvt2010.de

DESIGNING THE INTELLIGENT APARTMENT

Rising energy prices and demographic changes – these are the two major challenges that we must face in the 21st century. They were also the topics of the kick-off event for the network "Intelligent Systems for a Better Life – InSeL", which took place on 26 April 2010 at the Fraunhofer Center in Kaiserslautern.

The aim of the newly founded network, which is funded by the federal government, is to establish a collaboration, science, and marketing platform that deals with a central overall system for the integrated control of intelligent and energy-saving apartments. To get closer to this goal, strong partners are needed, such as IHK Zetis GmbH. They will coordinate and handle the build-up of the open network, which started off with nine partners.

The founding members are Fraunhofer IESE, Gemeinnützige Baugesellschaft Kaiserslautern AG, F.K. Horn GmbH & Co. KG, Westpfalz-Klinikum Kaiserslautern GmbH, Binder Elektronik GmbH, ESF Software GmbH, Bauunternehmung Rheinheimer GmbH & Co. KG, TWK - Technische Werke Kaiserslautern, and CIBEK technology + trading GmbH.

Furthermore, the kick-off event was supported by the Handwerkskammer Pfalz.

Michael Lill, executive manager of IHK Zetis, said about the goals of InSeL: "IHK Zetis GmbH is a subsidiary of IHK Pfalz. For almost 20 years, we have been working on so-called "topics of the future", such as changes in the work environment or technological innovations. We also have many years of experience in setting up and coordinating regional networks. The project InSeL, however, is something very special for us. We are confident that setting the course early by realizing concrete development projects will provide a major competitive edge to the companies in this region".

Frank Bomarius, deputy director of Fraunhofer IESE, added this about the research institute's involvement in this network:

"In the context of the project InSel, Fraunhofer IESE sees itself as a creative developer of technologies and as an integrator. We have been working on innovative solutions in the areas of Ambient Assisted Living and energy management for many years already. In addition, we know the requirements and

expectations of very diverse stakeholder groups as well as the technical possibilities existing today and the perspectives for the future. We see ourselves as an element linking the worlds of housing business, planners and tradespeople, providers, caregivers and medicine, home automation technology, and end customers. The goal is to design, test, and evaluate new, technologically trend-setting solutions that can be implemented technically and that are economically feasible."

More than 50 visitors were fascinated by the visionary goal of the research and development work envisioned by the InSeL network. Many of them visited the technical exhibit of the network partners and took a guided tour of the Ambient Assisted Living laboratory, then used the subsequent snack to talk to partners of the network. After this successful kick-off event, all interested parties are now invited to participate in the upcoming follow-up events.

Potential partners for the network can contact Michael Lill or Marion Marschall-Meyer (both IHK Zetis) directly via www. zetis.de.

ZUSE Z23 – A COMPUTER WITH A PAST

On the occasion of the 100th birthday of computer pioneer Konrad Zuse on 22 June 2010, the Fraunhofer Institute for Experimental Software Engineering (IESE) and the Department of Computer Science of the University of Kaiserslautern opened their treasury on 8 July 2010 and presented Zuse's famous computer Z23.

In a brief ceremony, Horst Zuse acknowledged his father's lifetime achievements and dedicated the refurbished Z23 as an exhibit for future generations. This computer was an important milestone for the development of commercially manufactured computers, and only a few of them are still in existence today.

The Z23 computer is a permanent loan of TU Kaiserslautern to Fraunhofer IESE. The Z23 was put on exhibit to coincide with the "Zuse Year". The computer will be accessible to everybody in the context of future Open House and similar events.

ZUSE Z23

The Z23 computer was developed in 1958; serial production started in1961. The Z23 was the evolution of the well-proven Z22 in transistor technology. The Z23 computer boasted a magnetic drum memory with 8192 words at 40 bits each, a ferrite core memory, extensive peripheral equipment (punch tape and teletype writer), analog input/output devices (Bull, Ferranti, Siemens), magnetic tape storage system (AMPEX), and a compiler for German-language Zuse formula code.

98 computers were sold at prices starting from 180,000.00 DM (about 92,000 euros). The Z23 was the most common transistor computer in Germany.

Prof. Dr.-Ing. Horst Zuse and Dr. Reinhard Kirchner, TU Kaiserslautern, present the Zuse Z23 in the atrium of Fraunhofer IESE.
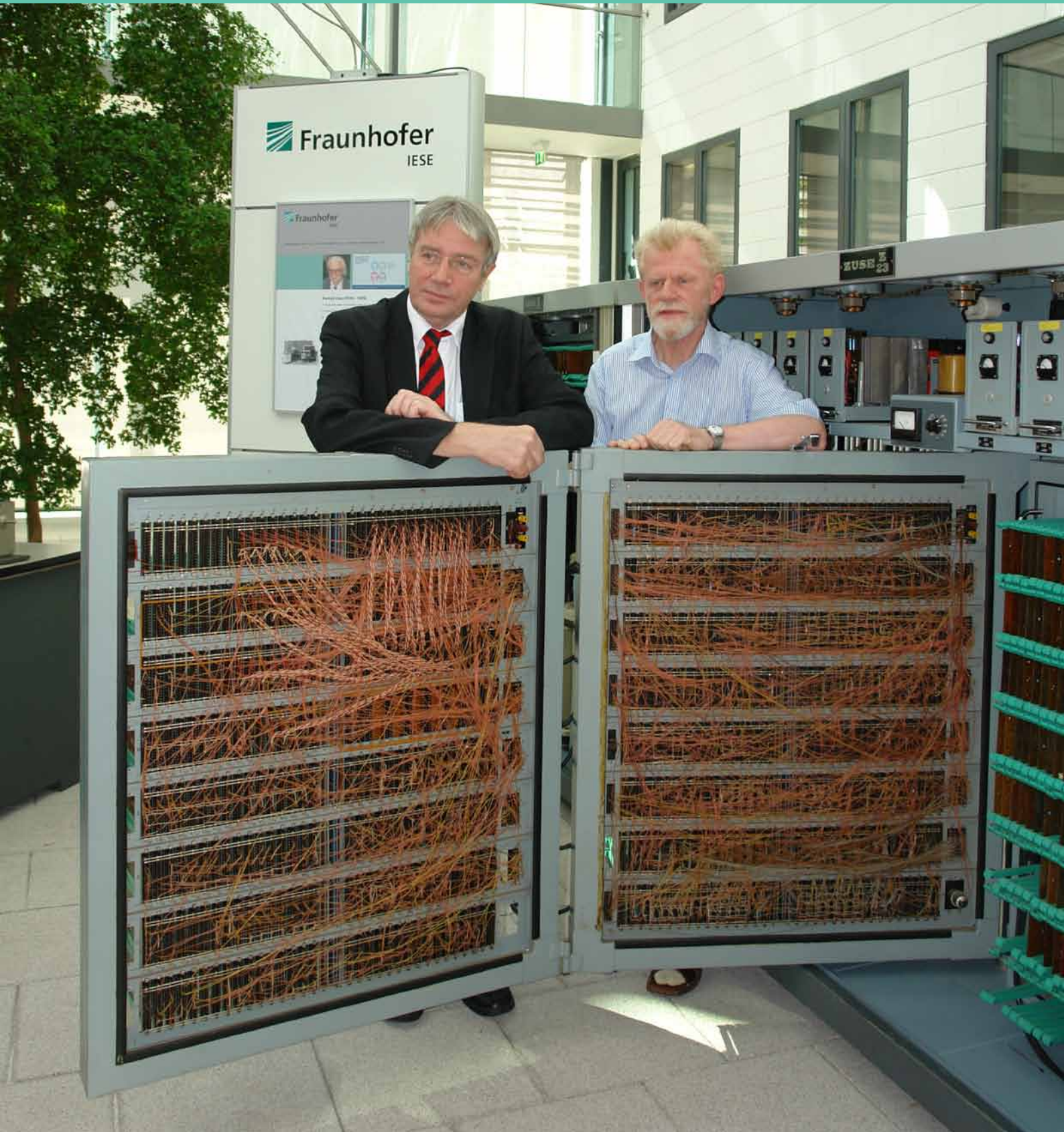
INDUSTRY DAY AND "SCIENCE NIGHT"

On Friday, 8 October 2010, the Fraunhofer Institute for Experimental Software Engineering (IESE) held an Industry Day on the topic of "Safety & Reliability for Embedded Systems", which led up to the "Science Night".

The Industry Day offered interesting professional presentations by Fraunhofer IESE scientists to all participants. Professor Peter Liggesmeyer spoke about "New Developments in the Area of Embedded Systems", and "Software Quality" was the topic of a workshop led by Dr. Thomas Kuhn.

In addition, there were three industry presentations illustrating the central role that embedded systems play in technical products. One current example of the relevance of embedded systems was the presentation "Safety in Rail Technology" by Reiner Heilmann, Siemens CT. Following the presentations, participants had a chance to meet directly with the researchers.

From 7 p.m. until midnight, Fraunhofer IESE opened its world of research to visitors in the context of the Kaiserslautern "Science Night". Various project demonstrations as well as guided tours of the Ambient Assisted Living laboratory provided deep insights into the work of the institute.

Entertainment was also offered – with music ranging from funk via classic rock to reggae, performed by the band "Cameleon" from Kaiserslautern.

The overwhelming response of the visitors was a surprise for everyone – more than 1000 guests used the opportunity to get a close-up look at the kind of research that is taking place at Fraunhofer in Kaiserslautern.

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6ᵀᴴ STATE SYMPOSIUM ON EMERGENCY MEDICINE

In emergency medicine, the time factor is of central importance. It is not only the time until help arrives that determines the prognosis for the emergency medicine patient. The focus is increasingly shifting to treatment in an institution that is suitable for the patient's illness or injury. Thus, logistical aspects join medical aspects in the narrower sense in occupying a central position in modern treatment concepts. Following this line of thought, the state government founded the German Center for Emergency Medicine and Information Technology (DENIT) and gave it a home at the Fraunhofer Institute for Experimental Software Engineering (IESE). The primary task of this center is to check structures and processes in emergency services, to support decision makers in developing future-oriented concepts, and thus to contribute to the dynamic adaptation of emergency services to medical, technical, and social developments such as demographic changes.

Under the patronage of Interior Minister Karl Peter Bruch, the Institute of Anesthesiology and Emergency Medicine of the Westpfalz-Klinikum in Kaiserslautern, the Emergency Medicine Center of the State of Rhineland-Palatinate, the Fraunhofer Institute for Experimental Software Engineering in Kaiserslautern, and the Rhineland-Palatinate Ministry of the Interior and for Sports held the 6th State Symposium on Emergency Medicine on 6 November 2010. The topic of the event, which took place at the Fraunhofer Center in Kaiserslautern, was "Emergency Medicine Services – a Logistical Challenge".

With a total of approx. 180 participants from emergency services, hospitals, and government agencies as well as a well-visited industry exhibit, the topic of the event received great attention. Nine presentations illustrated the impact that the optimal organization of the treatment process, and particularly information and communication technology, has on the prognosis of emergency medicine patients with time-critical illnesses or injuries.

Current technical developments such as the portable heart-lung machine, automatic emergency detection systems, as well as telemedicine support demonstrate some of the opportunities that will be available to emergency services in the future. Selected contributions from this symposium will be published in March 2011 in a special issue of the journal "Notfall und Rettungsmedizin" [Emergency and Emergency Medicine].

FRAUNHOFER IESE OPTIMIZES MULTICORE APPROACHES IN THE AREA OF EMBEDDED SYSTEMS

Currently, there is a trend towards consolidating and virtualizing servers. A similar trend can also be observed when it comes to Electronic Control Units (ECU) in embedded systems. This trend is boosted by the availability of multicore processors, which make it possible to efficiently distribute work to several computing cores. In addition, this enables greater redundancy and thus more failure safety. Model-driven development approaches for embedded software based on recognized tools such as SIMULINK are supported by the techniques and tools developed by Fraunhofer IESE for the parallelization of software models. Using a platform description as a basis, software models are substantially optimized and are parallelized either in a fully automated or in a supportive manner.

Thanks to continual progress in technical developments, the computing capacity of modern processors appeared to know no boundaries until recently. New processors became faster due to higher clock rates and applications automatically benefitted from this increase. However, in the last few years, processors have reached physical performance boundaries; the clock rates of common processors can hardly be increased further. These are due to the internal switching times of the processors – in order to reduce them further, power consumption had to be continually increased in the past, which led to more and more heat being generated and thus created ever greater problems for both the power supply and the cooling technology. If the clock rate of the processors is too fast, they may disrupt neighboring processors and busses due to electromagnetic interference radiation.

These problems present a major challenge especially for industrial users with high technical requirements in the area of embedded systems.

Processors in embedded systems are processors that regulate, control, or monitor the system into which they are embedded. These systems constitute a central ingredient of almost all technical products, for instance in aircraft and power plant controls, in medical technology, in innovative consumer electronic devices, or in the automotive industry. The automotive industry, in particular, needs ever faster processors for embedded systems, for example in order to be able to reliably process great amounts of data in driver assistance systems such as pedestrian detection.

Multicore processors provide an appealing solution for this problem, since just a single multicore processor can deliver the performance of far more than 100 traditional processors. These processors consist of a multitude of computing cores with slower clock rates, which may be specialized. This makes it possible to increase the computing power of modern processors and reduce their power consumption at the same time. However, in order to access this performance potential, applications, respectively their algorithms, must be parallelized – unlike in the past, they no longer automatically benefit from performance increases.

In addition to parallelizing algorithms, communication costs must also be taken into account. Parallel algorithms must exchange data with each other, which is done via partitions, bus systems, or point-to-point connections. Particular problems that need to be highlighted in this context include the problem of competition regarding these communication resources and the problem of intersecting message streams in communication networks, which may entail major performance losses.

The approach pursued by Fraunhofer IESE using model-driven tools such as SIMULINK takes into account specialized computing cores and communication networks during parallelization and thus prevents adverse effects resulting from these. At the same time, it ensures that critical time limits, for example, are adhered to, such as those that govern the reaction times of airbags. Until now, no alternative approach in the area of multicore processor optimization has managed to achieve this in such complexity.

Major benefit for developers: The entire process can be either fully automated or used as support, which ensures great savings during the effort-intensive development phase. A patent on this approach is currently pending.

Further information:
www.mware.fraunhofer.de

PROF. DR. DIETER ROMBACH ELECTED "FELLOW" OF THE ASSOCIATION FOR COMPUTING MACHINERY (ACM)

The renowned Association for Computing Machinery (ACM), the largest professional computer association worldwide in the area of academia and science, has elected Professor Dr. Dieter Rombach a Fellow on 7 December 2010. He is one of only a few scientists worldwide who have been elected Fellows of both large computer science associations (ACM and IEEE).

The director of the Software Engineering Research Group at the Department of Computer Science at the University of Kaiserslautern received the award "for contributions to empirical software engineering research and its successful application to industrial practice", as stated in the citation.

The ACM, which was founded in 1947 as the first computer science association in the world, unites computing educators, researchers, and professionals to inspire dialog, share resources, and address challenges in computer science. It promotes the professional careers of its members by offering opportunities for lifelong learning, career development, and professional networking.

The "ACM Fellows" program, initiated in 1993, celebrates the exemplary contributions of the leading members in the computing field. These individuals have helped to enlighten researchers, developers, practitioners, and end-users of information technology throughout the world.

Rombach is the executive director of the Fraunhofer Institute for Experimental Software Engineering (Fraunhofer IESE). Previous stations of his career took him to the University of Maryland, to the Software Engineering Lab of NASA, and to Carnegie Mellon University in Pittsburgh, USA.

Rombach regularly serves as an expert, auditor, and consultant for industry and provides advisory services to government bodies on the state and federal level. He also serves as a scientific adviser to various companies and research institutions. He is the author of more than 200 scientific publications, co-editor of several international journals, and is regularly called upon to serve as a program committee member of important software engineering conferences.

Prof. Rombach's research interests are in the area of "Software Engineering", particularly in engineering-style methods for the development of software with predictable quality; quantitative methods for the measurement of software products and processes for the purpose of project management and quality assurance; languages, methods, and tools for the creation and management of development processes on the basis of explicit software process models; as well as empirical methods and their application for determining the effects of software development methods.

For his excellent scientific work, Rombach has received numerous awards: for example the "Presidential Young Investigator Award" of the National Science Foundation (NSF) in the USA in 1990 or the Service Medal of the State of Rhineland-Palatinate in 2000. In 2009, he was awarded the Federal Cross of Merit on Ribbon of the Federal Republic of Germany and the honorary doctorate degree of the Finnish University of Oulu in recognition of his lifetime achievements.

THE "FRAUNHOFER ALLIANCE EMBEDDED SYSTEMS" PRESENTS ITSELF

In order to be able to play a major role in shaping the rapid developments taking place in the area of Embedded Systems, the Fraunhofer-Gesellschaft has founded the Fraunhofer Alliance for Embedded Systems on 18 October 2010. Prof.Dr.-Ing. Peter Liggesmeyer, scientific director of Fraunhofer IESE, is the speaker of the newly founded alliance.

Embedded systems constitute a central ingredient of technical products, e.g., in transportation, medical technology, automation technology, or in consumer electronics. In recent years, numerous product innovations and unique selling points of technical products "made in Germany" were the result of integrating embedded systems. Especially in the area of high-tech, there is a strong dependency on embedded systems, which is why their economic significance is enormous. As a reaction to the growing requirements and the increasing complexity of embedded systems, the Fraunhofer ICT Group as the largest European research network for information and communication technology pushed the initiative for founding a Fraunhofer Alliance.

Isolated approaches quickly reach their limits when new systems are being developed. In addition to competence in the areas of information technology, electrical engineering, and

mechanical engineering, interaction between these disciplines is an essential factor. The Fraunhofer institutes affiliated in the alliance (ESK, FIRST, FIT, FKIE, FOKUS, HHI, IESE, IGD, IIS, IOSB, and SIT) have the necessary comprehensive expertise in practically all topics in the area of embedded systems. The Fraunhofer Alliance Embedded Systems bundles the respective required professional competencies and maps them to the areas of information technology, electrical engineering, and mechanical engineering. At the same time, the alliance acts as a central point of contact for partners from industry, research, government, and the media.

Due to its expertise in the area of embedded systems, Fraunhofer IESE in Kaiserslautern is predestined for a leading role in the alliance. For a long time, safety analyses, embedded systems certification, especially in critical application domains, as well as innovative development methods for embedded systems have been focal research areas of IESE.

The Fraunhofer Alliance Embedded Systems will present itself on 1 March 2011 in the context of a press conference held at the embedded world Exhibition&Conference in Nuremberg, which is the biggest exhibition of its kind worldwide and the meeting place of the international embedded community.

Further information:
www.embedded.fraunhofer.de

Fraunhofer

EMBEDDED

FRAUNHOFER-ALLIANZ EMBEDDED SYSTEMS
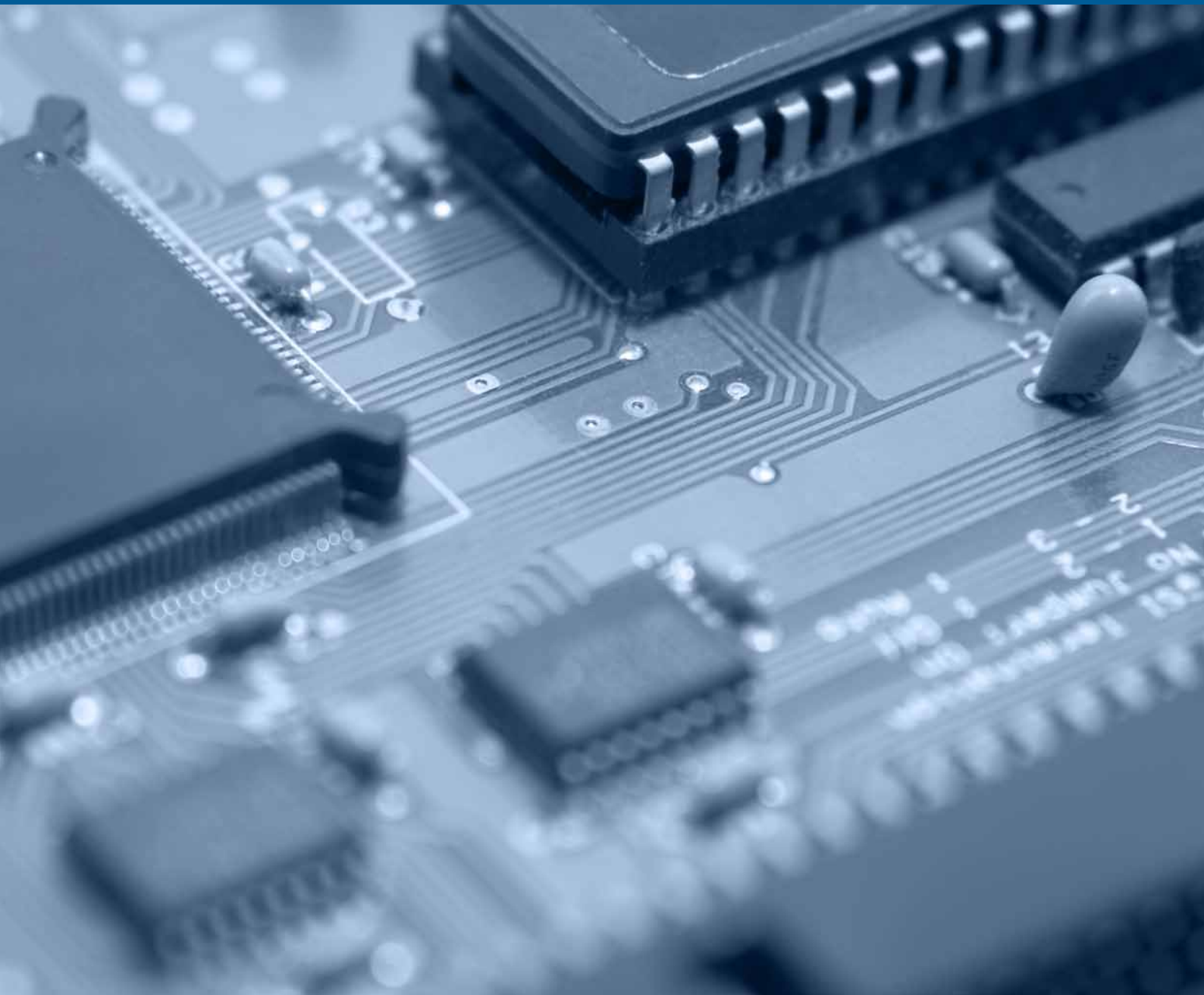
OUTLOOK ON 2011

EMBEDDED SYSTEMS ARE EVERYWHERE ...

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... and our modern economy and society would be unable to survive without them. Already today, more than three billion embedded components and devices are manufactured every year, incorporating 98% of all microprocessors built. In Germany alone, the market volume amounts to over 19 billion euros annually, with growth rates of up to eight percent. And this is just the beginning of the success story being written by embedded systems. Self-sustaining individual products will be replaced by systems that take over ever more complex tasks due to intensive cooperation and seamless connections with classical information systems. Newly emerging product classes, technological innovations, and methodological progress provide both opportunities and challenges. These are addressed by the division "Embedded Systems", which aims to develop solutions for the markets of tomorrow already today.

Autonomous Systems

In order to further expand the possibilities of embedded systems, there will be more and more autonomous systems in the future. Agricultural machinery that runs on its own, trucks that automatically dock at loading docks, or ever more intelligent vehicle assistance systems are just some examples. Thanks to their intelligence, autonomous systems can perform much more complex tasks. At the same time, however, it is much more difficult to predict the behavior of such systems. This calls for new approaches in the architecture as well as in quality assurance and safety cases in order to be able to use this flexibility without jeopardizing the safety and reliability of these systems.

Embedded Apps

Spoiled by cell phones and tablet PCs, users increasingly also expect more flexibility from embedded systems. Since much of a vehicle's functionality is already realized by software, one also wants to always stay up to date or even be able to simply expand the system's functionality. What appears to be so simple and natural on cell phones constitutes a major challenge for embedded systems. In cell phones, for example, we accept reduced performance and stability as a trade-off for flexibility. In embedded systems such as automobiles, however, this would quickly endanger lives. This is especially true since opening a system for flexible use also opens the door for hackers and thus to malicious manipulation of the system, which results in new sources of risks that are barely being mastered so far.
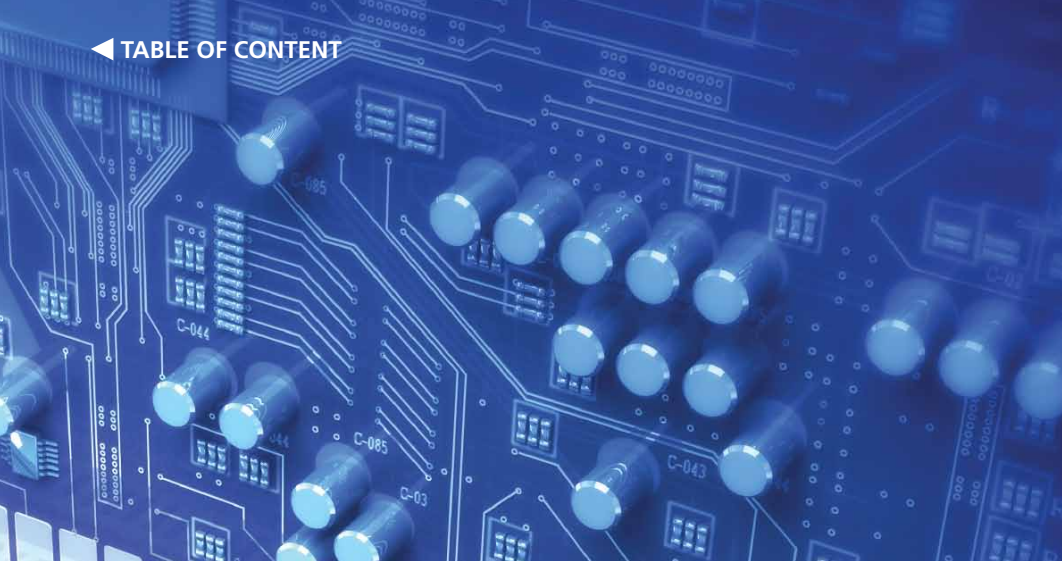
Embedded Systems of Systems

Whereas until now, embedded systems have frequently been realized as small, independent single systems that were loosely coupled with each other, the future lies in the intensive networking of embedded systems so that they can handle more complex tasks in cooperation. Cars connect with each other to form ad-hoc networks in order to alert others about obstacles or even to allow automatic intersection assistants. In the operating room, the aim is to flexibly connect devices from a wide variety of manufacturers in order to permit seamless support for the operating team. Which systems are connected how with each other is thus only determined dynamically at runtime and is almost impossible to predict during development time. Hence the sub-systems must be enabled to independently connect with each other during runtime without jeopardizing the quality of this system of systems. Many decisions that can no longer be made by the developers during the design phase must be transferred to the systems. In order to realize this, the systems do not only have to adapt dynamically to their environment, but they themselves must also "be aware" of their quality to enable them to make decisions regarding the quality of the system of systems. This calls for new paradigms – not only in system development, but also in quality assurance and in safety cases.

Seamless Integration of Embedded Systems and Information Systems

In addition to the networking among embedded systems, the systems are also being increasingly integrated with classical information systems. Agricultural machines collect data about harvest quantity and quality, which is evaluated by information systems and is included in the planning for the following year. The results, in turn, are used by the machines to ensure optimal fertilization of the field, for example. This is just one of many examples where embedded systems and information systems are approaching each other more and more. Whereas both embedded systems and information systems are developed with their own development methods and techniques, the seamless integration of the systems and the mastering of the resulting overall complexity often constitute major challenges. This starts with the elicitation of the requirements on such a complex system of systems and ends with assuring its quality. The divisions "Embedded Systems" and "Information Systems" are therefore collaborating closely with the intention of efficiently increasing the convenience and safety of systems and especially the productivity of companies with the help of a symbiosis of these classes of systems.

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NEW TRENDS IN PROCESS MANAGEMENT

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Business Alignment

Does this situation sound familiar to you: new standards are to be introduced, a product shall get new features, the testing department wants a higher budget, novel processes shall be implemented, etc. In most of these cases, it remains completely obscure what the value of these plans is for an organization. Software is generally seen as a cost factor, not as a value driver.

However, it is becoming increasingly important for any organization to see software and IT as drivers for innovation and value creation, and to be able to provide clear evidence of the value they contribute to the organization's business goals. The trend towards value-oriented software development clearly shows: Project management approaches such as Scrum, Lean, or Kanban are experiencing enormous gains in popularity. What all of them have in common is that software development activities are permanently aligned in such a way that "values" are created for customers and that so-called "waste" is eliminated.

Yet, challenges quickly arise in practical application: What actually are values, and which values are important? How can we determine these? How can we describe them? How can we measure whether we are really creating values? How can we check whether values are still up to date?

This is where Fraunhofer IESE comes in: Our goal is to support organizations in determining the values that are relevant for them and in aligning their software-related activities with these values. We develop methods that can be used to map software goals to an organization's higher-level goals. One example is the GQM+Strategies® approach. It supports companies in the integrated modeling of goals and strategies across all levels of an organization as well as in the development of suitable measurement systems for monitoring and optimization.

One of the goals of the "Process Management" division at IESE is to integrate all kinds of software and IT alignment and to support companies in the analysis and alignment of their respective strategies. This includes not only strategic alignment, but also architecture alignment, application landscaping, and the design of corresponding organizational structures.

Management of Information Quality

Decisions about company investments or business strategies depend to a large extent on available data and information. Low-quality data or information can have serious consequences for a company. Many software and IT departments are therefore currently undergoing a change from the classical IT organization to an information provider, which addresses information needs consistently on various levels of an organization and thus creates an added value for the company that goes beyond typical IT services.

However, no integrated approach exists at this time that would allow comprehensive mastering of the information quality in a company. This applies to both the evaluation of data and information quality depending on the respective company environment and the business goals pursued and to the general process of data and information management. The common approaches in the area of data and information quality are not sufficient. The operationalization of suitable concepts into guidelines and processes that can actually be applied as well as the derivation of comprehensive quality models often constitute a major challenge in practice and require expert support.

In the area of information quality, the "Process Management" division of Fraunhofer IESE focuses on methods, processes, and models for the customized definition, evaluation, and achievement of information quality in an organization. To this end, the company-critical information and information flows are made measurable, visible, and analyzable across the entire lifecycle of individual information objects in order to optimize the underlying business processes. The software engineering perspective, in particular, plays a central role: How can we objectively evaluate information quality? How can we specify and develop systems that will deliver high data quality? Fraunhofer IESE will continue to bundle its competencies regarding this topic in order to effectively support companies in achieving high information quality.

INFORMATION SYSTEMS WITH A FUTURE

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Hardly any company can nowadays make do without information systems. Whereas in the past, monolithic software systems were sufficient for an organization, we now notice that these no longer fulfill the needs of companies regarding usability and performance, and espe-cially regarding flexibility and interoperability. Progress calls for new business models. And new business models rely on the use of new technologies, such as clouds and mobile end devices. This results in new challenges for systematic software engineering, which is the domain of Fraunhofer IESE. In addition to innovation technologies, new business models increasingly also call for collaboration between companies. It therefore comes as no surprise that company IT systems are also expected to collaborate. Since summer 2010, Fraunhofer IESE has dedicated itself to the new paradigm of "emergent software" as part of the Software-Cluster "Software Innovations for the Digital Enterprise". Here, the "Information Systems" division of Fraunhofer IESE will be developing solutions in the next five years to meet the future challenges of modern IT systems.

Emergent Software and Cloud Computing
Under the main theme of "emergence", IESE pursues the vision that for an organization, the added value of interconnected IT systems is more than just the sum of the benefits of the in-dividual IT systems. New business models allow more flexibility in how to design business rela-tions. In order to create more interconnections between various IT systems in major companies on the one hand, and between IT systems of different small and medium-sized enterprises on the other hand, various challenges need to be met. The "Information Systems" division ad-dresses industry and research issues in the areas of interoperability and adaptivity of systems with topics from the areas of requirements management and architecture. This also includes systematic software engineering issues for, respectively in, the Cloud. Emergent system qualities that the customer and the user can perceive directly include IT safety and security, particularly data security, and a positive User Experience of the systems. Our declared goal is to construct these qualities, which partly contradict each other, and to harmonize them.

Use of Mobile End Devices
Already today, mobile end devices have established themselves firmly for private use. Many users can no longer imagine everyday life without the continuous connectivity and the innova-tive features offered by these small helpers. However, mobile applications also offer enormous

innovation potential in business environments, for many domains such as logistics, agriculture, ERP systems, and the financial sector. As a matter of fact, mobile end devices can perform the workflows in almost any domain more efficiently. Already today, Fraunhofer IESE is supporting companies in building up their competence in developing software for mobile end devices. The existing services in the area of systematic development of mobile end devices are being expanded by the research area "Business Goes Mobile", which was established in 2010. The core topic is systematic decision-making support for companies regarding questions such as: Which areas can benefit the most from mobile devices? Which end devices should we focus on? How can these devices be integrated seamlessly into existing business applications?

User Experience for Business Success
In our everyday lives, we are faced with less and less time and more and more complexity in our workflows, and thus often also with more features in our applications. Almost every IT system is designed sub-optimally in terms of usability. This is not merely annoying, but makes the execution of individual workflows in a company slower and more error-prone. For several years, Fraunhofer IESE has therefore been developing approaches to optimize the usability of business applications in the long term. In the past two years, we have been going beyond classical usability with our research area "Engineering User Experience". Whereas usability mainly focuses on the absence of annoying factors, User Experience methods lead to a positive user experience, which can help a product to clearly differentiate itself from that of a competitor or from a previous version. First empirical studies have shown us that we have had a significant impact on the business goals of an organization by increasing the User Experience in business applications.

Seamless Integration of Information Systems and Embedded Systems
In addition to the collaboration of IT systems among each other, these systems are also being increasingly networked with classical embedded systems. Future embedded systems, such as large sensor networks, will deliver many and exact data from the real world in real time that require fast responses. This creates new challenges for business applications. Whereas both embedded systems and information systems are each developed using their own development methods and technologies, the seamless integration of these systems and the mastering of the resulting overall complexity constitute major challenges. This starts with the elicitation of the requirements on such a complex system of systems and ends with quality assurance. The divisions "Embedded Systems" and "Information Systems" are therefore cooperating intensively in order to be able to efficiently increase the convenience and safety of systems and especially the productivity of companies by establishing a symbiotic relationship between these system classes.

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Cambridge, Massachusetts
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East Lansing, Michigan
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Plymouth, Michigan
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Beijing, China
Jakarta, Indonesia
Selangor D.E., Malaysia
Seoul, Korea
Singapore
Tokyo, Japan

Fraunhofer Locations in the Middle East

Dubai, United Arab Emirates

Fraunhofer Locations in Europe

Vienna and Graz, Austria
Brussels, Belgium
Porto, Portugal
Bolzano, Italy

Research of practical utility lies at the heart of all activities pursued by the Fraunhofer-Gesellschaft. Founded in 1949, the research organization undertakes applied research that drives economic development and serves the wider benefit of society. Its services are solicited by customers and contractual partners in industry, the service sector and public administration.

At present, the Fraunhofer-Gesellschaft maintains more than 80 research units in Germany, including 60 Fraunhofer Institutes. The majority of the 18,000 staff are qualified scientists and engineers, who work with an annual research budget of €1.65 billion. Of this sum, more than €1.4 billion is generated through contract research. Two thirds of the Fraunhofer-Gesellschaft's contract research revenue is derived from contracts with industry and from publicly financed research projects. Only one third is contributed by the German federal and Länder governments in the form of base funding, enabling the institutes to work ahead on solutions to problems that will not become acutely relevant to industry and society until five or ten years from now.

Affiliated research centers and representative offices in Europe, the USA, Asia, and the Middle East provide contact with the regions of greatest importance to present and future scientific progress and economic development.

With its clearly defined mission of application-oriented research and its focus on key technologies of relevance to the future, the Fraunhofer-Gesellschaft plays a prominent role in the German and European innovation process. Applied research has a knock-on effect that extends beyond the direct benefits perceived by the customer: Through their research and development work, the Fraunhofer Institutes help to reinforce the competitive strength of the economy in their local region, and throughout Germany and Europe. They do so by promoting innovation, strengthening the technological base, improving the acceptance of new technologies, and helping to train the urgently needed future generation of scientists and engineers.

As an employer, the Fraunhofer-Gesellschaft offers its staff the opportunity to develop the professional and personal skills that will allow them to take up positions of responsibility within their institute, at universities, in industry and in society. Students who choose to work on projects at the Fraunhofer Institutes have excellent prospects of starting and developing a career in industry by virtue of the practical training and experience they have acquired.
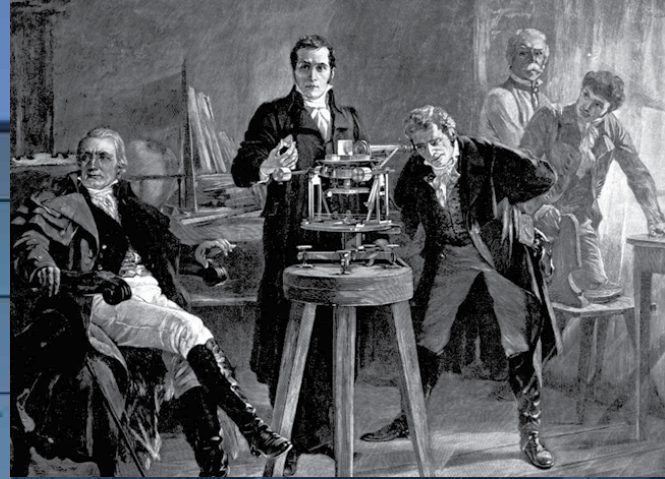
The man behind the name:

Joseph von Fraunhofer

The Fraunhofer-Gesellschaft owes its name to Joseph von Fraunhofer (1787-1826), the successful Munich researcher, inventor and entrepreneur. Born of a family of modest means, the glass-grinding apprentice Joseph von Fraunhofer joined the institute for optics headed by privy councillor Joseph von Utzschneider, who put the young researcher in charge of glass manufacturing at the early age of 22. Joseph von Fraunhofer's major developments include new methods of glass production and processing.

The optical instruments he himself developed, such as the spectrometer and the diffraction grid, enabled Fraunhofer to conduct fundamental research in the fields of light and optics. He was the first scientist to measure the spectrum of sunlight and characterize the appearance of the dark absorption strips: the "Fraunhofer lines". His work as an autodidactic researcher earned him great respect in academia and government, leading to the former apprentice becoming a full-fledged member of the Bavarian Academy of Sciences and Humanities.

FRAUNHOFER IESE AND ITS NETWORK PARTNERS

Fraunhofer IESE fulfills its mission of applied research and technology transfer through close collaboration with users of software engineering technology, providers of new technologies, and strategic partners in national and international collaborations. Thus, IESE actively promotes further development of software engineering technology and its transfer into industrial practice.

International Research Networks

Fraunhofer IESE is a member in several international research associations. The International Software Engineering Research Network (ISERN) with approx. 60 members from science and industry plays an important role in Fraunhofer IESE's international research collaborations. ISERN is a forum for applied software engineering researchers for exchanging the latest research results and experiences.

Further information:
http://isern.iese.de

In addition, Fraunhofer IESE is affiliated with the Center for Empirically Based Software Engineering (CeBASE), a project of the National Science Foundation (NSF) in the United States. Other CeBASE members include FC-MD, the University of Maryland, the University of Southern California, Mississippi State University, and the University of Nebraska-Lincoln.

Bilateral research and exchange programs for students and scientists exist with renowned institutions such as:

- Experimental Software Engineering Group at the University of Maryland, USA
- Center for Software Engineering at the University of Southern California, USA
- Universidade Federal da Bahia, Brazil
- Universidade Estadual da Paraíba, Campina Grande, Brazil
- Carleton University, Toronto, Canada
- Clemson University, South Carolina, USA
- Kyungpook National University, South Korea,
- Lancaster University, United Kingdom
- Simula Research Laboratory, Lysaker, Norway
- University of Calgary, Canada
- National ICT Australia Ltd (NICTA), Sydney, Australia
- Bay Zoltan Foundation for Applied Research, Budapest, Hungary
- Poznan University of Technology, Poland
- Universität Malta
- Software Quality Institute at Griffith University, Australia

National Research Networks

The **Science Alliance Kaiserslautern e.V.** is a coalition of ten internationally renowned research facilities in Kaiserslautern. Together they form a highly specialized multidisciplinary network, which provides students, scientists, and cooperation partners from industry, business, and the public sector with innovative solutions based on the newest technologies and methods available.

Members of the Science Alliance are the University of Kaiserslautern, the University of Applied Sciences Kaiserslautern, and eight research institutes, some of which are spin-offs of successful research completed at the University of Kaiserslautern. Their prolific work in the past years has added to the growing reputation of Kaiserslautern as a distinguished location for study, research, and technology.

Further information:
www.science-alliance.de

SafeTRANS e.V. ("Safety in Transportation Systems") is a Competence Cluster combining research and development expertise in the area of complex embedded systems in transportation systems. SafeTRANS drives research in human centred design, in system and software development methods for embedded systems, as well as in safety analysis and - for avionics and rail - its integration in certification processes, driven by a harmonised strategy addressing the need of the transportation sector.

Further information:
www.safetrans-de.org

Fraunhofer Alliance Embedded Systems
Further information on this recently founded alliance can be found on page 28 as well as at:

www.embedded.fraunhofer.de

The cluster **"Software Innovations for the Digital Enterprise"** (or **Software-Cluster** for short) focuses on the region around the software development centers Kaiserslautern, Darmstadt, Karlsruhe, Saarbrücken, and Walldorf. Its objective is to explore and develop the enterprise software of the future. This will enable companies that have only been using ICT as a tool to support their traditional processes, to transform themselves into completely digital enterprises where ICT is the major driver for product and process innovations (also see page 110 for further details).

Further information:
www.software-cluster.org

STI
Software Technologie
Initiative Kaiserslautern e.V.

Industrially-funded Collaborations

Fraunhofer IESE's industrial cooperation partners range from global players to small regional companies. They can be grouped into four categories:

- Large national and international organizations looking for support in their mid- to long-term strive for quality improvement in software development.
- Large national and international organizations with their own R&D department, who are looking for competent research partners.
- Medium-sized enterprises, who want to establish improvement programs or who must implement technology changes under very tight budget and schedule constraints.
- Small companies, who want to use proven technology that yields short-term return on investment.

Specialized Services for SMEs

The speed of modern innovations and the rapid changes of economic constraints place high demands on the management of IT companies. A company that wants to survive in the fierce competition is therefore well advised to continually improve both its own development processes and products and the qualification of its employees.

This is where the Software Technologie Initiative e. V. comes in. It offers all participants the opportunity to receive constant and first-hand information about current developments, trends, and background in the area of software engineering. Numerous events serve to acquire and consolidate applicable knowledge, while also offering the chance for people to get to know each other and to communicate with others. As a living network between research and practice, STI e. V. is the regional platform for direct, unfiltered exchange of knowledge, experience, and information in the area of software development.

Objectives:
- Promotion of software technology in small and medium-sized companies in the region
- Bundling of interests regarding the adaptation of research results in the area of software engineering
- Promotion of innovative software development approaches and their transfer into practice

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IESE IN FRAUNHOFER GROUPS AND ALLIANCES

FRAUNHOFER INFORMATION AND COMMUNICATION TECHNOLOGY GROUP

Shorter innovation cycles have turned IT knowledge into a perishable commodity. The Fraunhofer Information and Communication Technology Group (ICT) provides support in the form of customized solutions, consulting, and contract research for new products and services. The Fraunhofer ICT Group comprises 18 institutes as full members (among them also Fraunhofer IESE) and three associated members, representing a workforce of roughly 3000 employees and a yearly budget of approximately 180 million Euros. Its central office in Berlin serves as a one-stop shop, referring customers to the appropriate contacts.

The complementary focal fields of the participating institutes cover the entire value chain of the ICT industry. The business areas are:

- Medicine
- Automotive
- Production
- Digital Media
- Energy and Sustainability
- Financial Services
- Security
- E-business
- E-Government
- Information and Communication Technologies

The alliance comprises the Fraunhofer Institutes for

- Algorithms and Scientific Computing SCAI
- Applied Information Technology FIT
- Communication Systems ESK (associated member)
- Computer Architecture and Software Technology FIRST
- Computer Graphics Research IGD
- Digital Media Technology IDMT
- Experimental Software Engineering IESE
- Industrial Engineering IAO
- Industrial Mathematics ITWM
- Integrated Circuits IIS (associated member)
- Intelligent Analysis and Information Systems IAIS
- Medical Image Computing (MEVIS)
- Open Communication Systems FOKUS
- Optronics, System Technologies and Image Exploitation IOSB
- Secure Information Technology SIT
- Software and Systems Engineering ISST
- Telecommunications / Heinrich Hertz HHI (associated member)

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FRAUNHOFER E-GOVERNMENT CENTER

The Fraunhofer E-Government Center combines the expertise of some Fraunhofer Institutes in the areas of research needed to build up broad-based eGovernment services in Germany and Europe. Each institute has extensive experience in its particular area of technology and related applications, is already working on several applied e-government projects, and is actively involved in the definition of future-oriented, long-term solutions.

The Fraunhofer E-Government Center gives advice to politicians, public administrators and business people on the conception and development of complete, forward-looking and secure eGovernment-solutions and on the realization of service oriented architectures and standards.

The services it offers also include reorganizing business processes, evaluating and advising on technology, developing future-oriented e-government lab scenarios and evolving long-term e-government and security solutions, carrying out projects and quality management, helping with standardization, transferring know-how, and training. The Fraunhofer E-Government Center is completely independent of any vendor-specific solutions and political movements.

Each institute in the E-Government Center has many years of experience in the area of technologies and applications and is involved in various eGovernment development projects. As

the regional representative of the E-Government Center in Rhineland-Palatinate, Fraunhofer IESE supports both the public sector and software developing organizations in developing and extending benefit-oriented eGovernment solutions for business, public administration, and citizens. In particular, IESE offers the following services: execution of needs and ROI analyses, independent quality assurance and support of realization projects (with special attention paid to system architecture, usability, and IT security issues), as well as support in developing eGovernment know-how. In order to ensure optimal coverage of the technological and application-relevant issues, projects are performed in cooperation with other institutes of the Fraunhofer E-Government Center when appropriate.

The Center comprises the Fraunhofer Institutes for
- Applied Information Technology FIT
- Experimental Software Engineering IESE
- Industrial Engineering IAO
- Information and Data Processing IITB
- Intelligent Analysing- and Information Systems IAIS
- Open Communication Systems FOKUS
- Secure Information Technology SIT
- Software and Systems Engineering ISST

The speaker of the Fraunhofer E-Government Center is Prof. Dr. Dieter Rombach (IESE).

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FRAUNHOFER AMBIENT ASSISTED LIVING ALLIANCE

Research into Ambient Assisted Living aims primarily at enabling elderly people to lead independent lives in their own homes, and to provide assistance to people with special needs. Solutions are based on intelligent environments that offer autonomous, proactive, and context-sensitive adaptation to users' needs and to the tasks they wish to perform, helping them to carry out the necessary actions.

The Fraunhofer Ambient Assisted Living Alliance was set up by a group of six Fraunhofer institutes to market complete solutions in this area. The solutions offered include a variety of functions to improve a user's comfort at home and work, or to facilitate social care at home and in nursing homes, and the provision of mobile services. Another focus is that of rehabilitation, preventive healthcare, and solutions to preserve the independence of persons requiring medical care, daily assistance, or help to overcome physical disabilities.

The Alliance pursues the goal of a common system platform that permits seamless integration of diverse solutions and accommodates the evolution of ambient intelligence (AmI) technologies such as communications, power supplies, sensors, and actuators. This results in smart products that are mutually compatible, suitable for mobile applications, and can be integrated into other types of networks on an ad-hoc basis.

The contribution of Fraunhofer IESE is mostly in the area of systematic development of software-intensive systems. For the context of AAL, this includes approaches to the systematic development of integrated AAL solutions with predictable quality, development approaches for adaptable and adaptive systems, system modeling, and analysis, e.g., regarding dependability and usability.

The alliance comprises the Fraunhofer Institutes for
- Applied Information Technology FIT
- Computer Architecture and Software Technology FIRST
- Computer Graphics Research IGD
- Digital Media Technology IDMT
- Experimental Software Engineering IESE
- Industrial Engineering IAO
- Integrated Circuits IIS
- Manufacturing Engineering and Automation IPA
- Microelectronic Circuits and Systems IMS
- Photonic Microsystems IPMS
- Reliability and Microintegration IZM
- Software and Systems Engineering ISST
- Telecommunications, Heinrich Hertz Institute HHI

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Rolf Hendrik van Lengen

ORGANIZATIONAL STRUCTURE

Organizational Structure of the Fraunhofer Institute for Experimental Software Engineering IESE

Executive Director
Prof. Dr. D. Rombach

Scientific Director
Prof. Dr.-Ing. P. Liggesmeyer

Deputy Director
Prof. Dr. F. Bomarius

Business Areas

Product Industries R. Kalmar

Automotive & Trans-portation Systems

Automation & Plant Engineering

Medical Systems

IT & Service Industries M. Ochs

Information Systems
Finance, ERP / Software, Telecommunication

eGovernment

Health Care

Divisions

Embedded Systems (ES) Dr. Mario Trapp

Embedded Systems Development (ESD)
Dr. M. Becker

Embedded Systems Quality Assurance (ESQ)
Dr. R. Eschbach

Process Management (PM) Dr. J. Heidrich (acting)

Measurement, Prediction & Empiricism (MPE)
Dr. J. Heidrich

Process Compliance & Improvement (PCI)
Dr. J. Heidrich (acting)

Information Systems (IS) Dr. J. Dörr

Information Systems Development (ISD)
Dr. Marcus Trapp

Information Systems Quality Assurance (ISQ)
Dr. J. Dörr (acting)

The Fraunhofer Institute for Experimental Software Engineering IESE

The Fraunhofer Institute for Experimental Software Engineering (IESE) develops innovative constructive and analytical processes for the development of dependable software to be used for controlling technical products and processes as well as business processes. These processes are successfully introduced in companies from all branches of industry to increase quality and decrease costs, thus adding business value. Currently, many diverse collaborations exist with companies from the product industries "Automotive and Transportation Systems", "Automation and Plant Engineering", and "Medical Technology" as well as from the IT and service industries "Financial Service Providers", "ERP and Software Producers", and "Telecommunication" (Information Systems), "Health Care", and "eGovernment". Fraunhofer IESE supports companies from all branches of industry in their efforts to achieve "innovation with dependable software"!

Business Areas and Departments

The business areas of Fraunhofer IESE are found in industries with a focus on software in products and on software in IT and service industries. Regarding software in products, the following business areas are addressed:
- Automotive and Transportation Systems
- Automation and Plant Engineering
- Medical Technology

Regarding software in IT and service industries, the following business areas are covered:
- Information Systems, especially Financial Service Providers, ERP and Software Producers, Telecommunication
- Health Care
- eGovernment

Each of these two sectors is led by a Business Area Coordinator, who is responsible for acquiring new customers.

Fraunhofer IESE has organized its competencies into three divisions. Two divisions are home to the competencies for developing embedded systems with a focus on functional safety, reliability, and availability, and for developing information systems with a focus on usability and security.
- Embedded Systems division with the departments for Development and Quality Assurance
- Information Systems division with the departments for Development and Quality Assurance

In addition, the third division deals with the interdisciplinary competencies of measurement and process improvement:
- Process Management division with the departments for Measurement, Prediction, and Empiricism and for Process Compliance and Improvement

These interdisciplinary competencies are necessary in order to firmly entrench processes for the development of embedded systems and information systems in an organization.

New competence areas are built up in so-called Living Labs, where research takes place concomitant with business model development. Examples of these areas are Ambient Assisted Living or Energy Management.

Fraunhofer IESE receives guidance and counsel from an advisory board consisting of international experts from science and business. For many years, Fraunhofer IESE has been growing continually in terms of revenues and staff. The level of acquisition of third-party funds is also on a consistently high level, between 70 and 80%.

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THE ADVISORY BOARD

The Advisory Board consists of representatives of research, industry, and government. The board members support the Institute Directors with advice and counsel. (Chairman: Prof. Dr. Ernst Denert, Vice-Chairman: Prof. Dr. Jürgen Nehmer)

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Department of Computer Science
University of Maryland
USA

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Institute for Computer Science
Technische Universität München

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Computer Science Department
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vwd group Technology
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Regierungsdirektor, IT Systems
Federal Ministry of Education
and Research (BMBF)
Bonn

Dr. Achim Weber
Director, "International and
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Ministry of Education, Science,
Youth and Culture, *Land* Rhein-
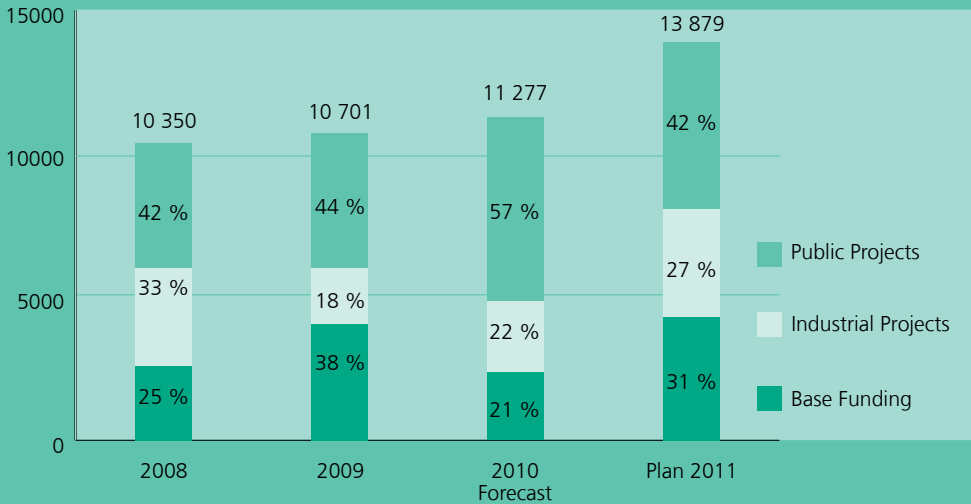land-Pfalz
Mainz

Private Members

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Former Chairman of the Board
IVU Traffic Technologies AG
Grünwald

Dr. Thomas Wagner
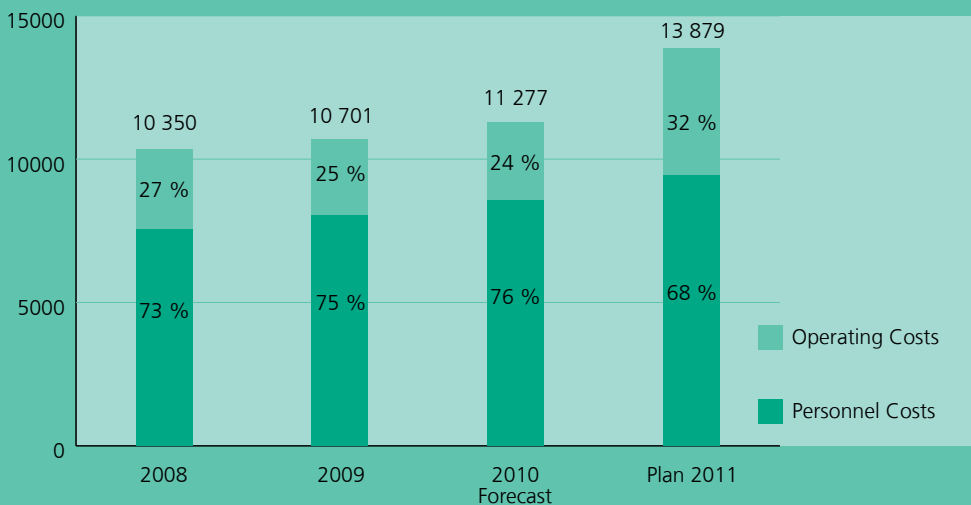Former Executive Vice President
Robert-Bosch GmbH
Stuttgart

Dr. Hans-Ulrich Wiese
Former member of the Executive
Board of Fraunhofer-Gesell-
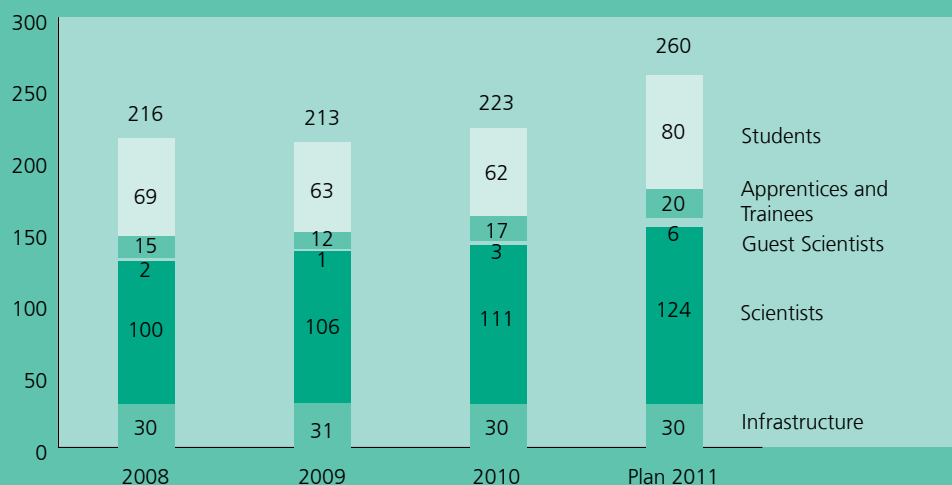schaft e. V.
Gräfelfing

PERSONNEL AND BUDGET

Development of Budget (in T euro).

	Public Projects	Industrial Projects	Base Funding
2008 (10 350)	42 %	33 %	25 %
2009 (10 701)	44 %	18 %	38 %
2010 Forecast (11 277)	57 %	22 %	21 %
Plan 2011 (13 879)	42 %	27 %	31 %

Development of Costs (in T euro).

	Operating Costs	Personnel Costs
2008 (10 350)	27 %	73 %
2009 (10 701)	25 %	75 %
2010 Forecast (11 277)	24 %	76 %
Plan 2011 (13 879)	32 %	68 %

Development of IESE Personnel.

	Students	Apprentices and Trainees	Guest Scientists	Scientists	Infrastructure
2008 (216)	69	15	2	100	30
2009 (213)	63	12	1	106	31
2010 (223)	62	17	3	111	30
Plan 2011 (260)	80	20	6	124	30

Development of Personnel and Budget

Fraunhofer IESE continued its planned growth in 2010, with the search for qualified personnel gaining increasing importance. The cost structure is stable; the proportion of women among the employees was 23%.

In 2011, the institute plans to further increase its scientific staff.

BUSINESS AREAS

The successful implementation of research results in innovative products requires building a solid bridge between technology-oriented researchers and product-oriented companies. Bridging this gap in the best possible way is the task of the business areas of Fraunhofer IESE. Standards, financial constraints and time restrictions, number of items produced, and many other impact factors differentiate areas of application that at first glance appear similar to those not familiar with these topics. Automobiles, a mass product, are produced in much greater quantities than, for instance, airplanes – which are an investment asset. In both cases, we are dealing with transportation systems, but the differences between them have far-reaching consequences regarding the suitability of methods and techniques in software and systems engineering. Business area managers have the broad view necessary to assess research results in terms of their use in specific application areas and to combine them in the best possible ways. Fraunhofer IESE is currently setting its focus on business areas that are important for both technical and business application areas.

AUTOMOTIVE AND TRANSPORTATION SYSTEMS

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Ralf Kalmar

Software Technology for a World in Motion

Modern technologies for electromobility as well as for increasing safety or comfort cannot be realized without electronics and software. The business area "Automotive and Transportation Systems" especially aims at manufacturers and users of embedded systems, primarily in automotive and rail technology as well as aerospace. Automotive Software Engineering comprises processes, techniques, methods, and tools adapted specifically to the requirements of the automotive industry.

Automotive Software Engineering defines a holistic approach that includes all development activities, starting from automobile-specific process models on the basis of established standards (ISO/IEC 12207, ISO 26262) and the use of maturity level models (ISO/IEC 15504, Automotive SPICE, CMMI). Product planning is supported through product line engineering and architecture standards (keyword: AUTOSAR), which take into account possible variants as well as technology and market requirements.

Special tasks such as the configuration of a tool chain, the integration of security and safety, the evaluation of software product qualities (ISO/IEC 9126), as well as systematic technology transfer for individual process steps are solved by Fraunhofer IESE.

Customer Benefits:
- Competitive development productivity
- Adherence to quality requirements
- Provable process and product qualities
- Flexible variation management
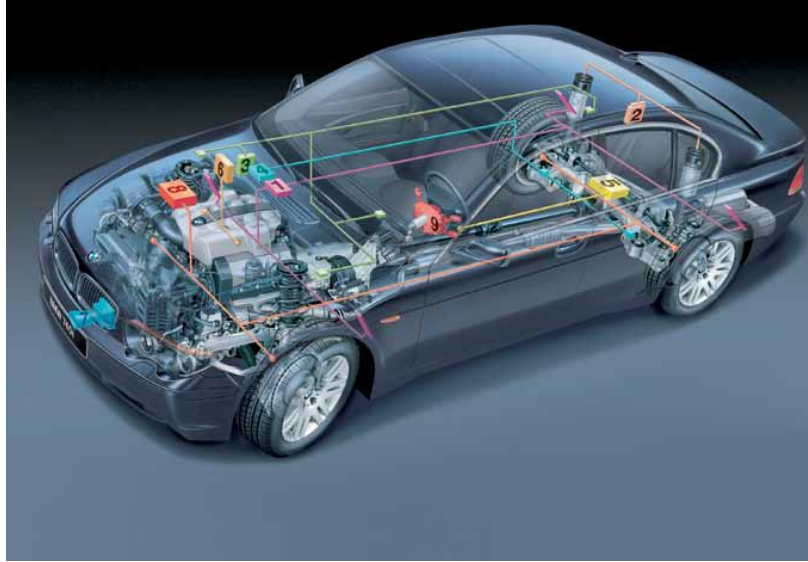
Competence in Software and Systems Engineering

Fraunhofer IESE accompanies the manufacturers and users, resp. integrators, of embedded systems for automotive and transportation systems during all phases of software and system development.

Automotive Software Development

Requirements Management

We help you to plan, structure, and design your specifications, as well as to administer extensive specifications in tools such as DOORS™.

Requirements Analysis, Specification-based Quality Assurance

We support you in implementing inspection processes and sequence-based analysis or formal model checking in your organization in a profitable manner.

Software Product Lines

We endorse you in adapting software architectures to efficient reuse for different product variants while taking advantage of cost- and quality-relevant effects.

Component Design

We back you up in designing your components and show you how to use modern designs and languages such as UML for developing memory- and runtime-optimized software.

Software Quality Management

Software Architecture Evaluation and Restructuring

We support you in evaluating and restructuring your software architecture, taking into account special constraints such as runtime behavior or memory requirements.

Checking Techniques for Requirements, Design and Code

Software can already be checked before testing: semi-automatically with the appropriate models (such as state machines) or through structured reviews (software inspections).

Software Measurement Systems

We make software quality measurable quantitatively with systematically derived metrics.

Cost Estimation

We show you how development expenditures can be estimated with certainty and how risks can be made visible.

Security Analysis

We perform well-founded security analyses for software and support you in avoiding weak points (security engineering).

Safety Analyses

We design safety analyses for software systems for you that must, for example, fulfill certain SIL levels of ISO/IEC 61508 or ISO 26262, or we provide support.

Testing and Test Automation

Many tests can be generated in an automated manner for regression tests. We provide support in designing and implementing suitable concepts such as model-based testing or SIL/MIL/HIL tests.

Testing of Distributed Systems

The testing and diagnosis of distributed systems constitute a special challenge. We support you in modeling and planning test processes, in developing test cases, and in evaluating system quality.

AUTOMATION AND PLANT ENGINEERING

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Contact

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Dr. Daniel Görlich

Modern Software Development

Decentralized and intelligent control systems, modular plants, small lot sizes, individual manu-facturing according to customers' wishes, extensive variation management, the increasing ubiq-uity of PCs, and wireless data transfer are just some of the trends in automation and plant engi-neering in the new millenium. Classical hardware tasks are increasingly taken over by software, partly for reasons of efficiency and costs, partly due to the necessarily higher complexity, which leaves no other choice than to shift functionalities from hardware to software.

It goes without saying that quality must continue to be ensured in this transition: The high standards that have existed for decades in terms of the quality of machines, plants, and au-tomation technology must also apply to software. Only if software is developed according to comparable, engineering-style principles can it conform to the high expectations of the plant engineering and automation industries.

Fraunhofer IESE as one of the worldwide leading research institutions in the area of software and systems engineering offers customers and research partners its expertise in the entire range of modern engineering-style software development. From embedded systems to interactive systems – Fraunhofer IESE studies, develops, and adapts software development processes, mea-surement methods, test procedures, and algorithms in order to realize innovative products for and with its customers.
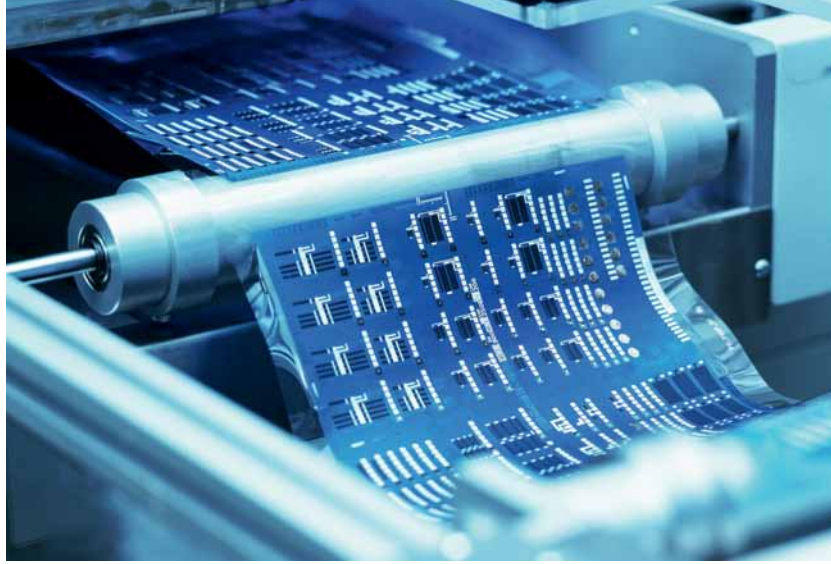
Customer Benefits:
- Modern, engineering-style software development
- Adherence to safety and quality requirements
- Controllable complexity and measurable quality

Example Project:

Competence in Software and Systems Engineering

Software engineering means developing software in an engineering-style, systematic manner in accordance with established or standardized processes and procedures. It allows measuring the quality of software and proving adherence to requirements, such as those regarding the safety and reliability of software-supported plants. Fraunhofer IESE offers the methodological competence, the creativity, and the spirit of research needed to develop modern concepts and innovative products with the help of software engineering.

Software Development

Our software and system construction offers you a variety of solutions that are easy to integrate and that will help you to ensure the required qualities during development already. The **product line approach PuLSE®**, for instance, helps you to reduce unnecessary complexity in variant-rich systems, to make strategic use of reuse potentials, and thus to avoid expenses. By using **multi-core platforms**, we can often increase the computational power of your systems, and **reduce their energy consumption** at the same time, by making only minor modifications. Fraunhofer IESE will propose processes that are suitable for you and adapt these to your special requirements, then support you during the entire development process.

Incremental **requirements engineering** means you can be sure that requirements on new hardware and software versions will be elicited and assessed completely, in order to balance user requirements and company goals with the lowest possible change effort. In addition, professional **usability engineering** measurably increases the satisfaction of the users of your hardware and software by ensuring that the structure and design of user interfaces are oriented towards their requirements, tasks, and wishes. **Domain-specific languages** for the **configuration, monitoring, and programming of plants**, for example, increase productivity and customer satisfaction while requiring only minor effort. Fraunhofer IESE considers usability and user friendliness as a precisely specifiable construction goal.

Continuously **model-driven development** allows controlling complex systems with the help of view creation, automatic analyses, and code generation. We assess and restructure **complex software and system architectures** for you, taking into account non-functional characteristics as well, for example by using an **integrated simulation of all system components**.

Software Quality Management

Continuous, especially **automated testing** in conjunction with systematic **inspections** optimizes **quality assurance** in the software development process and allows saving costs thanks to early elimination of defects. To achieve this, we use and develop dedicated tools and state-of-the-art model-based, analytical, or stochastic **verification and validation techniques**. Even products already in use can be evaluated and optimized using testing procedures.

The range of services offered by Fraunhofer IESE also includes systematic SWOT analyses and **evaluations of your development processes**, proofs of process conformance, **well-grounded safety anal-** yses, as well as support in increasing your **process maturity** (CMMI, SPICE). We plan and implement improvement measures for you. Furthermore, we develop customer-specific **software measurement systems** and IT Business Alignment measurement.

Competence Management

Experiences from practice are a valuable asset that is hard to capture and to provide. Fraunhofer IESE enables you to reuse your employees' experience by structuring experiences in a context-specific manner, and possibly validating and packaging them. On top of that, we offer to develop **experience and knowledge management systems** specifically adapted to your company.

Your company's internal knowledge management is supported by Fraunhofer IESE through **training courses and seminars,** for instance on software process management, UML, Business IT Alignment, IEC 61499, and SOA. **Certifications**, for example as "Certified Professional for Secure Software Engineering," and the career-compatible **master degree distance study program** "Software Engineering for Embedded Systems" at the University of Kaiserslautern round off our portfolio.

HEALTH CARE

Contact

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Rolf Hendrik van Lengen

Software Technology for innovative Health Care

Our health care system is currently undergoing dramatic changes. The demographic development, the scarcity of public funding concomitant with the increasing demand for health services, a rapidly developing information and communication technology, and last but not least, regulatory requirements stipulated by law create challenges for the system on various levels.

The use of information technology in the health care sector aims at digitally linking all stakeholders and processes in health care. This includes both software-based applications and the process workflows supported by them.

Modern information systems effectively support automated data elicitation and communication processes and thus make a major contribution to improving quality and increasing efficiency in health care.

Fraunhofer IESE provides support to all stakeholders in the health care sector when it comes to developing and testing software-based innovations. The institute assists its customers from the health care domain in developing complex information systems as well as in implementing domain-specific requirements on modern process management.

Customer Benefits:
- User-oriented software systems
- Controllable complexity and variants
- Provable safety and quality requirements

Example Projects:

Competence in Software and Systems Engineering

The development and quality assurance of software using established methods and standardized software engineering processes form the basis for innovative software systems in health care.

Software Development

Requirements Analysis and Management:
We support you in developing high-quality requirements and specification documents. The renowned requirements approach Fraunhofer TORE guarantees that you will get traceability, already integrated usability, and minimal documentation of the necessary requirements decisions.

Usability and User Experience:
We optimize the usability of your systems already during development or detect weak spots in the finished product. Using our proven methods, we collaborate with you on developing systems that not only provide support for the user, but also deliver a positive User Experience. This is beneficial for the user, but has also been proven to further the business goals of your organization, and thus will contribute to long-term business success.

Architecture-centric Engineering:
With our successful Fraunhofer ACES approach, we support you in defining and evaluating architectures for complex information systems. The iterative, scenario-based procedure allows you to master the complexity of architecture definition and migration and to make reliable predictions regarding critical system properties early on.

Software Product Lines:
With our PuLSE® approach, we support you in defining and introducing the concept of software product lines and in defining suitable and safe reuse concepts. PuLSE® helps you to reduce the unnecessary complexity of systems with many variants, make strategic use of reuse potentials, and thus avoid excess costs.

Software Quality Management

Checking Techniques for Requirements, Design, Code:
We enable early quality assurance for your documents in the software development cycle through the use of the Fraunhofer tool DETECT in order to avoid cost-intensive rework in a later development phase.

Quality Management:
We support you in defining, structuring, and establishing a standard-compliant quality management system for your software development in the style of standards such as ISO 9000-3 or ISO 13485 or the FDA Quality System.

Safety Concepts:
We support you in determining your safety requirements in terms of pertinent guidelines and standards and define infrastructure and software concepts together with you, or assess existing systems and concepts in terms of the relevant safety requirements and standard compliance.

Improvement Programs based on Measurement Data:
In cooperation with you we determine the potential need for optimization in your development processes on the basis of empirical findings. This makes it possible to capture and assess even such aspects as method efficiency and acceptance, which are otherwise hard to specify quantitatively.

MEDICAL SYSTEMS

Contact

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Daniel Kerkow

Software-based Systems for Health and Quality of Life

The domain of medical systems faces particular challenges: The market demands innovative products in less and less time, which constantly increases the complexity and networking of the systems. Yet, absolute reliability and safety of the systems and the (embedded) software are required. There is hardly any other area of our daily lives where computer technology is so close to humans, and consequently, mistakes can have very serious effects.

Our software and systems engineering approach supports you all the way from the elicitation of requirements on the medical product to validation. Together with our customers, we develop innovative solutions for software development that efficiently fulfill the requirements of IEC 62304, DIN EN 60601-1-4, and ISO 12207, and provide assistance in systematically implementing them in daily practice. We integrate future-oriented methods and techniques that ensure quality requirements (e.g., in accordance with ISO/IEC9126) efficiently and economically. Safety is the top priority in this respect. We use new methods to support you in performing risk management according to ISO 14971 for software, and to use techniques such as Failure Mode and Effects Analyses (FMEA) and Fault Tree Analyses (FTA) for analyzing software safety. Custom-tailored quality management approaches (e.g., similar to ISO 13485) are defined as supporting processes.

Your benefits:
- Higher safety of the software and thus of the medical products
- More efficient development and faster time to market
- Reduction of the development and quality assurance costs
- Measurable quality

Example Project:

Competence in Software and Systems Engineering

Fraunhofer IESE provides support for manufacturers of medical systems during all phases of software and system development.

Software Development

Requirements Management

Domain standards such as IEC 62304 require the appropriate design of requirements and specification documents during development. We support you in eliciting requirements and in developing suitable requirements specifications as well as in managing the requirements.

Usability Engineering

With our approach Usable Software Products Based on Innovative Requirements Engineering, we support you in ensuring that usability is considered during development, and in integrating it into the software and systems lifecycle.

System and Software Architectures

We support you in the specification and implementation of future-oriented architectures and in the evaluation and re-structuring of your existing software architecture, taking into account special constraints such as runtime behavior or memory requirements.

Software Product Lines and Reuse

Systematic reuse, for example in the form of software product lines, helps to decrease a product's time to market. With our PuLSE® approach, we support you in defining and introducing the idea of software product lines, and in defining suitable and safe reuse concepts.

Software Quality Management

Risk Management

Standards demand a lifecycle-wide risk management process, especially also for software. We support you in the standard-compliant implementation of ISO 14971 requirements by defining and implementing a risk management process for software and the corresponding documentation that is adapted to your context.

Safety Analyses

We support you in selecting and using adapted techniques such as FMEA, FTA, or more recent processes such as component fault trees. In particular, we make these processes applicable to software in medical devices.

Development Processes

We support you in the standard-compliant definition (e.g., IEC 62304, ISO 12207, V-Modell), structuring, documentation, and implementation of development processes and in the selection of methods, tools, and techniques that are suitable for passing certification procedures.

Static Quality Checking Techniques

Together with you, we define appropriate and innovative processes for verification in parallel to development.

Testing of Distributed Systems

We support you in modeling and planning test processes, in developing test cases, and in evaluating system quality.

Model-based Testing and Test Automation

We support you in the design and introduction of model-based testing techniques for embedded software, focusing in particular on test automation aspects.

Quality Management

We support you in defining, structuring, and establishing a standard-conformant quality management system for your software development in the style of standards such as ISO 9000-3 or ISO 13485, or the FDA Quality System.

Software Measurement Systems

Through the use of defined metrics, which we derive in a systematic manner adapted to your demands, quality aspects can be expressed in concrete statements.

INFORMATION SYSTEMS

FINANCE – ERP / SOFTWARE – TELECOMMUNICATION

Contact

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Michael Ochs

Example Projects:

Software in the Age of Information

Information systems permeate our daily lives in many areas. Especially in the areas of eCommerce and eBusiness, we carry out many everyday tasks using online shops, auction platforms, or online banking systems. Company-internal information systems, in particular, such as ERP, CRM, accounting and billing systems support and automate business processes and thus perform millions of transactions each day.

Neither operators nor users pay much attention to the technology of these highly complex software-based systems and their multiple interactions, and yet, modern business life is simply inconceivable without functional, secure, and user-friendly software operating in the background. Using existing potential to increase efficiency and quality in the development and operation of information systems helps to optimize business processes in a sustainable and cost-efficient manner. Mobile services and applications as part of multi-channel strategies are an important means for making information available to customers and users independent of place and time and provide optimal and reliable support for their actions and decisions, which leads to a significant increase in flexibility and agility.

The services offered by Fraunhofer IESE range from development activities for large, heterogeneous, distributed information systems via classical applications to mobile applications. This also comprises the design of systems on the level of coarse-grained and fine-grained requirements, taking into account non-functional requirements, usage designs that integrate business and user goals, User Experience design and (service-oriented) software architectures. Agile principles as well as innovative and proven state-of-the-art methods are also used here to increase the benefits for you as a customer. In quality management, Fraunhofer IESE is your competent and reliable partner for process management and optimization, governance and compliance topics, and the management of organizations and projects via key performance indicators (KPI) ranging from the strategic to the operational level. Here, too, we systematically integrate best practices from the area of agile methods with best practices from proven standards such as CMMI®, V-Modell® XT, SPICE, and ITIL. Goal-oriented quality assurance through integrated inspections and testing as well as IT security audits and the definition of security concepts round off our portfolio of services.

User Benefits:

- Provable product quality in all important aspects starting from the design phase already
- Competitive productivity for software and application development
- Optimized, controllable, agile, and risk-minimizing IT and software processes
- Controllable complexity of systems and applications

Competence in Software and Systems Engineering

Consistent and economical processes characterize the work of our institute, which transfers state-of-the-art validated results in combination with best practices into industrial practice – information systems and processes in top quality, ready for the future.

Information Systems Development

Requirements Specification and Management. In every other failed software project, some of the reasons for the failure can usually be found in the requirements. We support you in eliciting and specifying requirements on the basis of our proven approach Satisfy. This guarantees traceability and minimalist documentation of the necessary requirements decisions. In addition, functional as well as non-functional requirements are taken into account.

User eXperience. Today, good usability of information systems alone is no longer enough for achieving success among users. With our proven approach UXelerate, we support you, on the one hand, in evaluating existing systems and improving them based on such an analysis. On the other hand, we help you to develop information systems in such a way that the users have a positive User Experience.

Architecture-centric Engineering. The architecture of your information system is the key to mastering complexity and to efficiently fulfilling many requirements. This is especially true for quality requirements and technical constraints. With our successful approach ACES we support you in defining and evaluating architectures even for complex information systems.

Business Goes Mobile. Multi-channel strategies and mobile services are becoming more and more important. We develop prototypes for mobile devices to help you make decisions and use these as a basis for developing an entire app. We are your competent partner for your mobile product and service strategy and for the selection of an adequate mobile software platform and development environment. Go mobile!

Variation Management. Complexity is often the result of a great multitude of variants and customer-specific configurations of software products. With our successful PuLSE™ approach, we support you in establishing, developing, and managing software variants.

Software Quality Management

Process Management. Processes constitute a success factor for the quality of software. Based on a process analysis, we detect strengths and weaknesses in your processes so that improvement potentials and established best practices can be recognized. Actions for improving your processes can be defined systematically and can be implemented later on, which will increase the efficiency and quality of your processes in the long run.

Measurement, Key Performance Indicators, and Prediction Models. Transparency from the strategic to the operative level is an important factor for successful organizational control. We work with you on designing customized KPI systems that improve transparency and controllability – and enable you to predict certain attributes such as quality.

Effort Estimation and Benchmarking. We support you in estimating the effort required for your software projects, in identifying effort drivers, and in performing productivity benchmarking of projects. To do so, we use our proven CoBRA® method, which combines expert knowledge with measurement data and supports you in recognizing and controlling risks in a project early on.

Integrated Testing and Inspections. We help you to focus and reduce your testing efforts by coordinating testing activities with constructive activities such as requirements analysis. In addition, early quality assurance measures such as inspections provide important information on how to focus testing activities. We also support you in deriving test cases from requirements.

Security Audits and Security Concepts. Security standards such as PCI-DSS or IEC15408 keep coming up with ever new requirements on systems and development. Security gaps must be avoided, since they result in a loss of trust and can negatively affect a company's business success. We define security concepts and evaluate systems and concepts in terms of relevant security requirements.

eGOVERNMENT

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Thomas Jeswein

eGovernment Solutions for Public Sector and Business

The public sector with its more than four million employees represents one of the largest "business sectors" in Germany. It has to balance regulatory constraints, economic feasibility, and quality of service for its customers. Whether new IT solutions meet with success depends most of all on how well the public sector, business, government, and IT collaborate.

Whereas during the early years of eGovernment, the citizen as a customer of the public sector was the main focus of developments, recent years have seen a growing shift of this focus towards the interface between the public sector and business. This is where the highest gains in efficiency are expected.

ROI analyses performed prior to implementation projects ensure a project's return on investment. Using systematic and integrated requirements management and involving all stakeholders early on creates the prerequisites for high acceptance of a system. The adaption of the process model V-Modell® XT to a development organization and support for a standard-compliant process ensure that projects are performed efficiently. Service-oriented, standards-based architectures allow the integration of legacy systems and guarantee reuse and interoperability.

Your benefits:
- Needs-oriented and secure software systems
- Implementation of eGovernment strategies on the basis of empirically determined priorities
- Asset protection through future-proof, interoperable technologies
- Transparent design and development decisions

Competencies in Systems Engineering

Fraunhofer IESE assists partners from all levels of government and public institutions on their way to becoming a high-performance service provider for business and citizens. It provides advice to the public sector and to business on how to optimize their joint business processes, focusing on proving the benefits for the user. Concentrating on selected business sectors allows responding to their specific requirements and bundling online services in a way that is appropriate for each sector. A wide range of services provides support in planning and realizing needs- and future-oriented eGovernment solutions.

ROI Analyses

With the use of the screening method developed at Fraunhofer IESE, we support you in identifying, evaluating, and prioritizing process chains between business and the public sector. Extended ROI analyses permit assessing the return on investment of an IT project. Effort estimates performed prior to development projects provide the basis for deciding whether to develop on one's own or join a development alliance.

Needs Analyses and Subcontractor Support

How well a system is oriented towards the demands of the user is a decisive prerequisite for how well it will be accepted later on. We support you in eliciting these demands by involving all stakeholders and in formulating the functional and non-functional system requirements. Based on these requirements, we develop bidding documents and provide support during the subcontractor process (esp. in accordance with the UFAB regulation).

Adaptation and Use of the V-Modell® XT

Applying the V-Modell® XT, which was developed with the participation of Fraunhofer IESE, increases the quality of project results while minimizing project costs and risks. We support you in successfully planning and performing projects in accordance with the V-Modell® XT. This also includes the adaptation of the V-Modell® XT to the specifics of your software development organization.

System and Software Architectures

The use of open standards in the context of Service-oriented Architectures (SOA) ensures the interoperability of your systems. We support you in designing and implementing future-oriented architectures and in evaluating and restructuring your existing software architecture. We develop organization-specific concepts for the introduction and operation of SOA.

Security

We support you in designing secure software systems, in checking system security in terms of conformity with BSI basic IT protection, and in planning and checking secure IT infrastructures, e.g., by simulating system attacks.
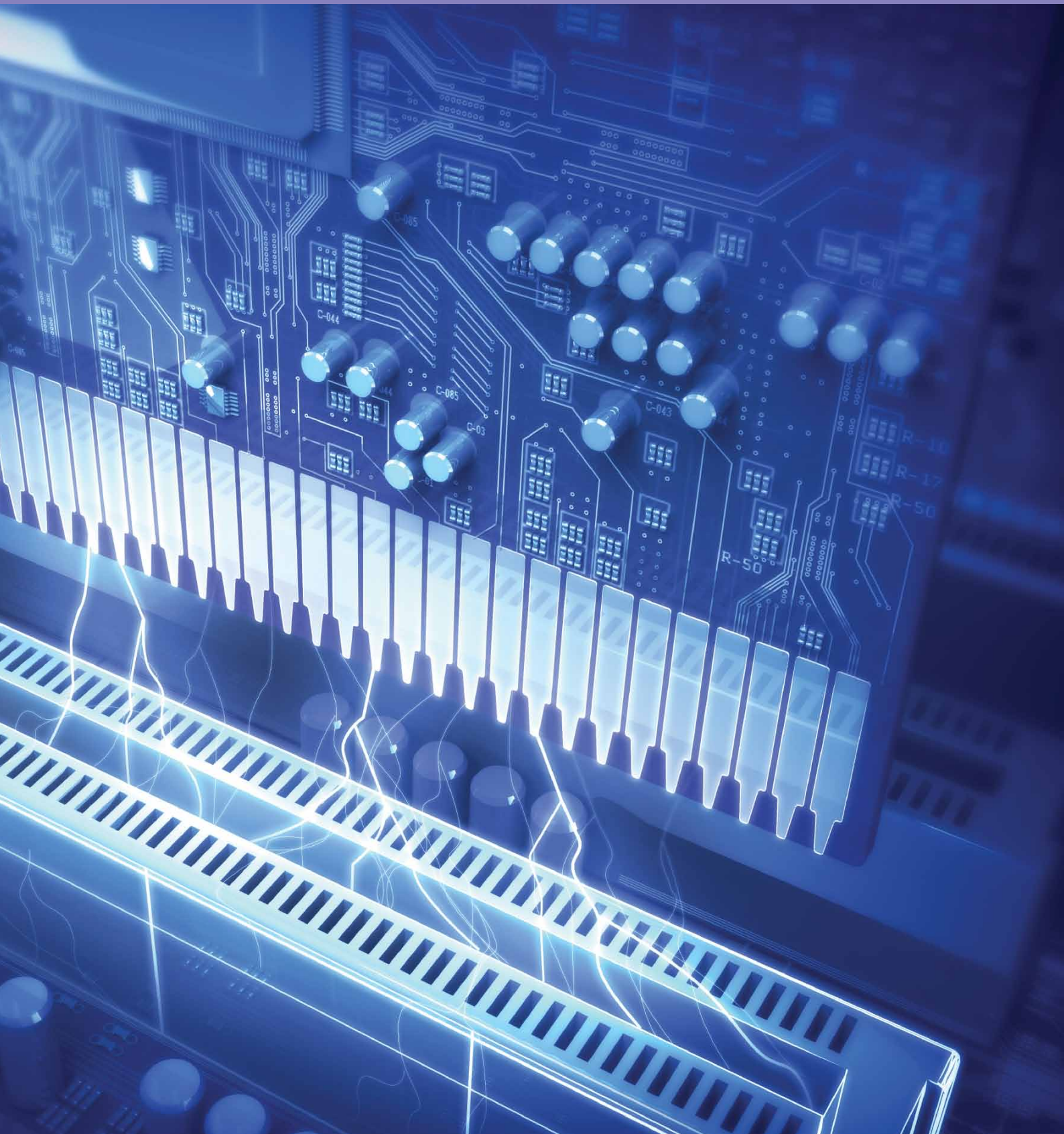
Usability

Deficiency analyses of your user interfaces based on known usability problems and pilot tests with users from representative user groups permit us to provide a solid empirical assessment of usability. Tests in our "Assisted Living Laboratory" allow us to evaluate the suitability of a given system especially for elderly people.
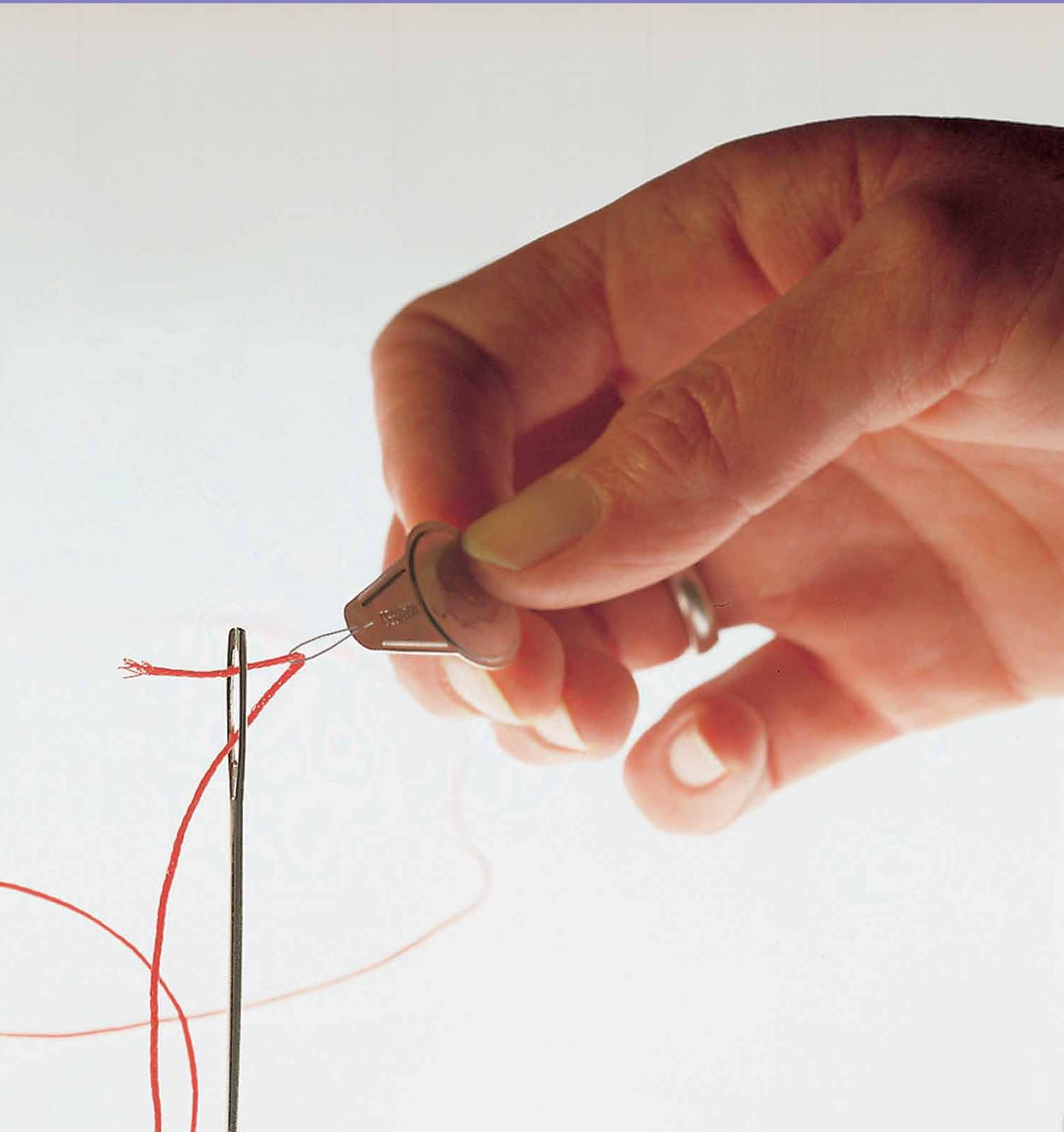
DEPARTMENTS

The divisions and departments of Fraunhofer IESE are the central pillars on which the institutes research topics are based. In the year 2010, these areas saw major restructuring, which will continue into 2011 in order to improve the line-up of the institute. The new division structure combines work on Embedded Systems on the one hand and activities in the area of Information Systems on the other hand. Particularly for the many industry partners of Fraunhofer IESE, this makes it easy to find a match to the structure of the institute. Research work related to both embedded systems and information systems or work that is independent of the type of system takes place in the division Process Management. The divisions Embedded Systems and Information Systems are each divided into two departments focusing on development methodology on the one hand and quality assurance on the other hand. This division corresponds to the structures found in industry and therefore facilitates collaboration even more. The division Process Management is divided into a department for measurement, prediction, and empiricism and another department for process compliance and improvement. The new structure reflects the current needs and allows for further strengthening of the important research areas of Fraunhofer IESE.

DIVISION EMBEDDED SYSTEMS

Hidden in transportation systems, medical devices, consumer goods, and almost all other technical products, embedded systems are performing essential tasks that make our daily lives safer and more comfortable. Every year, more than three billion embedded components and devices are manufactured, incorporating 98% percent of all microprocessors built. Embedded systems are omnipresent, and our modern economy and society would be unable to survive without them.

The requirements on the reliability and functional safety of such systems are correspondingly high. Failures can rarely be tolerated – particularly when such failures might jeopardize people or the environment. At the same time, the complexity of these systems is increasing ever faster. They are tightly interconnected, developed in a distributed manner, and have to fulfill numerous, sometimes contradictory, functional and non-functional requirements.

In order to meet these challenges, the division "Embedded Systems" focuses on innovative methods and techniques for developing highly reliable and safe systems in a cost-efficient manner.

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EMBEDDED SYSTEMS DEVELOPMENT (ESD)

In order to be able to develop such highly reliable and safe systems in a cost-efficient manner, development must focus on system quality right from the outset. This means that efficient support is needed for the developers to allow them to keep track of everything, despite rapidly increasing system complexity, and to make the right decisions based upon facts. The ESD department supports its customers during the entire development cycle from requirements to implementation.

■ Model-based Development
  If we want to model not only software, but entire systems including the relevant non-functional properties, "off-the-shelf" products often do not suffice. When it comes to selecting, adapting, and combining suitable languages and tools, the experts of Fraunhofer IESE will provide comprehensive support for model-based development.

■ Architecture Development
  The system architecture influences quality and development costs across system generations. Systematic processes in combination with automated, tool-supported architecture analyses and simulations make it possible to assess existing architectures and to identify and assess possible architecture variants early on. Architecture faults can thus be avoided proactively already during development.

■ Variation Management
  Embedded systems are often not single products, but rather product families. They must be extensible and changeable throughout their lifetime. The strategic planning of system variants and modifications enables reuse rates of over 90%. Thus, system quality increases while costs and development times decrease. The ESD department supports its customers with efficient methods for variation management – from the initial potentials analysis to the introduction of customized solutions in the organization.

EMBEDDED SYSTEMS QUALITY ASSURANCE (ESQ)

To ensure product quality, a major portion of the development costs is invested into quality assurance. Complex systems, in particular, call for efficient methods that make high quality requirements achievable and reduce quality assurance costs at the same time. The ESQ department offers its customers cost-efficient methods that allow determining a system's quality effectively and verifiably.

■ **Safety Engineering**

Fraunhofer IESE is one of the leading institutions in the area of functional safety. Our spectrum of services ranges from the introduction and implementation of all safety activities via hazard and risk analyses to safety cases. Process efficiency is particularly important in the development of software-intensive systems. By using innovative and largely automated processes, the IESE safety experts support their customers in developing even highly safety-critical systems efficiently.

■ **Model-based Testing**

Important keys to reducing costs include early performance and automation through tests. The test experts of IESE support their customers in performing model-based tests that employ automatically generated test cases to check the system already during early development phases. This saves not only costs and time, but also makes it possible to quantify the system's quality and thus make quality statements that stand up to scrutiny.

■ **Static Analyses**

Efficient quality assurance is characterized by the fact that products are not only tested, but also checked with the help of static analyses. On the one hand, this means manual inspections; on the other hand, it implies automatic checking of source code or models. The ESQ department develops innovative, cost-efficient procedures and supports its customers in performing static analyses effectively.

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DIVISION PROCESS MANAGEMENT

Processes are the core of software and systems engineering. They are an important prerequisite for managing large software and IT projects and expedite the successful realization of software innovations. High product quality is the result of high-quality processes.

Mastering and improving processes is a great challenge. In order to achieve positive effects on products and business goals, processes must be goal-oriented, efficient, and verifiable, and must be based on solid experience. We support organizations in implementing domain-specific requirements on modern process management and in evaluating software-based innovations.

Goal-oriented measurement processes, customized process techniques, advanced prediction techniques, and technology evaluations are key parts of our service portfolio. The primary goal is to link processes and their intended effect. The benefit is a significant increase in the contributions of software and IT to an organization's business performance.

References

Ericsson uses the measurement approach GQM+Strategies® of Fraunhofer IESE to model the goals and strategies of a software development unit in an integrated manner and to control it with appropriate measurement systems. For this purpose, the approach was integrated into the goal specification process and adapted to the needs of Ericsson. The adaptation of the approach led to a more accurate specification of the goals and to integrated alignment of the goals and strategies on different levels of the organization. By systematically deriving an integrated measurement system, significant improvements could be achieved in terms of monitoring goal achievement and assessing the success or failure of a strategy. The transparent documentation of goals, strategies, and appropriate measurements also provided support for the effective communication of goals and strategies within the organization.

Software systems in the space industry are subject to special quality requirements – in a collaboration project with the Japanese space agency JAXA, Fraunhofer IESE is working on the definition of appropriate development processes. In addition, Fraunhofer IESE has produced a customized process model (SETG) of the relevant European ECSS Standards for Software Development and Software Management for the European Space Agency (ESA).

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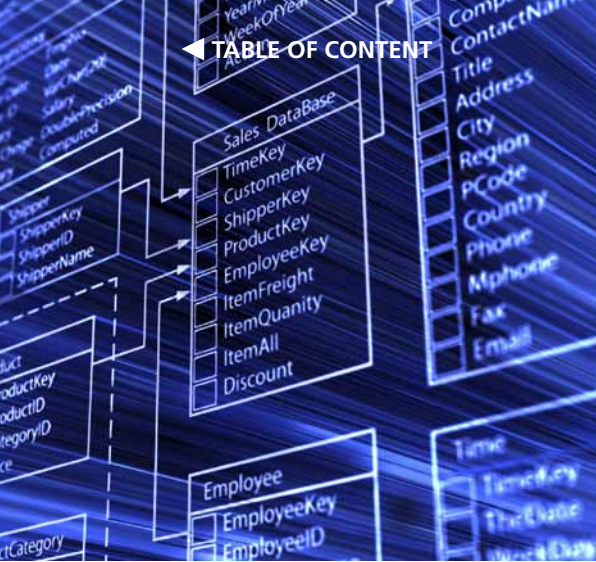jens.heidrich@iese.fraunhofer.de

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Dr. Jens Heidrich

MEASUREMENT, PREDICTION AND EMPIRICISM (MPE)

In order to develop software-intensive systems and services that fulfill all given requirements and that are delivered on time and within budget, engineering-style processes are indispensable. This includes the definition and establishment of suitable measurement systems, measurement-based controlling and evaluation of products, processes, and techniques, as well as systematic use of data for prognoses and process optimization. The practice-oriented work of the department MPE focuses on the following core topics:

- Measurement and IT/Business Alignment:
  We develop measurement systems and bring transparency to the development so that possible problems can be identified early on, risks can be minimized, and the quality of products and processes can be improved with lasting effects. We use measurement techniques to systematically align software and IT strategies with organizational goals and to achieve a clear value orientation of an organization's IT.
- Cost and Effort Estimation as well as Sizing:
  We develop prognoses early on and determine the functional scope of software. This makes it easier to assess offers and project costs and to avoid project risks.
- Quality Modeling and Defect Management:
  We develop customized quality models for evaluating software quality characteristics and establish integrated defect management.
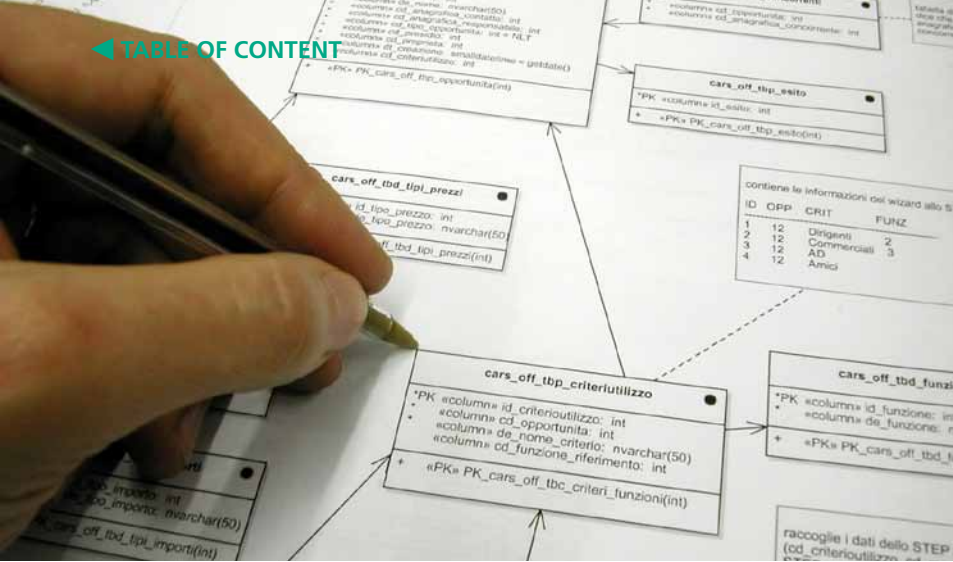
PROCESS COMPLIANCE AND IMPROVEMENT (PCI)

Processes are the driving force in the value chain of modern organizations. However, benefits can only be generated if processes are also accepted and lived. Thus, it is important to not only create process handbooks, but also to monitor the implementation and evolution of processes in daily practice. Furthermore, it must be possible to prove adherence to requirements on processes that have been accepted as binding requirements. The focus of the department PCI is on the following topics:

- **Modeling, Documentation, Evolution, and Introduction of Processes:**
  We support you in establishing lean, modifiable processes that are guaranteed to be compliant with relevant standards.
- **Process Analyses, Audits, Assessments, and Compliance Management:**
  Adherence to standards such as Automotive Spice or ITIL is required in many areas. We support you by performing gap analyses, help you to prepare for audits and assessments, teach special in-house training seminars, and assist you in fulfilling compliance requirements.
- **Evidence-based Process Improvement:**
  We offer you a simple starting point for reliably identifying improvement potential in your processes and for continually optimizing your processes, with special emphasis on the evaluation of process performance and on the ROI of improvement measures.

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DIVISION INFORMATION SYSTEMS

Modern information systems and interactive systems are becoming ever more complex. Hype topics such as service orientation or cloud computing as well as increasingly mature technologies including those in the area of mobile end devices further increase the complexity of these systems. The challenges that our customers often face are the result of multi-dimensional project settings with many stakeholders, interests, and systems as well as the complex workflows of one or several networked companies. Other typical challenges include complex user interfaces, ensuring and verifying required system qualities, and last but not least, the multitude of variants and configurations of our customers' systems.

The division Information Systems develops innovative methods and solutions for the development of complex information systems and interactive systems. In order to offer an immediate added value, we apply our methods directly during our customers' product development and/ or transfer our methods and solutions to our customers. These include organizations that use software solutions for their business processes, e.g., from the banking and insurance sector or from the domain of medical IT systems, organizations from such areas as public administration and defense, as well as software developing companies (both large corporations and SMEs).

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Dr. Marcus Trapp

INFORMATION SYSTEMS DEVELOPMENT (ISD)

We address challenges arising during development early and continuously with the help of constructive, innovative development approaches and methods, from requirements elicitation via architecture to design. Our strength lies in examining the non-functional (quality) require-ments, which are hard to capture and often affect the entire system. Clearly defined software development artifacts with clearly defined levels of abstraction allow focusing on what is really important and interlink with both traditional and agile process models.

- **Requirements Engineering**
  We support you with our renowned requirements approach Satisfy, which is tailored to your needs and goals and ensures traceability, integrated usability, and minimal documentation of the necessary requirements decisions.
- **User Experience for Business Applications**
  With our proven methods we support you in developing systems that not only support their users, but also allow having a positive User Experience. This has been proven to contribute to the achievement of your business goals.
- **Architecture-centric Engineering**
  With our successful Fraunhofer ACES approach, we support you in defining and evaluating architectures for complex information systems. The iterative, scenario-based process allows you to master the complexity of architecture definition and migration and to make reliable predictions regarding critical features of the system early on.
- **Product Line Engineering**
  Our successful approach Fraunhofer PuLSE™ supports you in establishing, developing, and managing a software product line as well as in analyzing and improving your already exist-ing configuration infrastructure for variant-rich information systems.
- **Business Goes Mobile**
  With our product GoMobile we help you to exactly identify those areas where a mobile app makes sense as support for your business processes. We can also develop a prototype that can be executed on various mobile devices to help you make your decisions.

INFORMATION SYSTEMS QUALITY ASSURANCE (ISQ)

In addition to the constructive activities needed to achieve the required product quality, efficient and effective methods are needed for quality assurance. The department ISQ offers its customers cost-efficient methods for validating the required system quality. One special focus is on the quality of security, which is becoming increasingly important for networked information systems.

- **Integrated Testing**
  Many projects expend more effort on testing activities than necessary. Fraunhofer IESE focuses testing effort by aligning and integrating testing activities with preceding software development activities such as requirements analysis, but also with inspections. Our support includes training and technology transfer, evaluation of existing testing processes, support during testing, and test case derivation.

- **Tool-supported Inspections**
  Defects that remain undetected until the testing phase cause unnecessary costs. Inspections permit performing quality assurance of your documents early in the software development cycle. We support our customers' inspectors by using the Fraunhofer tool DETECT to perform efficient manual evaluation of your development documents. DETECT offers suitable reading support, can be customized to individual quality features, and teaches the inspectors expert knowledge. Last but not least, DETECT generates clearly structured defect reports.

- **Security Audits and Definition of Security Concepts**
  Security gaps in IT systems can cause serious damages and the ensuing loss of trust can negatively affect business success. We support our customers in determining their security requirements regarding pertinent guidelines and standards. For our customers' projects, we define security concepts for infrastructure and software or perform tool-supported assessments of existing systems and concepts in terms of relevant security requirements and standard compliance.

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PROJECTS

A large number of third-party funded projects with industry for transferring innovative methods into practice and publicly funded projects for establishing new competencies is characteristic of the application orientation of Fraunhofer institutes. With all three of its divisions, Fraunhofer IESE has established itself as a strategic and dependable partner both in public programs and in major industries.

In the public sector, Fraunhofer IESE plays a leading role in important major projects. In the area of Embedded Systems, these include the BMBF project SPES2020 on the development of a platform for the model-based development of embedded systems; in the area of Information Systems, IESE is involved in the BMBF project ADiWa as well as in the BMBF Software-Cluster "Software Innovations for the Digital Enterprise" aimed at the development of interoperable, adaptive, and secure software in support of business processes. Finally, in the area of Process Management, IESE is a partner in the BMBF project Quamoco on the development of industrial quality standards. In these public projects, we are also collaborating closely with industry partners. Beyond that, the Fraunhofer-Gesellschaft is investing internal funds to establish competencies in the area of commercial vehicles (Innovation Cluster DNT) and to accelerate the transfer of know-how from the University of Kaiserslautern to Fraunhofer IESE (Innovation Center).

Direct industry projects exist with leading companies in Germany's major industries. Examples include Bosch and Audi in automotive technology, John Deere in the area of commercial vehicles, and Lufthansa Systems in the area of information systems. Projects with small and medium-sized enterprises (such as Finanz Informatik, Testo) are another focal point of our work. Our commitments abroad are steadily growing as well (e.g., JAXA, Mitsubishi, or Fujitsu in Japan, Tekla in Finland). Another special focus is on collaboration projects in Brazil in the area of medical devices as well as on collaboration projects in Australia in the area of logistics.

JOHN DEERE – MASTERING SOFTWARE DIVERSITY IN AGRICULTURAL TECHNOLOGY

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John Deere
www.deere.com

Diversity of variants as a challenge

Modern agricultural technology must deal with many product variants resulting from various usage scenarios, customer wishes, and regulatory requirements. This leads to the development of numerous variants for the respective hardware and software parts of these systems. Reuse on the level of software components is of central importance in this context: Components that are used in different ways by all variants must be identified and managed.

However, it is not easy to identify and centrally manage reusable components. Reasons for this include the complexity of the systems and of the development processes, which often results in parallel development projects not being coordinated adequately. This may lead to redundancies between the variants. Productivity losses, significant maintenance costs, and longer times to market are hard to avoid in such a situation.

**Systematic reuse of system components**

In the context of the collaboration with John Deere, Fraunhofer IESE has developed and employed systematic control of software diversity. The research topic was software for displays that are used in John Deere tractors. The displays allow controlling various functions of the tractor and of the attached implements and have a wide variety of variants due to the numerous configuration possibilities. The steps we performed to increase reuse in variants were:

- Tool-supported analysis of the differences in system variants
- Structural system modification to improve the handling of diversity
- Operationalization of the new structure with the help of configuration management

The tool-supported analysis is an extension of the SAVE tool of Fraunhofer IESE used for the static evaluation of systems. The tool is able to analyze several system variants at the same time and to identify common as well as specific software parts efficiently. In this project, four system variants with more than one million lines of code each were thus analyzed within just a few minutes.

Productivity gain for the future

On the basis of the data obtained from the analysis, the structure of the system was modified (refactored). This improvement minimizes redundancies and fully exploits the reuse potential. Subsequent projects benefit from increased development productivity due to lower implementation effort and less defects. In order to ensure the sustainability of the new system structure,
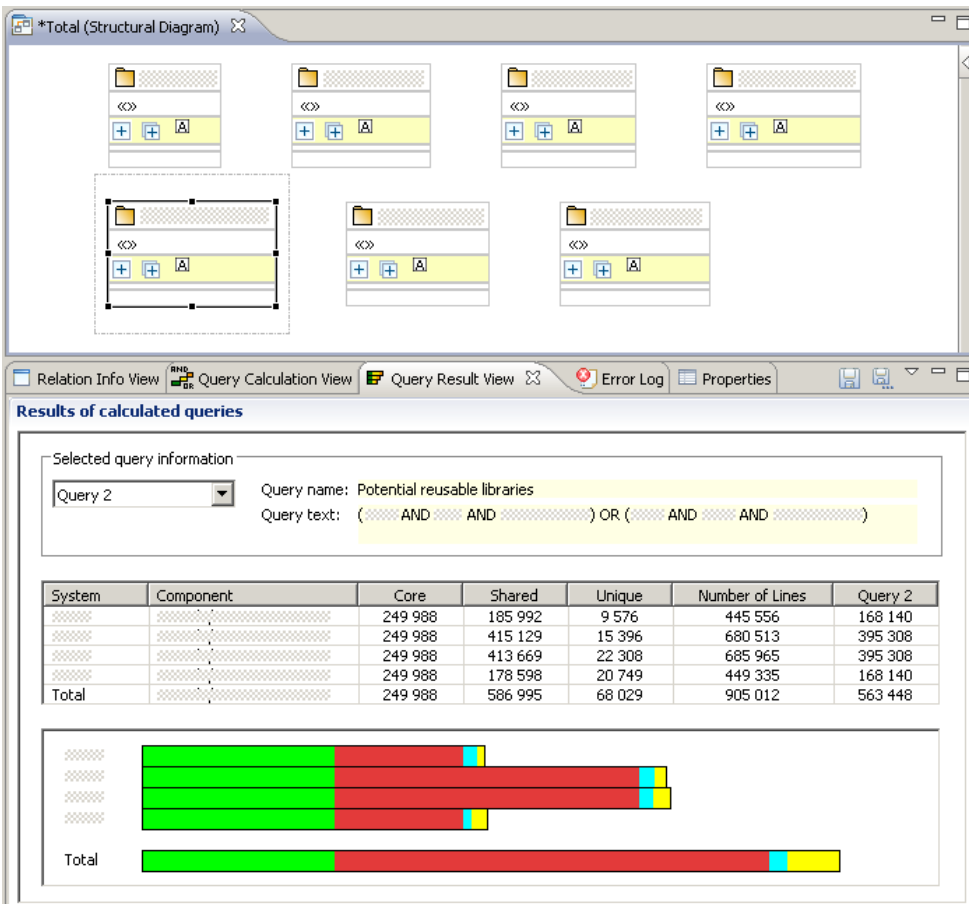
Potentials analysis for reuse made easy:

An extension of the SAVE tool allows analyzing several system variants at the same time. Bar charts and queries can help to quickly find common and variant-specific software parts.

the last step is to include it in the configuration management and to pin it down in terms of the organization. Here the focus is on the coordination mechanisms (e.g., split projects, branches) that are entered into the tool chain.

"The future-oriented applications in agricultural technology require highly interconnected, reliable, and flexible software systems. Fraunhofer IESE is our preferred partner when it comes to structuring and introducing new software architectures and system concepts."
Dr. Thomas Engel, Manager ISG Europe, John Deere

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E-NORM(OUSLY) SAFE
ELECTROMOBILITY YES, BUT SAFETY FIRST!

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"We must re-think automobiles" (Federal Research Minister Annette Schavan)

This is the goal of the AUDI research alliance "e performance" with regard to electric vehicles. The goal proclaimed by the federal government, namely, to make Germany a leading market for electromobility and to put one million electric vehicles on the road by the year 2020, is another indicator of the innovation power hidden in electromobility. This is the reason why the Federal Ministry of Education and Research provides 22 million euros worth of funding for the alliance. Under the leadership of the AUDI AG and in collaboration between partners from industry, universities, and research institutes, a totally novel system concept shall be developed for high-performance electric vehicles.

Since current automotive developments are already increasingly evoking the image of the "computer on four wheels", this goal also means, in particular, that innovative software and systems engineering is pursued. One essential aspect here is safety-oriented development. Re-thinking functional safety does not only mean applying safety standards such as ISO 26262 ("Road Vehicles – Functional Safety"), but also anchoring the requirements of this standard reflected by the accepted state of the practice in a constructive safety engineering lifecycle.

For this reason, Fraunhofer IESE as an expert in software and systems engineering in general and as a professional expert for functional safety in particular was included in the project as a sub-contractor by Audi Electronics Venture GmbH. The support provided by IESE concerns the entire safety lifecycle as demanded by ISO 26262. During the course of the project, it shall be implemented with innovative ideas and techniques using electric vehicles in order to learn today already about the safety-oriented development of the future in practice.

Further Information

Project Homepage
www.audi.de/eperformance

Special challenges include mastering the complexity of future, strongly interlinked vehicle functions and their efficient and effective validation. To achieve this, Fraunhofer IESE is migrating paradigms of traditional, engineering-style development to safety-oriented development. After less than half of the project's runtime, significant successes can already be seen. The project leader on the side of AUDI, Dr.-Ing. Christian Allmann, commented:

"Today, the development of safety-relevant applications in vehicles demands sophisticated safety engineering methods in order to prove that the requirements are fulfilled. Fraunhofer IESE is the first place for us to go when it comes to evaluating new methods in this area. This is also reflected by our partnership in the research project e performance, which propagates the holistic approach for the development of electric vehicles in the area of safety as well."

The current project results include:

- A model-based approach to hazard and risk analyses developed by IESE, which addresses not only the completeness of the analysis but also provides automated validation of the consistency of the risk assessment.
- The application and reuse of the modular and model-based approach "Safety Concept Trees" (SCT) developed by IESE for the efficient and effective development of safety concepts.
- The integration of safety analyses and functional, model-based development using "Component-integrated Component Fault Trees" (C²FTs). These enable the use of architecture information for deriving and creating component-based fault trees (CFTs).

Collaboration Partners

AUDI AG
www.audi.de

Audi Electronics Venture GmbH
www.audi-electronics-venture.de

RWTH Aachen
www.rwth-aachen.de

Robert Bosch GmbH
www.bosch.de

Bosch Engineering GmbH
www.bosch-engineering.de

Further Reading:

FUNCTIONAL SAFETY IN THE MODEL-BASED DEVELOPMENT OF EMBEDDED SYSTEMS – SPES 2020

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SPES

GEFÖRDERT VOM

Bundesministerium
für Bildung
und Forschung

Embedded systems are of crucial importance for our economy and our society. Most of the time, we only realize how dependent we are on these systems – which usually work behind the scenes – when they do not work. Particularly in safety-critical systems such as airplanes, automobiles, or trains, software defects can easily have life-threatening consequences. Companies are thus not only faced with the challenge of developing ever more complex systems with novel types of technologies within less and less time, but they must also be able to guarantee and prove the safety of such systems at the same time. Whereas new processes for mastering the complexity of system development are being developed on a large scale, companies must frequently rely on conventional, outdated processes when trying to provide documented evidence of adherence to safety requirements. Safety cases thus increasingly become the bottleneck and, in light of rapidly increasing system complexity, lead to an explosion of development time and costs. The ability of an organization to perform safety cases efficiently is thus increasingly turning into a crucial factor for staying competitive. In the innovation alliance "Software Platform Embedded Systems - SPES2020", which is funded by the German Federal Ministry of Education and Research, safety cases and the certification of embedded systems therefore form one of the central cores of work under the leadership of Fraunhofer IESE.

In order to optimize the efficiency of safety analyses, fault trees as a well-established analysis technique have been integrated seamlessly into model-based development in the context of SPES2020. In addition to the support provided for the modeling approach developed in SPES2020, the UML as an established modeling language has also been extended. This makes it possible to model not only the function itself, but also modular fault trees as an integral part of the system, which has two major advantages: (1) It makes fault trees an integral part of system components. If these components are reused, the fault trees that were created can also be reused automatically. (2) At the same time, many steps can be automated. It is, for example, sufficient to model the fault trees of individual components – the analysis of the overall system is then automated. Another example is that the consistency between development models on the one hand and safety models on the other hand is easy to check automatically – a step that requires large manual effort today. Note that the approaches developed here are not merely theoretical in nature, but have rather been integrated into commercial tools and are being evaluated together with Cassidian Electronics in the area of aviation. In collaboration with industry partners, the approaches have also found their way into application outside the project.

EMBEDDED
SYSTEMS

Innovation durch Intelligenz
Software macht´s!

IKT 2020
Softwaresysteme
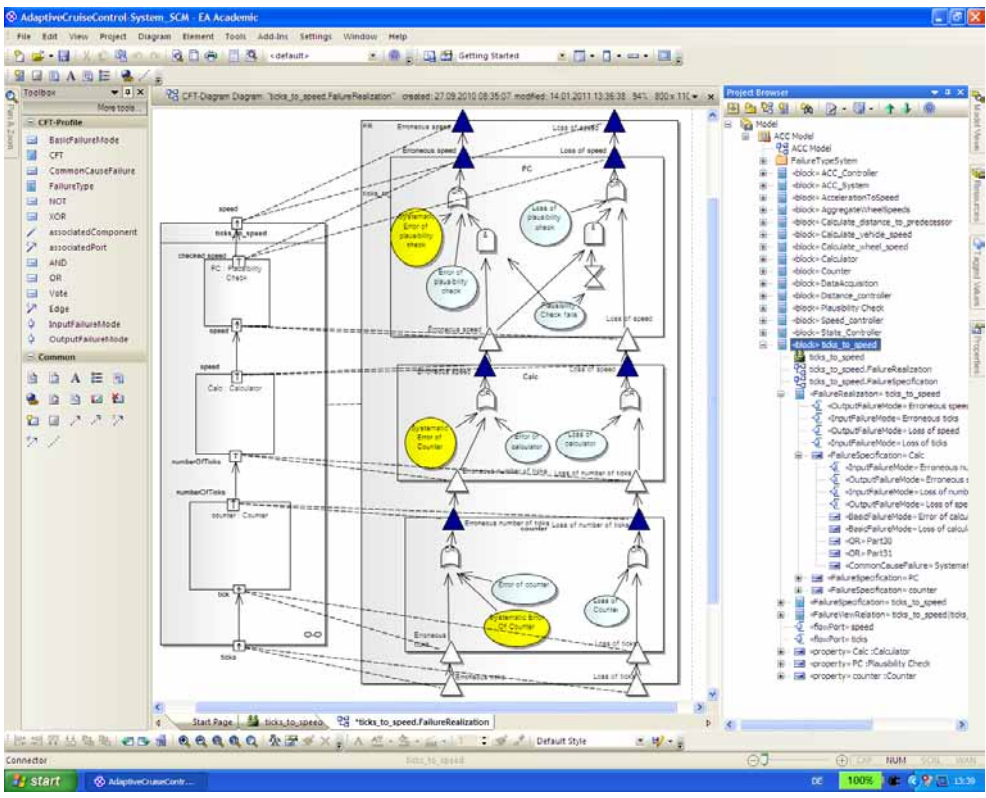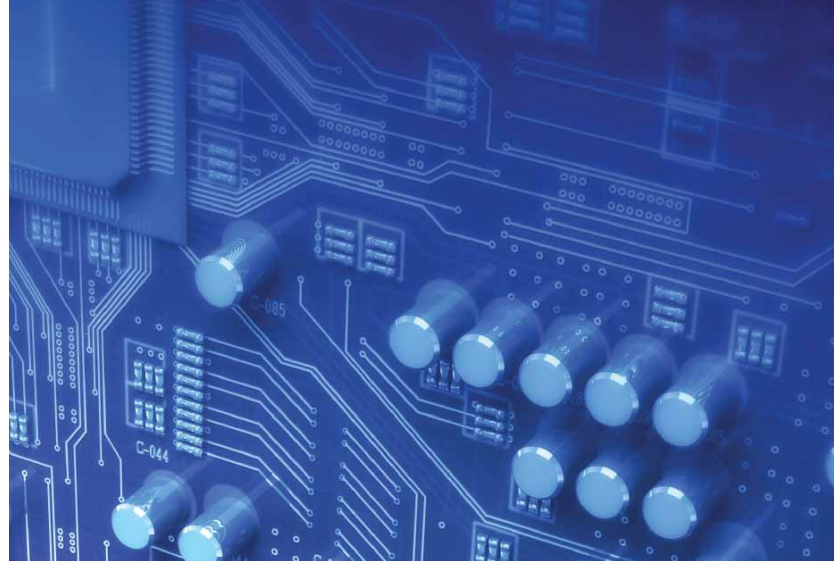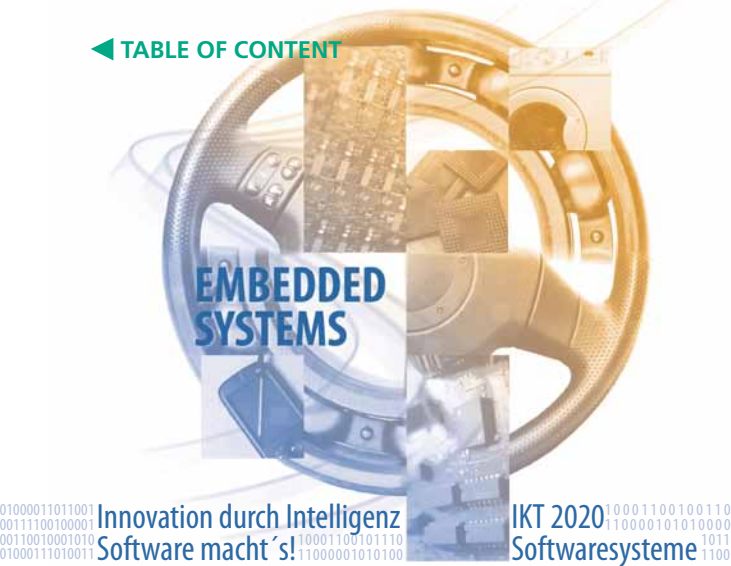
Through the seamless integration of fault trees into commercial SysML modeling tools, safety analyses can be performed much more efficiently. Many steps can be automated; reuse is simplified, and the consistency between the development model and the safety model is formally validated.

The approach is being studied together with Robert Bosch GmbH in the context of plausability checking in industrial environments. If we look at so-called integrated architectures, such as AUTOSAR in the automotive industry, the execution platforms and the applications executed on them are developed independent of each other. The supplier of the platform wants to supply a safe platform that is certified, if possible, without knowing the applications. Application suppliers want to be able to guarantee safety without knowing other applications or the platform. At the same time, the integrator wants to ensure that all applications together with the platform will constitute a safe system. In the context of this project, an approach has therefore been developed that makes it possible to model the respective safety concepts independent of each other and to get the sub-components certified in a modular way. When integrating application and platform, it is then possible to a large extent to check automatically whether the resulting system will fulfill the overall safety requirements. This increases the reusability of components in safety-critical environments and decreases the effort that needs to be spent on providing safety cases for the overall system.

Collaboration Partners

see Project Homepage
http://spes2020.informatik.tu-muenchen.de/partner.html

Further Reading:

FRAUNHOFER INNOVATION CLUSTER "DIGITAL COMMERCIAL VEHICLE TECHNOLOGY"

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Further Information

Fraunhofer Innovation Cluster DNT
www.nutzfahrzeugcluster.de

Modern agricultural machines and implements are software-controlled high-tech constructions. The driver can comfortably control all important functions via touchscreen: Thanks to this ingenious technology, the vehicle stays on track in the field and harvest quantities are entered into electronic maps, enabling the farmer to trace them at any time. Similar requirements are also fulfilled by the systems used in modern trucks, construction vehicles, or busses. The proportion of electronic control systems, the use of embedded software, and especially the simulation employed in the development of new products are continually increasing everywhere.

Pre-competition preliminary research in the Innovation Cluster
In order to deal with this complex issue, collaborations between research and business are expedient. Therefore, since April 2007 the Fraunhofer Innovation Cluster "Digital Commercial Vehicle Technology" has been aiming at linking the research and development competencies in the area of commercial vehicles and at advancing the development of embedded software in vehicle development as well as the use of software-supported simulation methods. To this end, the cluster unites the two Rhineland-Palatinate Fraunhofer Institutes for Industrial Mathematics (ITWM) and for Experimental Software Engineering (IESE) with companies from south-western Germany as well as from the region of Saarland/-Lorraine/Luxembourg with the goal of establishing a platform for the cooperation of researchers and engineers from universities, research institutions, and industrial companies. The Fraunhofer Innovation Cluster is embedded into the Commercial Vehicle Alliance of the state of Rhineland-Palatinate and focuses on the technology transfer of innovative technologies and methods into industry. Financial support for the pre-development of demand-oriented solutions comes from the Fraunhofer-Gesellschaft and the state of Rhineland-Palatinate. The cluster partners can use the research results in bilateral projects in real time and participate in the research planning via regular interchanges with the Fraunhofer researchers.

Technology transfer into companies
One example of the application-oriented cooperation of IESE in the Innovation Cluster is the collaboration with John Deere, a large, internationally operating manufacturer of agricultural machinery. The goal of this collaboration is to make modern IT technologies usable. GPS-con-

Modern agricultural machines are high-tech products on wheels.

trolled field work, for example, increases the efficiency of the harvest, provides data for fertilization and for the use of pesticides, and hence offers major advantages compared to former, non-GPS-supported methods. In order to develop products such as this in a market-oriented fashion, the Innovation Cluster closes the still existing gap between research and the application of new methods in everyday industrial life by linking research work tangibly with practice-oriented application.

In terms of content, the researchers from Fraunhofer support the agricultural machinery manufacturer in mastering the ever more extensive and complex software parts in their vehicles. The challenge lies in creating a flexible system architecture, which must sustain new technologies and functions while maintaining the high requirements of an investment asset regarding safety and reliability – at acceptable development costs. The work thus comprises research on the ideal software-product structure as well as measures to increase productivity during development. One important aspect in this context is variation management for the various vehicle configurations. With the help of appropriate tools, common software parts can be identified and combined within the scope of a structural modification of the system. This reduces the effort for maintenance and changes and increases the productivity of the development.

In the years 2011-2013, the successful cluster concept will be continued with new focus areas in the application context of commercial vehicles under the motto "Vehicle / Environment / Human-Interaction".

Cluster Partners

Bomag
www.bomag.de

BPW Bergische Achsen
www.bpw.de

Daimler AG
www.daimler.com

EvoBus
www.evobus.com

GE Transportation Systems
www.getransportation.com

John Deere European Techno-logy Innovation Center
http://www.deere.de/de_DE/about_us/jd_germany/etic_kaiserslautern

John Deere Werke
www.deere.de

Keiper GmbH & Co. KG
www.keiper.com

Liebherr EMT
www.liebherr.de

LöSi GmbH
www.loesi.de

MB-technology GmbH
www.mbtech-group.com

Robert Bosch GmbH
www.bosch.de

Schmitz Cargobull AG
www.cargobull.com

Terex
www.terex.de

Volvo CE GmbH
www.volvo.com/constructionequipment/europe/de-de

Further Reading:

INNOVATION CENTER
APPLIED SYSTEM MODELING

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Fraunhofer ITWM
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Transferring research results into practice – this is the mission of the Fraunhofer-Gesellschaft. In order to support this even better in the future, the Applied System Modeling Innovation Center was founded in Kaiserslautern. In the context of this center, scientists from Fraunhofer and from the University of Kaiserslautern are performing research on new software engineering topics and their transfer into practice.

This results in accelerating the transfer of research results in the area of software engineering into industry. One special focus is on the areas of modeling and evaluation of embedded systems, on their visualization, on development methods for safety-critical systems, and on distributed as well as on parallel software systems.

- Modeling and evaluation of embedded systems: Even though software plays an ever greater role in the development of embedded systems, it must still be developed in the context of electrical and mechanical components. Furthermore, integration with the system's environment is necessary. In order to make this possible, we explore improved interfaces and simulation processes that allow looking at systems in their future environment already during development and make it possible to detect faulty interfaces, resource bottlenecks, as well as undesirable interactions early on.
- Another topic is the visualization of embedded software systems. Modern software quickly becomes so complex that some form of intelligent visualization is required. Developers can focus on the essential aspects of the system and can simply disregard irrelevant details. In this way, they can quickly get an overview of a system. By integrating this visualization into our proven SAVE tool, it can be ensured that the developers will not get lost in the system.
- One focus area of Fraunhofer IESE are safety-critical embedded systems. In the context of the Innovation Center we are developing a technology that allows separating safety-critical functions from less critical functions. Fallback levels are also supported, which are activated immediately in the event of a failure. This simplifies the development of complex systems under increased safety standards.

■ Future software systems will be distributed and parallel – independent of whether we look at large information systems or high-performance embedded systems. In the context of the Innovation Center, we thus develop and transfer software development methods for distributed and parallel software systems. These enable even developers who are not experts in parallel software development to develop service-oriented systems and to make efficient use of the performance spectrum of modern multi-core processors.

The results of these key topics are integrated with each other in a so-called Living Lab, which is application-oriented. During the center's first stage, the focus is on the area of vehicle technology.

This Living Lab offers scientists, engineers, representatives of industry, and students the opportunity to use the technologies described above on site and to make experiences with them. This ensures that the research results are used in industry-oriented scenarios and thus result in an actual benefit. Results from basic research at the university can be transferred into a practice-oriented environment much faster and can be evaluated, and students gain practice-oriented experience.

Representatives from industry can also use the services of the Living Lab to improve the quality of their products without having to purchase the necessary complex and expensive tools themselves. This enables small and medium-sized enterprises, in particular, to use expensive technologies and tools whose purchase and use would otherwise not be economically feasible.

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Further Reading:

BUSINESS ALIGNMENT IN THE OIL AND GAS INDUSTRY
ON THE ROAD TO SUCCESS WITH THE RIGHT SOFTWARE AND INFORMATION STRATEGY

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ECOPETROL S.A.
www.ecopetrol.com.co

Further Information

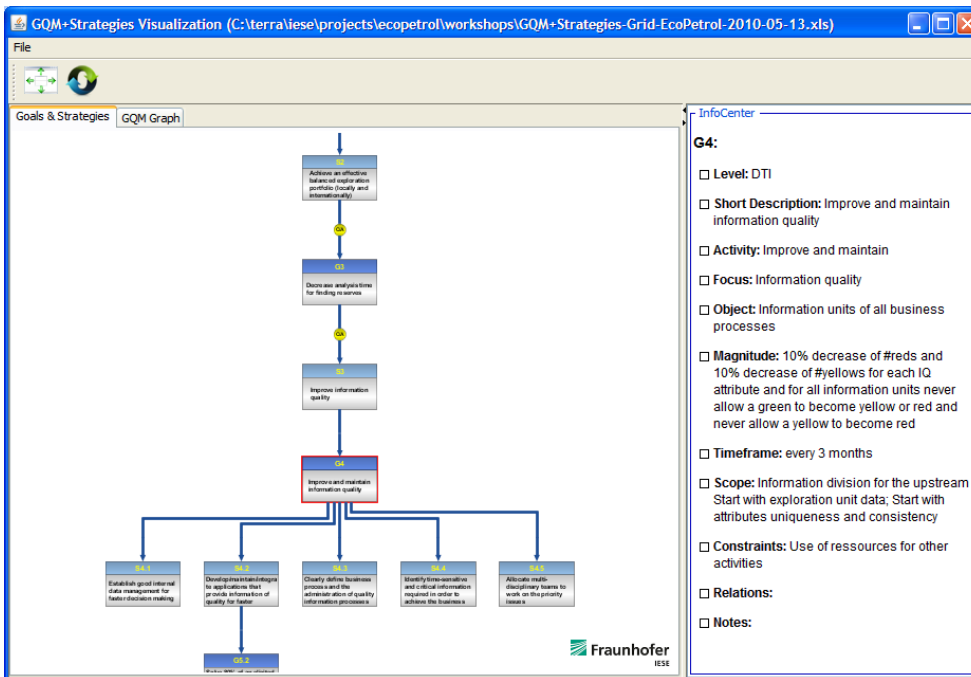GQM+Strategies®
www.iese.fraunhofer.de/
products/gqm

Software-intensive systems and services are becoming increasingly important in today's information society and thus constitute a central driver for innovation and growth in an organization. One of the consequences is that business success depends on IT and software strategies and that it is extremely important for an organization to look at these strategies in the context of the business goals pursued and to align them accordingly across the entire organization. This comprises the systematic derivation of IT and software strategies from business goals on the one hand and the ability to clearly demonstrate the contributions made by IT and software development to the business goals on the other hand.

In order to address these issues and to provide systematic support for "Business Alignment", the GQM+Strategies® approach has been developed in recent years. This approach uses goal-oriented measurement processes to support the explicit alignment of goals and strategies across all levels of an organization. Goals, strategies, and measurement data are systematically aligned with each other, gaps and inconsistencies are shown, and the derivation of action recommendations is facilitated by means of a decision model.

In the year 2010, ECOPETROL, one of the worldwide leading companies in the oil and gas industry, launched an initiative for aligning its IT- and software-related activities better with its business goals. This initiative changed the traditional role of IT from a classical service provider and easily replaceable cost factor in the company to a central information provider that contributes to the company's success by providing high-quality information when critical management decisions must be made. In order to achieve this, the goals and strategies of the IT department had to be mapped to the business goals of ECOPETROL and their value had to be made more transparent in terms of the overall organization. In addition, a KPI system was developed to enable the objective assessment of the success/failure of a strategy and its optimization over time.

The application of GQM+Strategies® at ECOPETROL has shown that its use can noticeably improve the transparency and traceability of strategies and goals:
- Transparent description and harmonization of goals, strategies, and measurement data across all organizational levels.
- Clarification of the value contributed by IT and software development in terms of the organization's business goals.
- More consistent communication of goals and strategies across all organizational levels.
- More objective decision making by measuring the achievement of goals and the success/failure of strategies.
- Clear rationale why goals and strategies are pursued.

The GQM+Strategies visualization tool is used interactively in workshops to model the relationships between an organization's goals and strategies and their success and to assess them by means of measurement data.

In the first projects with ECOPETROL, the focus was on measuring the quality of the information as a central basis for assessing the IT services. In the future, the measurement program and the GQM+Strategies® model shall also be extended to other areas and the circle of users shall be expanded. The tool support provided by the approach for visualizing the resulting models (see figure) shall also be extended in this context. Future focus areas will include using the approach in highly dynamic business areas and applying it in the context of small and medium-sized enterprises (SMEs).

"With GQM+Strategies®, we were able to make the contribution of the information management strategy to the business goals explicit."
Dr. Alexis Ocampo, Group Leader Enterprise Architecture, ECOPETROL

Further Reading:

ESTABLISH STANDARD-COMPLIANT PROCESSES AND MAINTAIN THEM SUSTAINABLY WITH OPTIKON

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In global competition, particularly small and medium-sized enterprises (SMEs) are facing ever greater challenges. Customers are no longer just the partners next door, but often include globally-oriented organizations, which demand mainly one thing: compliance with their requirements and rules, often also with numerous additional (industry) standards. There exist a great number of such standards and norms, ranging from very general works such as ISO/IEC 12207 or ISO/IEC 15504 via specializations such as ECSS and Automotive SPICE to very industry-specific standards such as the DIN standard 087 Fahrweg und Schienenfahrzeuge (FSF; Railway Standardization Committee) for railroad applications. Furthermore, standards of other countries must frequently be complied with as well – an issue that also plays an important role for the export-oriented German industry. Proving compliance with the required standards is usually done via formal checks of projects or processes (often called "assessments" or "audits" in the area of software). When the number of standards that an organization must be compliant with rises, the number of checks to be performed thus also rises – resulting in an enormous increase in the effort and costs required for such checks. This affects both suppliers, represented in this project by the Schalker Eisenhütte Maschinenfabrik, and their customers, in this project represented by Deutsche Bahn.

This regularly results in a problem for SMEs, which sometimes even threatens the very existence of such a company: How are SMEs supposed to know which rules, standards, and laws they must adhere to for a specific customer, in a specific country, for a specific product? And once the constraints to be adhered to have been determined, the next question arises: How do SMEs manage to adhere to these constraints concurrently for a multitude of customers, markets, and products and how can they prove this adherence in a cost-efficient way? In addition, the processes of SMEs must be maintained and evolved in the mid- and long-term in such a way that this standard compliance, which often required a lot of effort to achieve and prove, can be maintained – how can SMEs manage all this?

In the context of the project OPTIKON, concepts and technologies are being developed that help to provide answers to these questions. The focus is on:

- A scoping methodology for determining the requirements on the processes and for focusing the corresponding processes (taking into account one or several standards);
- A multi-model gap analysis for simultaneously checking compliance with one or several standards and verifying the respective standard compliance; and
- A methodology for the long-term, standard-compliant evolution of the processes.

The scoping methodology evaluates and controls the development of business software processes explicitly in terms of the foreseeable and planned future development of the organization. This includes determining the organization-specific process needs and aligning them with the capabilities provided by the current and potentially usable processes. Recommendations can then be derived on which processes should continue to be used and possibly could and should be evolved, and which processes are less helpful and may thus be eliminated in the future. Existent knowledge regarding planned products and projects and mid-term business goals are used to determine which standards and norms must be implemented.

Multi-model gap analysis allows companies to check adherence to all or the majority of the standards that are relevant for them with a single audit. This translates into enormous savings, since no separate audit is required for each standard. Example: A company delivers software products for worldwide use. The European automobile market requires compliance with ISO/IEC 15504, whereas the American market requires compliance with CMMI. Both standards cover, among others, the areas of development and project management. Here, ISO/IEC 15504 is significantly more detailed regarding the development processes, whereas CMMI focuses more on the project management processes. If a company were to orient itself solely towards one standard, this would inevitably result in gaps regarding compliance with the other standard, with possibly serious consequences for the success on the respective market. If a company were to perform parallel checks in accordance with both standards, the result would be significant extra effort, since the fundamental questions that are identical in both standards would be asked twice. The multi-model gap analysis from the project OPTIKON, however, allows avoiding this double effort and still checking each standard completely.

In order to achieve long-term evolution of a company's processes in compliance with standards, the corresponding methodology relies on a proactive approach: By tightly connecting the processes with the standards affecting them it can be decided for each suggested change whether process parts are affected that are relevant for compliance. If this is not the case, the change can be implemented directly; if such a part is affected, a more profound analysis is per-formed in order to maintain standard compliance either by means of suitable measures – or to give it up in a conscious decision.

Collaboration Partners

OrgaTech GmbH
www.orgatech.org

Schalker Eisenhütte
Maschinenfabrik
www.schalker-eisenhuette.de

Deutsche Bahn AG
www.deutschebahn.de

Further Reading:

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SOFTWARE QUALITY MODELS FOR USE IN PRACTICE

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Project Homepage
www.quamoco.de

Quamoco
Der Qualitätsstandard für Software

Bundesministerium
für Bildung
und Forschung

A consortium from research and industry is currently working on developing a quality standard for software products made in Germany. The goal: to make it possible in the future to measure and prove the efficiency and feasibility of software. The project members are therefore working towards an approach for the certification of software products in terms of quality. In this way, a quality seal "Made in Germany" shall be established for software as well, with other industries serving as a model: There, criteria for quality assurance and detailed standards have already proven their value; in some cases, adherence to these criteria and standards is even prescribed by law. Although the software industry is of central economic importance, similar approaches are missing to date.

Already existing standardized frameworks for software quality such as ISO 9126 and the ISO 25000 series currently being developed are rarely used directly, since the criteria provided there are too general and are hard to transfer to concrete software development projects. Some companies make do with their own quality guidelines, which frequently only consider selected areas of software quality. However, an integrated and verifiable quality standard would be desirable, especially in the context of outsourcing and offshore development, since this would enable more unambiguous and improved controls. The project Quamoco (Software Quality: Flexible Modeling and integrated Controlling) aims at establishing such a standard. To do so, requirements from different areas are integrated and placed on a common foundation.

The quality standard will take into account the multitude of different software products, such as embedded systems, mainframe applications, entertainment systems, or highly safety-critical control systems. The basic quality standard being developed will be applicable across different domains and will be complemented by exemplary, domain-specific quality standards. In order to achieve this, organizations focusing on different areas in software development and several research institutions are involved in this collaboration: Capgemini, Fraunhofer IESE, itestra, SAP, Siemens, and Technische Universität München.

The standards are described using detailed quality models. These refine important quality characteristics of the software product in order to enable quality assessments from different perspectives. In addition, they contain information about the properties of software artifacts that have an impact on the quality of the product, as well as measurement data for measuring them. Assessment rules defined in the model, which are determined using sound processes, allow the software quality to be assessed early and to identify potential weak spots in the checked products.
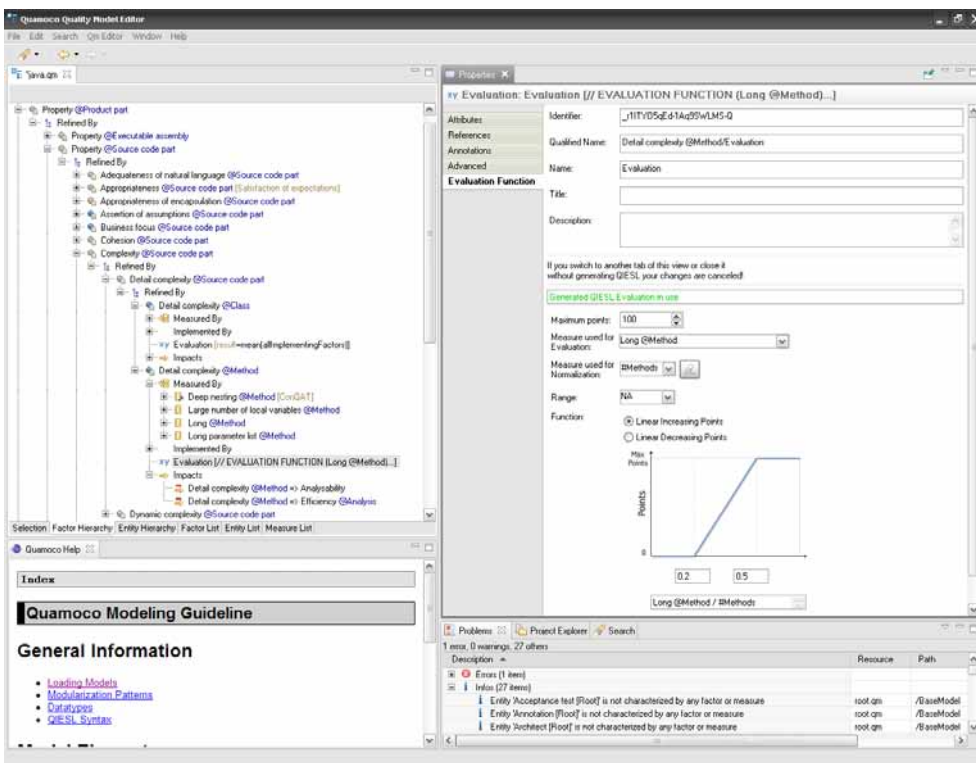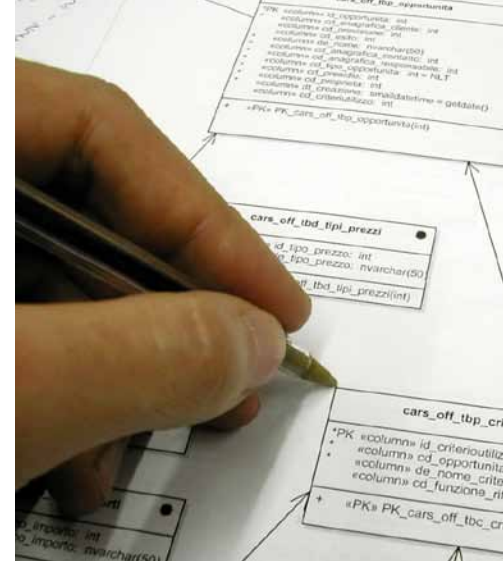
The Quamoco QM-Editor provides support in the creation and adaptation of consistent software quality models.

Collaboration Partners

Capgemini AG
www.capgemini.de

itestra GmbH
www.itestra.de

SAP AG
www.sap.de

Siemens AG
www.siemens.de

TU München
www.tum.de

In order to keep detailed quality models consistent and to allow them to be adapted to different circumstances, the partners are developing a specialized editor to support the creation and maintenance of quality models. This editor does not only check the syntactical correctness of the respective model by means of an empirically validated meta-model, but also provides support in selecting and adapting the model and in defining specific assessment rules. Another tool offers support in collecting and packaging the information needed for the assessment, for example by activating existing or new measurement tools.

The contribution of Fraunhofer IESE to the project mainly consists of its expertise in the measurement-based definition and assessment of software quality as well as an understanding for the forces that affect software quality. The focus is on the sound definition and application of quality models tailored to concrete usage environments and purposes. Testing of the quality standards is being supported by Fraunhofer IESE as well and takes place in several cycles together with the industry partners.

Further Reading:

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PROASSIST4LIFE
PROACTIVE ASSISTANCE FOR CRITICAL SITUATIONS – EMERGENCY DETECTION FOR SENIOR CITIZENS

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Thr Project ProAssist4Life

According to current estimates, one out of three people over the age of 65 suffers a serious fall once a year; for people over the age of 80, it is almost one out of two. Many accidents happen in private homes during everyday activities, often at night. It frequently takes hours until help arrives for the affected person. Even home emergency call systems only offer limited support, since an elderly person is often not capable of issuing an emergency alert because he or she is injured or disoriented, or is simply not carrying he push button. If helplessness is detected late, the effects can be very serious. Epidemiological studies show that following a fall and subsequent hospitalization, elderly patients are much more likely not to be able to continue living on their own, but must rather be released to a nursing facility.

Help shall be provided by an intelligent system that recognizes such emergencies automatically and reacts to them. Although promising approaches exist in research environments regarding the automatic detection of helplessness at home, these have not yet been realized in concrete products so far and are thus not available on the market – despite great demand. This supply gap can be closed effectively with this project. The project ProAssist4Life is therefore about developing an integrated software and hardware solution for home environments that can be used to detect situations of helplessness in a cost-efficient, anticipatory, and unobtrusive way, and it is about providing adequate assistance.

The ProAssist4Life Solution

The partners are working on developing an unobtrusive system that will permanently "accompany" elderly people in their own home or in a senior citizens' home. Multi-sensor nodes mounted to the ceiling of the rooms capture the resident's movement patterns. The data are then transmitted wirelessly to a computer. Software is used to document the resident's activities of daily living, and thus continually learns what his "normal behavior" is. The evaluation

program permanently compares the current activity of the resident with the model. This is how it recognizes deviant situations that might indicate that the person has suffered a fall, is lying motionless on the floor, and is in a situation of helplessness. If the elderly person does not react to the contact made by the system, the software will send a text message to inform a trusted person, such as a family member or caregiver.

The ProAssist4Life solution comprises:

■ A novel, cost-efficient multi-sensor node, which can be used to capture the activities and conditions in the home environment and on the part of the user;
■ An integrated framework for personalized situation recognition from the home environment, which can be used to detect and anticipate stereotypical assistance situations automatically and which can also be used to plan and provide assistance that is appropriate for the respective situation;
■ An interaction module that allows intuitive integration of the resident and his/her social network as well as professional assistance services into the assistance process, and
■ A compact middleware, which allows using the software components on different hardware platforms, such as set-top boxes.

"Initially, our solution is intended as a supplement to conventional home emergency call systems and shall improve the feeling of safety of users and family members. In the long run, both systems shall be integrated. "
Prof. Dr. med. Christian Madler, Medical Director, Institute for Anesthesiology and Emergency Medicine I, Westpfalz-Klinikum Kaiserslautern

Collaboration Partners

Westpfalz-Klinikum GmbH
www.westpfalz-klinikum.de

Binder Elektronik GmbH
www.binder-elektronik.de

CIBEK technology + trading GmbH
www.cibek.de

Further Reading:

STANDARD-COMPLIANT MONITORING OF MEASUREMENT DATA

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Securely capture production parameters electronically that require verification

In the production of food or pharmaceutical products, there are high requirements regarding production, storage, and transportation conditions in order to exclude any hazard for the consumer. This is the reason why critical process parameters such as temperature and moisture are carefully monitored and documented. Nowadays, electronic records are preferred. With its guideline 21 CFR Part 11, the U.S. Food and Drug Administration (FDA) sets a recognized standard that determines the conditions under which electronic records and electronic signatures are recognized by the FDA as valid proof.

Testo AG in Lenzkirch is a leading manufacturer of measuring and monitoring systems. With the measuring system Saveris™ Testo offers a product family for the distributed, wireless monitoring and recording of temperature and moisture values. Testo has also developed an FDA-compliant Saveris variant that corresponds to the particularly strict requirements of Part 11. Since the regulations of 21 CFR Part 11 allow some room for interpretation, the manufacturers and users of Part 11-regulated systems are worried whether their technical and organizational implementation will really be accepted by the FDA. Testo therefore decided to collaborate with Fraunhofer IESE in order to have the standard compliance of its Saveris series independently validated. With Fraunhofer IESE, they found a natural competence partner for such a check, since most of the requirements relate to properties of software and software-related processes.

In this collaboration project, the task of Fraunhofer IESE mainly consisted of eliciting and running through all Use Cases that are Part11-relevant when using the measuring system and to check whether all the requirements of the CFR guideline are fulfilled completely in terms of such performance features as authentication, authorization, user guidance, data integrity, data authenticity, or data availability. The top principle of 21 CFR Part 11 is that only authorized employees may obtain access to the measurement data, and that each interference with the data or with the measuring system must be traceable at all times and must be allocable unambiguously to a specific user. Furthermore, it must be ensured that the recorded data can be reproduced true to the original at all times during the entire burden of proof period and can be presented to the FDA for checking in a suitable format.
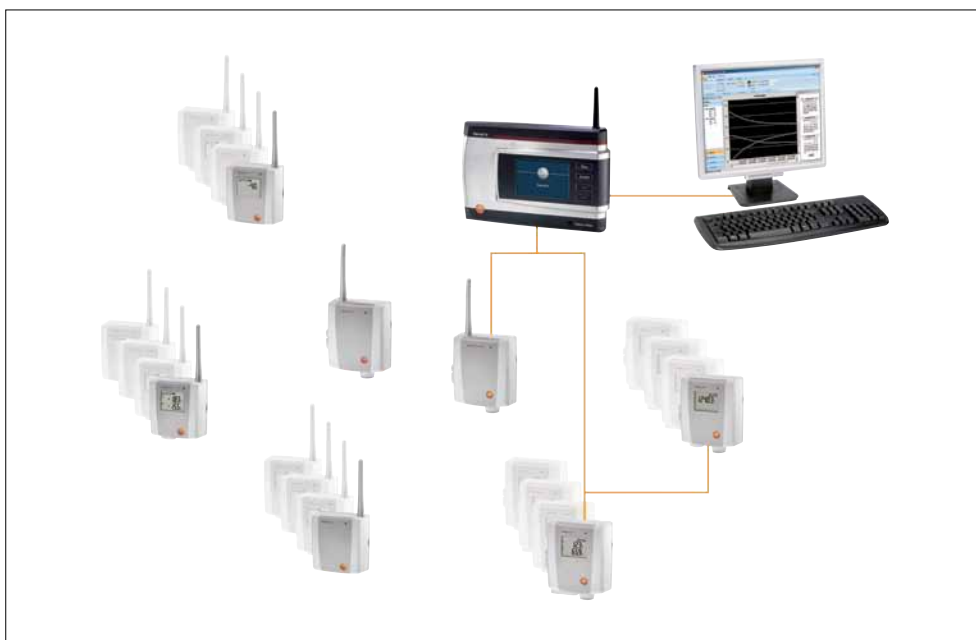
Components of the measurement system Testo Saveris™

For the conformance checks, a reference configuration was set up at the institute and subjected to systematic tests. During the course of the evaluation, Fraunhofer IESE was able to identify various critical usage steps whose technical implementation was modified systematically in order to ensure unambiguous standard compliance even under adverse conditions and at acceptable costs in the best possible way. Concurrently, instructions were designed for the system user to help him/her operate the system in compliance with the guidelines.

The result was a checking report created by Fraunhofer that provides comments on all requirements of 21 CFR Part 11, point for point, and demonstrates how the Saveris system implements the respective requirement and which concomitant measures (so-called procedural controls) the system user should take to fulfill his burden of proof towards the FDA. With its documented standard compliance, the measurement system Saveris™ of Testo AG opens up promising market opportunities in FDA-regulated usage environments.

Further Reading:

EMPIRICALLY PROVEN LAYOUT DECISIONS WITH THE HELP OF A USABILITY TEST

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Usability issue: Which presentation variant is the most suitable one?

What is the most suitable presentation and combination of different pieces of information? This question arises on the one hand when systems are developed with varying options for presenting the contents; on the other hand, this is also an issue when a migration is due or when an integrated overall solution is to be created from various systems. Larger monitors with higher resolutions also offer more freedom for arranging information. Considering usability and the speed of cognitive processing, one important issue is, for example, whether information should be presented in one or two columns. This is not only a challenge faced by web designers, but also by all large IT service companies, such as Finanz Informatik, the IT service provider of the Sparkassen Financial Group, whose total banking solution OSPlus is already being used Germany-wide by more than 185,000 employees.

Study design. Evaluation. Statistically verifiable results.

Fraunhofer IESE designed a usability test whose empirical and statistically verifiable results serve to clarify usability and user experience issues – in this particular case regarding the optimal arrangement of information within OSPlus.

In the study, an objective eye-tracking process was used instead of observation. This process tracks and records a user's eye movements on the monitor. This makes it possible to accurately detect weak spots in the design and in the interaction.

50 study participants with and without knowledge of the system

50 test persons took part in the study. 40 participants formed a neutral group. This allows achieving results that are independent of both prior experiences of a general kind as well as experiences with specific systems of Finanz Informatik. Both subjective data and objective eye tracker data were collected and evaluated. The analysis of the empirically elicited data showed a clear result. This enabled us to make concrete recommendations regarding the structuring of information, which also became part of the company-internal style guide.
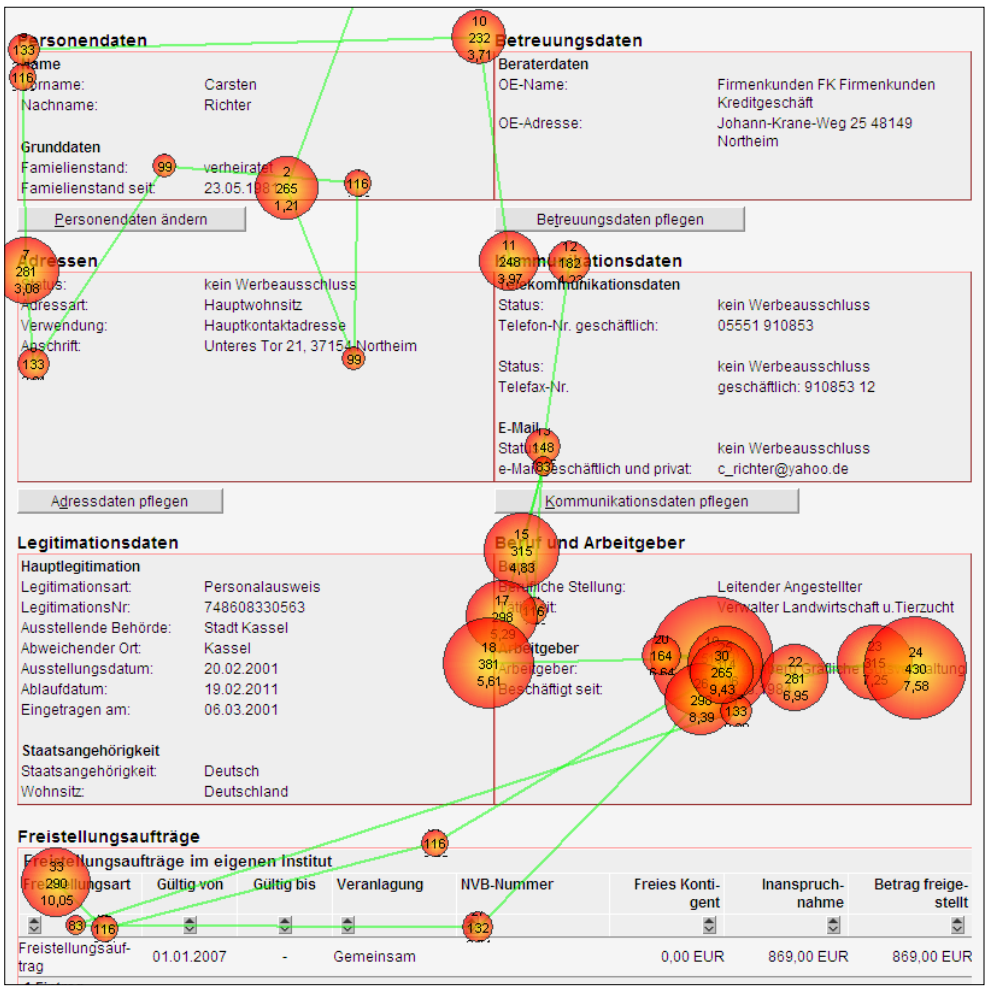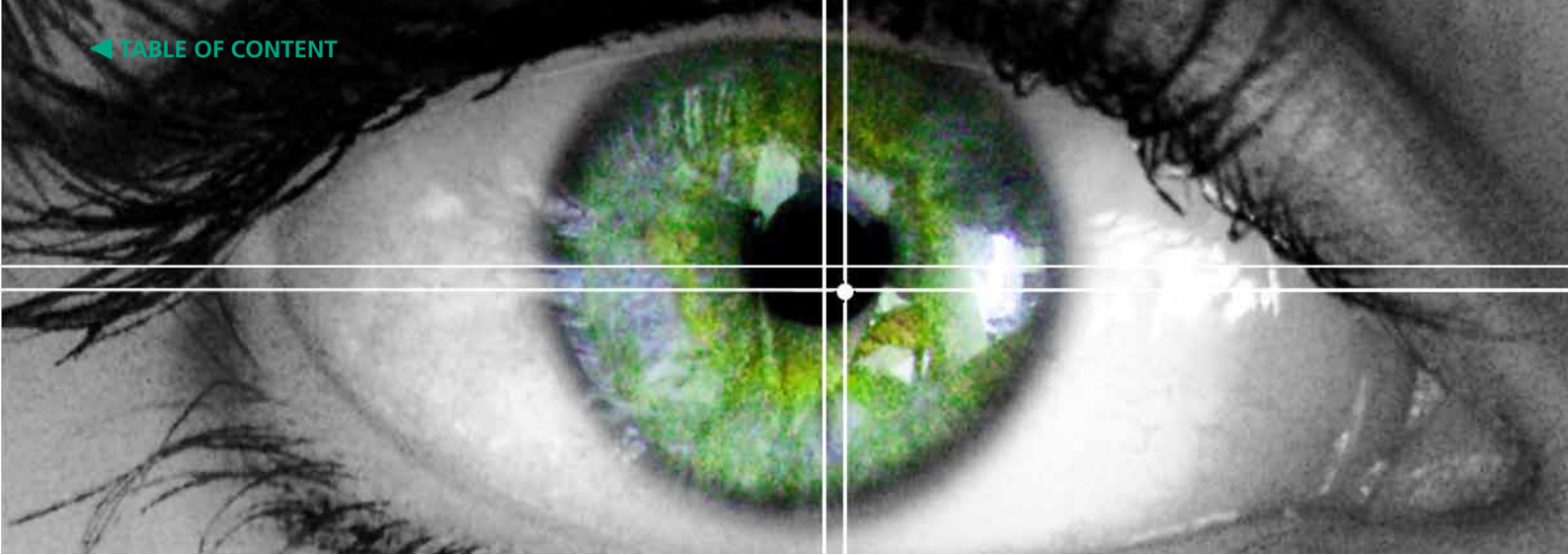
Eye Tracking –
Precise and objective

Fixations (circles) show the direction and duration of the user's gaze and the sequence in which he looks at information.

"Styleguide of Finanz Informatik with trend-setting design"
"The eye tracking study proves that the styleguide of Finanz Informatik is future-oriented and allows the effective and efficient implementation of new functional and non-functional requirements. It supports the consistent evolution of the styleguide with scientific methods and increases the performance of more than 185,000 employees every day."
Dipl.-Ök. Matthias Knobel, responsible for the OSPlus Portal Styleguide, Finanz Informatik

Further Reading:

Business Area Information Systems

PROTOTYPING OF MOBILE APPLICATIONS

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Mobile applications (mobile apps) are increasingly being used professionally to offer innovative services to customers or to increase the productivity of one's own staff with the help of mobile technology. In doing so, many organizations are faced with the problem of which services they should provide in the form of apps on mobile end devices, which platforms (iOS, Android, Blackberry, Symbian, Windows Phone 7,…) to choose, and whether and/or how such an application can be implemented on the respective platform.

In its research area "Business Goes Mobile", Fraunhofer IESE explores issues such as these and offers its customers methodological support in implementing mobile apps. The services offered include working out the requirements for a mobile app in collaboration with the customer, selecting a suitable platform, designing a platform-specific UI design, designing an architecture for the mobile app and its integration into the organization-specific IT infrastructure, and implementing the mobile app as a prototype on the selected platform.

Lufthansa Systems offers IT services for a wide variety of industries and is a worldwide leader in the aviation industry. Its portfolio ranges from IT consulting via the development and implementation of industry solutions to running its own computing centers. Just like in other industries, mobile support is increasingly being taken for granted in the aviation industry, too.

In 2010, Fraunhofer IESE and Lufthansa Systems agreed on preparing the standardized development of mobile apps as a supplement to existing products. Based on a concrete example, a process was defined and tested from a feature to an executable prototype. iOS, respectively the iPhone, was selected as the initial platform, but with the premise that it shall also be easy to transfer the methodology to other platforms.

The concrete application was of secondary importance: Primarily, the declared goal was to provide methodological support for the development of a native iPhone app that supports high User Experience. High User Experience is of essential importance in mobile apps, since experience has shown that users will otherwise de-install the app after one-time use. The applied methodology envisions providing support for the UI interaction design through techniques such as Paper Prototyping in order to give potential users an early chance to execute certain usage scenarios. The methodology also calls for an explicit architecture design phase, since even mobile apps that appear to be small require explicit design decisions, for instance in order to neatly integrate the app into an airline's infrastructure and to enable the fulfillment of additional quality requirements such as maintenance or performance.

The UI and the interaction design as well as the architecture design were primarily created by experts from the research area "Business Goes Mobile", whereas the implementation of the prototype could be performed by a team of student developers, as in other similar customer projects of Fraunhofer IESE. This makes it possible to invest a major portion of the project budget into the design of a mobile app and to save expenses for the implementation of the prototype.

In 2011, Fraunhofer IESE and Lufthansa Systems will therefore continue their collaboration on the topic of mobile apps. Lufthansa Systems has just published the first mobile app it has developed, Lido/iRouteManual, in Apple's App Store.

Further Reading:

Business Area Information Systems

SOFTWARE-CLUSTER
SPEARHEAD OF THE SOFTWARE INDUSTRY

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Dr. Christian Webel

Collaboration Partners

A total of 34 partners from
industry and research
www.software-cluster.org

Further Information

Project Homepage
www.software-cluster.org

The cluster **"Software Innovations for the Digital Enterprise"** (in short: Software-Cluster) is one of five winners in the "Spitzencluster" ("cluster of excellence") competition, a flagship of the high-tech strategy of the Federal Ministry of Education and Research (BMBF), whose declared goal is to lead Germany to the top of the technology nations.

The goal of the Software-Cluster is to enable the transformation of companies that so far have only used ICT as a tool for supporting their traditional processes into completely digital enterprises where ICT is the decisive driver for product and process innovations. Digital enterprises are engaged in highly flexible Internet-based enterprise networks and dynamically orient their business models and processes towards these. In digital enterprises, all data regarding processes, equipment, and resources of the real enterprise world are constantly available for planning, control, and optimization in real time. The Software-Cluster achieves this by developing concepts, technologies, and business processes for so-called emer-gent software in initially two concurrent network projects.

The goal of the project **EMERGENT** is the collaborative exploration and development of fundamental methods, techniques, algorithms, and data structures for emergent software. The term "emergent software" stands for a new category of distributed, innovative information systems that emerge across companies from the interaction of individual components and services in the Internet of Things and Services and which thus exhibit a higher quality of performance. The open integration of different software components, which is far more than just the sum of the integrated business software parts, leads to a dramatic improvement in value creation.

Fraunhofer IESE is the consortium leader in this project and is thus responsible for the exploration and development of the enterprise software of the future. In addition, fundamental issues are being investigated in three different research areas. In the area of interoperability, we are engaged in further evolving requirements, architecture, and reuse methods for the development of emergent systems. The development of constructive UX methods as well as the development of concepts providing positive support for a homogeneous look&feel in the use of emergent software systems are part of the work in the area of novel user interfaces. Furthermore, a specification language for security guidelines as well as methods and techniques for determining the implementability of a specified security guideline are being developed in the area of security.

Software-Cluster
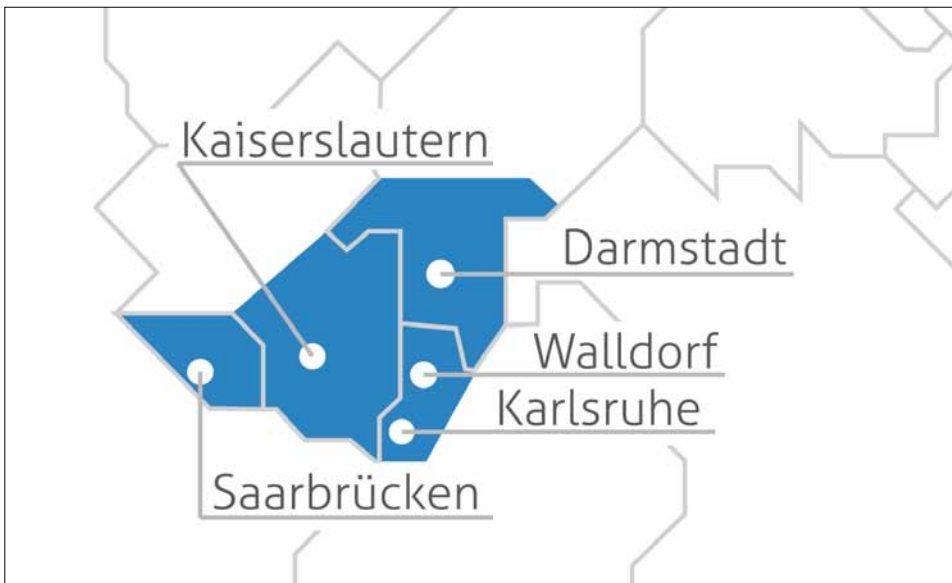
The Software-Cluster region

The goal of the project **SWINNG** is to strengthen the competitiveness of enterprises in the cluster region and beyond, all across Germany. This is achieved by developing linked process chains for the management of modern business processes and for the exploitation of new business areas. Here, the main challenge lies in enabling these processes simply by creating novel emergent software systems. Therefore, methods shall be provided for the modern exploitation of software as a key innovation. These methods must accommodate the required dynamics in companies and in agile enterprise networks and must be suitable for process-oriented emergent software.

In the context of the collaborative project SWINNG, Fraunhofer IESE is responsible for the empirical investigation of methods for the development and exploitation of software beyond mere technical considerations. This makes it possible to measure and improve the practical use of classical and modern methodologies. In this context, we also look at the industrial need for emergent software and evaluate the overall success of the cluster. Through close cooperation with the Software Technologie Initiative e.V. (STI), we ensure that the solutions provided by the Software-Cluster are transferred quickly, especially to small and medium-sized enterprises.

Further Reading:

FROM THE INTERNET OF THINGS TO INTELLIGENT BUSINESS PROCESSES

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Collaboration Partners

15 partners from research
and business
www.adiwa.net

Further Information

Project Homepage
www.adiwa.net

In many areas, the electronic integration of intelligent objects and the Internet has reached a high degree of maturity thanks to RFID (Radio Frequency IDentification) technology or the OPC standard for non-proprietary communication in automation technology. One of the goals is to tie each individual product into the product logistics and to use the delivery and sale of a product to generate automated actions for complex enterprise resource planning systems and other business processes. The full potential of the Internet of Things can only be exploited, however, if there is a stronger focus on the processing of dynamic information and on the real-time automatic detection and processing of business-relevant events.

This can be illustrated very well in the application domain of "Logistics", in particular. In logistics, globally operating service providers must, in the future, be able to integrate the status of their product flows into their services in order to be able to react to critical events along the supply chain proactively and thus effectively. Depending on where events happen, the consequences not only affect the intra- or extra-logistical processes, but also, in particular, their interfaces. The challenge consists in coordinating the internal and external transportation networks with the help of real-time information from the Internet of Things.

The goal of the Alliance Digital Product Flow (ADiWa) is to explore technologies for business applications that integrate the real world into complex and dynamic business processes via the Internet of Things. ADiWa focuses especially on the dynamic composition, control, optimization, and modification of business processes based on the evaluated information from the real world. To achieve this, a comprehensive set of corresponding tools and mechanisms for the design and for the runtime of business processes is adapted, respectively newly created, taking into account complex events. The ensuing results are visualized in a demonstrator that maps the defined scenarios as marketable services into intelligent business processes and that can react to external influences and complex events.

In the context of ADiWa, Fraunhofer IESE is responsible for the analysis of the requirements and the definition of logistics scenarios as well as for their design and prototype implementation. This includes, among other things, the definition of an SOA (Service Oriented Architecture)-based architecture style focusing on the integration of information systems and embedded systems as well as the design of a process for the architecture-centric integration of existing systems in accordance with the SOA paradigm in order to guarantee that quality requirements are fulfilled. This also includes the integration of mobile end devices into the logistical processes and the development of a corresponding user interface. In addition, Fraunhofer IESE is responsible for the empirical evaluation of the scientific and technological results and their exploitation in the demonstrators. This makes it possible to assess the practical benefit and make improvements, if necessary.

After the completion of the project, the goal is to have a fully functional demonstrator in the logistics domain that has been evaluated. Initial joint intermediary results of the Fraunhofer institutes IESE, IML, ITWM, and SIT will be presented at the "transport logistic" fair in Munich in May 2011.

IT-supported gate occupancy plan to support the building manager based on information from the Internet of Things

Further Reading:

MANAGEABLE, SIMPLE AND INTUITIVE – MORE MOTIVATION FOR SOFTWARE USERS THROUGH NATURAL INTERACTION

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Further Information

Project Homepage
http://fun-ni.org

The research project "Fun of Use with Natural Interactions" (FUN-NI) investigates how **natural forms of interaction** in the software can increase the User Experience (UX), which leads to higher acceptance of software products and better motivation of the users.

Graphical software user interfaces that are common today usually employ keyboard and PC mouse as interaction devices. There also exist other forms of interaction and other interaction devices. The goal of the project FUN-NI is to develop user interfaces that can be operated using natural forms of interaction, such as language, gestures, or multi-touch. This results in the interaction being designed in a way that corresponds to what the user is accustomed to from non-technical objects, which increases the UX when working with the software.

Many application scenarios are conceivable: **information systems** such as modeling of business workflows with multi-touch control, or applications from the area of **Ambient Assisted Living**, such as gesture control for shutters and light in the home, or a multimedia control system for the iPad.

The main contributions of this project are:

- **Constructive UX**: Identification, documentation, and evaluation of more than 90 successful natural forms of interaction, so-called patterns.
- **Specification of natural interaction**: DESIGNi, a workbench, which enables SMEs to "find" matching natural forms of interaction in future new projects, to specify these, and to explicitly think about the underlying metaphor of the interaction concept.
- **Lightweight evaluation method**: Development of an evaluation method that enables software producing SMEs to check the desired UX properties in their products on their own in early phases of the development. This decreases the risk inherent in developing innovative software products.
- **Positive evaluation result**: In addition to performance data that remain the same compared to "classical" usability, users are particularly enthusiastic about the intuitive usability: *"When it comes to trying something new, I am usually a rather fearful type. But here everything worked really well, I was totally surprised."*
"I felt right at home, very intuitive!"

fini
Natural Interaction
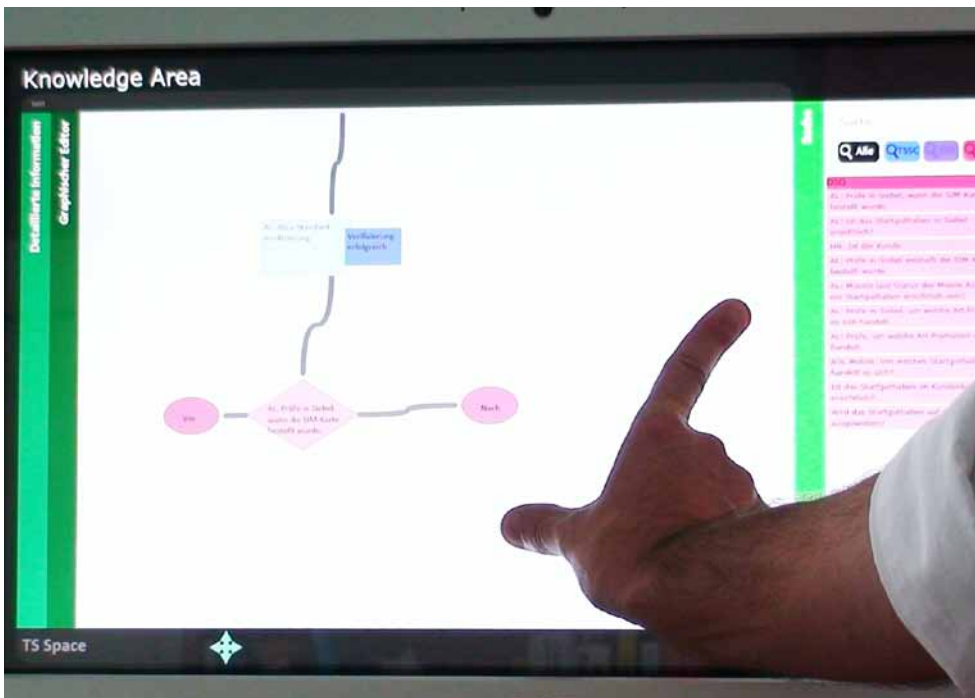
Prototype implementation of an information system component for modeling workflows (left) and a multi-touch control for music systems (top).

Collaboration Partners

a3 systems GmbH
www.a3systems.com

CIBEK technology + trading GmbH
www.cibek.de

Folkwang Universität der Künste
www.folkwang-uni.de

What our project partners think:

"Positive user experience leads to improved user performance. Software products that have been proven to increase the user's willingness to use them also offer a clear competitive edge compared to traditional products. The users concentrate more; they use their software more efficiently, and the investment costs can be written off faster."
Rudolf Klein, member of the Board of Directors of a3 sys-tems GmbH

"User Experience is essential, not only the technology."
Bernd Klein, CEO of CIBEK technology + trading GmbH

Further Reading:

LEA
LEARNING WHILE AGING –
AGING WHILE LEARNING

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Collaboration Partners

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www.uni-kl.de/paedagogik

Volkshochschule
Kaiserslautern
www.vhs-kaiserslautern.de

Further Information

Project Homepage
www.lea-projekt.de

As a result of the current demographic changes, the number of people who want to make use of learning programs also in older age is on the rise. Although it has been scientifically proven that learning in older age is important for the whole society, many learning programs cannot be used by elderly people due to limited mobility, since such programs often require the learners to be present at the educational institution.

It is thus important to enable elderly people who are no longer able or willing to leave their homes to continue to take part in education and social interaction. This calls for innovative approaches such as the state-funded project LEA ("Learning while aging – Aging while learning"). In this collaborative project with VHS KL (Kaiserslautern Adult Education Center) and the University of Kaiserslautern, a technical solution as well as suitable course concepts are being developed for mobility-impaired elderly people (65+) who would like to participate in learning programs from home. The user interface of the LEA learning system was specifically tailored to the needs of the target group. For example, no computer skills are necessary to operate the LEA learning system.

The project wants to pursue new paths in teaching learning content to elderly people. The area of "age-appropriate user interfaces and intuitive forms of interaction" still offers a lot of research potential. LEA wants to do pioneer work with the first generation of elderly people who are using the Internet. Based on the LEA learning system, which is executed on multi-touch-capable devices (e.g., tablets), innovative usage concepts (such as gesture control) shall be tested in direct collaboration with the target group.

The LEA learning system enables direct communication and joint learning in the specifically developed age-appropriate classroom. Voice and video messages that are easy to generate enable the course participants to talk to each other between fixed course dates and to communicate with each other. During the first course, we were able to observe that these means of communication were not only used to discuss learning contents, but that the participants also used them for private, social exchange.

RheinlandPfalz
MINISTERIUM DES INNERN
UND FÜR SPORT

RheinlandPfalz
MINISTERIUM FÜR BILDUNG,
WISSENSCHAFT, JUGEND
UND KULTUR

Currently, an evaluation of the first course is taking place. The feedback we are receiving is very positive and encouraging. From the technical perspective, the participants especially praise the use of a mobile end device, the uncomplicated use of the LEA learning system, and the access to multi-media content. With regard to the social aspect, the participants especially appreciate getting to know the other course participants and communicating with them with the help of the system, as well as the direct contact with the course instructor and with the technical support team.

"In my opinion, the social level was something I considered positive." (Mr. H., age 79)

"I was very satisfied with the course. I really enjoyed it and had a lot of fun. And you can learn a lot from it. This is very good, especially when you are older."
(Mrs. K., age 69)

"I think that the project itself is good and interesting. I also believe that it is definitely suitable as far as the interface is concerned [...]. The thing with the sound and video telegrams is wonderful and simple, since you do not need to type anything."
(Mr. Hodapp, course instructor)

The concepts and technologies developed for the LEA learning system can be used in all areas requiring communication and exchange within groups with common interests. Distributed learning is not the only area of use – we intend to expand the use to social and psychosocial areas. The use of the LEA concepts and technologies is independent of age and is very versatile:

■ Supports distributed communication that transcends barriers
■ Overcomes technical barriers for users with few computer skills
■ Can serve as a central starting point for communication-based assistance systems (such as ambulant care)

Live class:
A participant uses the touch screen of a suitable device to take part in the weekly virtual class.
He sees a video image of the course instructor. He can have a discussion with the instructor and with the other participants and can discuss materials (e.g., exercises).

Further Reading:

SMART ENERGY FORECAST
FORECAST USAGE – REDUCE COSTS

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Dr. Martin Wessner

Collaboration Partner

Axpo AG
www.axpo.ch

The electric energy industry is experiencing some fundamental changes: these changes are triggered by the unbundling of network operation, energy generation, and trading, the liberalization of metering, as well as increasing decentralized energy generation based on renewable energies through power plants that widely fluctuate in their output (wind- and sun-powered).

Since generation and consumption in the power grid must be in balance at all times, so-called balancing power is needed to balance the differences between forecasted generation (in accordance with the expected usage curve) and actual consumption at short notice. Balancing power must be made available at very short notice, e.g., through power plant capacities that are ready for use at all times, and thus generally comes with significantly higher costs than procurements that can be planned a long time ahead. The more accurate the forecast of feed-in and consumption, the earlier and more accurately energy procurement can be planned and the lower the need for expensive balancing power.

In light of this background Fraunhofer IESE has been contracted by Axpo AG, a leading Swiss energy company, to explore the feasibility and the constraints of "Smart Forecasts". The goal of Smart Forecasts is to be able to provide a more accurate forecast of the energy consumption of individual households, respectively regions, on the basis of detailed measurement values and other data sources. In a first step, a household's forecasted energy consumption is studied using various measurement methods. Based on that, the second step will consist of expanding the forecast to a specific region on the basis of selected households and of investigating the accuracy of the forecast.

For forecasting the consumption of individual households, different ways of equipping a household with energy measuring devices will be studied in terms of the potential of these devices to forecast the household's energy consumption. Is it enough to measure the overall consumption in order to make an acceptable forecast, or does measuring consumption by level, by power circuit, or by individual user allow a much more accurate forecast? What is the role of other parameters such as weather forecasts or planned absences and activities of the residents? Which possibilities exist to efficiently capture this information in a way that is acceptable for the residents? Which forecast methods are suitable best under which conditions for forecasting consumption? In order to answer these questions, weather forecasts and residents' plans are also captured in addition to the measurement values, and are included in the analysis.
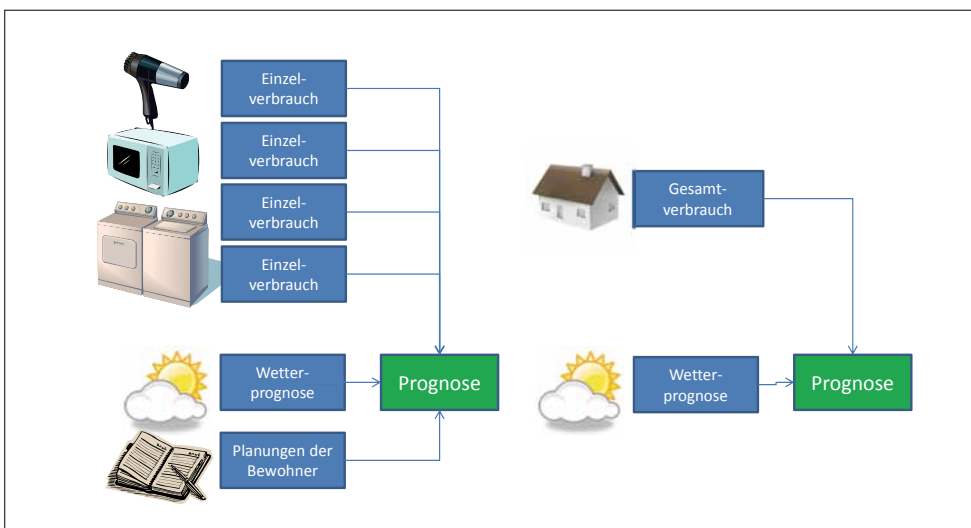
Two of the investigated forecast approaches. Left: The forecast includes the consumption of important individual users, weather forecasts, and the plans of the residents. Right: Simple approach, which only takes into account the overall consumption and the weather forecast.

As a result of the analysis of the collected measurement data and other data, each morning the energy consumption expected for the following day is forecast in 15-minute increments. In addition, the residents take part in a study. Every day, they record possible special occurrences that impact this energy consumption. These reports are used for plausibilizing the actual usages post-mortem.

To prepare the study, a typical household is selected and equipped with additional measurement devices; the residents are informed about the study and about the participation required of them. Over a period of several weeks, all measurement data as well as additional information (plans of the residents, weather forecasts) are collected and evaluated with the help of various forecast methods. Interviews are also conducted with the residents in order to determine such things as acceptance of the data elicitation.

The result of the study will be an evaluation of the measurement and forecast approaches used – with or without consideration of additional data – in terms of their forecast accuracy and usability.

"From the cooperation with the experts of Fraunhofer IESE, we expect important findings regarding the potential of decentralized forecasts and the associated cost-benefit ratio."
Philipp Meisel, Project Manager Business Development, Axpo AG

Further Reading:

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Fraunhofer CESE
USA

Fraunhofer
IESE

Project Center
Brazil

Project Center
Australia

INTERNATIONAL ACTIVITIES

Fraunhofer IESE has a very strong international orientation. This is not only reflected in the fact that IESE currently employs staff from twelve different nations and that the language of the institute is English, but can also be seen in the growing number of international projects.

Fraunhofer IESE has established subsidiaries in the strategically important countries USA, Australia, and Brazil (called Centers):

- Fraunhofer Center for Experimental Software Engineering (CESE) at the University of Maryland, College Park, MD, USA (since 1998)
- Fraunhofer Project Center on Transport & Logistics at NICTA, Sydney, Australia (since 2010)
- Fraunhofer Project Center for Software and Systems Engineering in Bahia, Salvador, Bahia, Brazil (to start in 2011)

From the perspective of Fraunhofer IESE, these subsidiaries pay off for various reasons: additional competencies that we can in turn offer to our customers in Germany and in Europe; additional third-party industry project funds; and the acquisition of highly qualified staff. Examples of additional competencies are the development of the reverse engineering tool SAVE or the business alignment method GQM+Strategies®. An example of industry projects is the collaboration project with Campina Grande, Brazil, on the topic of medical technology. Personnel acquisition is currently most promising via our contacts in Brazil.

In the following, we present our subsidiaries and describe some selected international projects:

Fraunhofer

USA

FRAUNHOFER CENTER FOR EXPERIMENTAL SOFTWARE ENGINEERING, MARYLAND (CESE)

Director: Prof. Dr. Rance Cleaveland

The Fraunhofer Center for Experimental Software Engineering, Maryland (CESE) in College Park, Maryland, conducts applied research and technology transfer in software engineering processes and technologies. It collaborates with private-sector companies, government agencies, and academic institutions to develop innovative, useful approaches to address organizations' software development and management issues.

CESE has affiliations with the University of Maryland at College Park and the Fraunhofer Institute for Experimental Software Engineering (IESE) located in Kaiserslautern, Germany.

The Center's projects include a mixture of research efforts into new software technologies and empirical evaluations of existing tools and processes, and service-provision contracts to assist clients with software development or acquisiton needs. Project customers include government agencies such as the Department of Defense and NASA and large multi-national companies such as Boeing, Lockheed-Martin, and Robert Bosch. CESE also supports small and medium-sized companies with software needs in the Washington, D.C. – Baltimore, Maryland corridor.

Competencies

- Measurement and Knowledge Management
  Contact: Dr. Forrest Shull
- Software Management and Process Improvement
  Contact: Ms. Kathleen Dangle
- Software Architecture and Embedded Software
  Contact: Dr. Mikael Lindvall
- Software Verification and Validation
  Contact: Prof. Rance Cleaveland

Business Areas

- Aerospace / Defense
  Contact: Kathleen Dangle, Frank Herman
- Automotive
  Contact: Prof. Rance Cleaveland
- Medical
  Contact: Dr. Mikael Lindvall

PROJECTS IN PROGRESS

Architecture Analysis of Dynamically Reconfigurable Systems

In 2010, CESE initiated a new project called Architectural Analysis of Dynamically Reconfigurable Systems. The project is sponsored by NASA's Independent Verification and Validation (IV&V) Center as part of their Software Assurance Research Program (SARP). The project addresses a critical issue in modern software architectures: increased flexibility decreases analyzability. That is, the easier it is to add new components and features (thanks to a flexible and configurable software architecture), the harder it is to understand system structure and behavior. The problem is that if it is difficult to analyze and understand the inner workings of the system, then there is a risk that defects will escape the regular quality assurance processes and cause problems in the field.

In this project, CESE staff are collaborating with several project groups at the Goddard Space Flight Center. These groups have spent considerable resources over the past few years developing the Core Flight System (CFS) and the Goddard Mission Services Evolution Center (GMSEC), which are reusable frameworks for flight and ground systems. A key architectural feature of these systems is a publish-subscribe messaging system that is established during runtime. In addition, CFS supports dynamic loading and unloading of applications while the system is running. Basing mission-critical software on such a flexible and dynamically reconfigurable architecture is uncommon in the conservative world of space software because such software must be extremely reliable.

The CESE team is developing an approach that allows analysts to investigate and verify the behavior of flexible and configurable software systems in various situations and configurations. First, the software is run, and various forms of runtime data are collected. This step typically creates a lot of low-level information that is difficult to handle. The next step applies a pattern recognizer that knows how the runtime data can be combined into architecture-relevant events that are of interest to the analyst. The data is then imported to Dynamic SAVE (Fraunhofer's tool for Software Architecture Visualization and Evaluation), which automatically visualizes the data as a sequence diagram. The sequence diagram shows complete as well as incomplete (erroneous) events together with timing and parameter information. By studying the sequence diagram, the analyst can immediately detect certain deviations from the expected behavior. In addition, the analyst can apply timing constraints and other design rules to let Dynamic SAVE find behavioral defects that otherwise would have been very difficult to find. For the CFS, we are currently building a model focusing on detecting inter-application communication defects. For the GMSEC, we found problems in the behavioral equivalence of different implementations of interfaces.

For more information, see: Dharmalingam Ganesan, Mikael Lindvall, Lamont Ruley, Robert Wiegand, Vuong Ly, Tina Tsui (GSFC GMSEC team), "Architectural Analysis of Systems based on the Publisher-Subscriber Style," 17th IEEE Working Conference on Reverse Engineering (WCRE 2010).

Improving NASA's Space Communications Network

A key project added to the CESE portfolio in 2010 is the Space Network (SN) Ground Segment Sustainment (SGSS) Project. The SGSS Project is responsible for upgrading ground station space-communications infrastructure in the White Sands Complex in New Mexico and a Tracking and Data Relay Satellite System (TDRSS) Terminal at the Guam Remote Station, which supports NASA's near-earth SN tracking and data acquisition facilities and systems in support of space-flight missions. In addition to the replacement of hardware, millions of lines of legacy software code will be replaced and enhanced to incorporate a new architecture and modern network technology and support new requirements.

Using its specialty expertise in software engineering, CESE staff are applying experience in evaluation, measurement, and process improvement best practices from the other NASA SN projects as well as from other NASA and similar environments to determine how the Space Network community can benefit from those practices as it upgrades and modernizes the Space Network. CESE's SGSS project consists of three task areas: Management through Measurement, Risk Mitigation using Software Technologies, and Independent Verification and Validation.

Management through Measurement
In CESE's first task area, Management through Measurement, CESE workers are building upon research previously performed to enhance the ability of NASA projects to quantitatively and qualitatively measure software development and maintenance risks so that SN project managers are better able to objectively evaluate their projects with respect to performance and quality

criteria. This includes defining and analyzing development metrics/indicators, including software size; validating development contractor earned value cost and schedule estimates and metrics; analyzing source code and evaluating defect metrics; tracking requirements volatility; and providing recommendations regarding development process effectiveness. These analyses assist us in identifying and prioritizing risk areas by determining and collecting relevant metrics.

One significant accomplishment in this task area for 2010 included the development of in-house cost estimates for the implementation contractor's work statements using the results from previous effort estimation research. This work will be showcased at NASA's Project Management Challenge Conference in February 2011 via a presentation titled "Taking the Evolutionary Road to Developing an In-House Cost Estimate", which was developed jointly by CESE and NASA.

Risk Mitigation using Software Technologies
The purpose of CESE's second SGSS project task area, Risk Mitigation using Software Technologies, is to take full advantage of emerging and available software technologies to support mitigation of risks associated with incorporating changes to legacy software systems without affecting customer needs. CESE staff applied various research techniques to the analysis of the entire Space Network code base to establish a risk baseline for supporting change impact analysis. Depending on the risk level for a particular type of change, specific verification and validation strategy approaches are recommended.

In 2010, CESE analyzed about ten million source lines of code pertaining to the Space Network by developing dependency models and metrics summaries containing various metrics

related to the complexity of the analyzed software such as Mc-Cabe's complexity metric, the number of function parameters, and the number of dependencies. A project summary that identified all objects defined in the source code as well as other important information such as call trees and declaration trees was produced for all the code. The team also defined a risk model based on well-known software development and testing risks such as the number of paths (which translate into the number of necessary test cases) and the number of parameters (which translate into the number of variations of the same test cases). The risk model included additional types of metrics such as the degree of dependency on the operating system, databases, and COTS in order to get an understanding of testing complexity. The measures were aggregated to provide a high, medium, and low risk for each component, sub-system, and project.

Independent Verification and Validation

The purpose of this study area is to provide unique, unbiased, and independent evaluations of project processes and products by combining subject matter expertise with applied research. The types of activities that will be undertaken in support of this research include providing formal evaluations of proposed technical approaches, evaluating development efforts and products to predict performance, and establishing methods and techniques for improving IV&V processes. In 2010, CESE contributed to numerous requirements, operational concepts, designs, and architectures related to legacy and new systems. Center staff analyzed and provided recommendations for source code architectures to determine the risks involved in changing the code. We also identified risks involved in changing the code based on suggestions from the implementation contractor's software change impact assessment documents.

Measuring and Monitoring Technical Debt

Also in 2010, CESE undertook a project funded by the National Science Foundation (NSF) on exploring the issues related to "technical debt" on software projects, a metaphor originally coined by Ward Cunningham. In software projects, developers can almost invariably be so focused on accomplishing the needed functionality that the software itself grows less understandable, more complex, and harder to modify. Since this deterioration of the system usually reflects a lack of activity spent on refactoring, documentation, and other aspects of the project infrastructure, it can be viewed as a kind of debt that the developers owe the system.

Ward Cunningham's metaphor helps make clear an important tradeoff: Although a little debt can speed up software development in the short run, such benefit is achieved at the cost of extra work in the future, as if paying interest on the debt.

In collaboration with the University of Maryland-Baltimore County (UMBC), a CESE research group has been engaging with a number of different organizations on questions related to technical debt. Project researchers have been working with a number of different teams to look at what strategies can be effective for them with respect to identifying and deciding what to do about technical debt.

It should not be a surprise to anyone that what constitutes technical debt can vary greatly from one project to another - as do the tradeoffs that teams are willing to make regarding it. The common thread that has been found across all of this work is that it is a healthy thing for projects to take a bit of time to reflect on what kinds of technical debt they are most concerned about - and think of ways to keep an eye on

how much debt is accumulating. Some examples include the following:

■ CESE researchers worked with a team at a multi-national company that provides document-related business solutions, products, and services. The team was working on device drivers for the company's high-end products, and due to the size and variety of the customer base, maintainability and portability were a must. To find areas where the code had decayed, the CESE staff investigated computer-assisted support for detecting "code smells," anti-patterns formulated by Kent Beck as a way to help identify areas where good design principles were breaking down. Although some tailoring of the heuristics was necessary, these "smells" turned out to be a useful way of identifying areas the team agreed were accumulating technical debt.

■ With a mid-sized, local software development company that focuses on database-driven web applications, CESE researchers found that they highly value the use by their projects of a reference architecture. In this case, instances where developers design their own solutions and avoid re-use represent technical debt, since redesigning the system to be in compliance is expected to lead to greater understandability and maintainability over time in the future. In this same context, CESE also had some promising results with finding potential code smells and out-of-date documentation as indicators of technical debt.

■ With a team developing high-performance code for supercomputers, CESE scientists noticed that they solve the difficulty involved in making optimal use of the parallel processors by strongly separating calls to the parallelization libraries from the code doing scientific simulation - thereby allowing both the computer scientists and the domain experts to focus on what they know best. A topic under exploration concerns whether the instances where this separation of concerns breaks down should be treated as technical debt - that is, by detecting and fixing where the planned architecture of the system is not followed, and whether CESE can help the developers create a more maintainable, more flexible system.

In all cases, the research team has developed a process that is bearing fruit for these teams: Find some initial examples of what appears to constitute technical debt for the development team; show those examples and have a group discussion about whether it would be useful to take some time to "pay down that debt"; then either find additional examples that seem to fit the same mold or update relevant definitions of debt in this environment. It turns out to be quite useful to take a little time for having the team members reflect a bit on whether they agree with the proposed definitions - and why or why not - and how they would trade off corrective action against the other project demands. It can also be quite constructive to have a conversation about the team's expectations for which types of debt will never really cause a problem, which ones have the potential to make work much harder over time, and which ones are increasing risks (e.g., deferring testing or hazard tracking).

Building Empirical Decision Support for Web-Based Software Development

A long-time CESE process improvement customer, Keymind, a division of Axiom Resource Management, Inc., continued their move up the software development process maturity ladder in 2010 with help from the CESE's innovative application of empirical methods and tools.

Demonstrating effective software development processes, for example through compliance to process improvement approaches such as the CMMI®, is a strategic differentiator for many companies. Central to any process-improvement initiative is the idea that the selection and application of appropriate processes using empirical methods produces good products. This empirical mindset provides a basis for choosing the appropriate processes, analyzing the effects of those selections, and packaging the resulting knowledge for reuse and evolution; it drives an effective process improvement initiative. Under the leadership of Applied Technology Engineer Michele Shaw, CESE does unique work in this area that involves application of the latest research results in tight collaboration with the customer organization. The work at Keymind exemplifies some of the important factors that differentiate the CESE approach, including:

- Tying the measurement of technical processes specifically back to the organizational and strategic goals, to give both technical leads and managers a "top-to-bottom view" that helps them understand how their specific projects further the overall goals of the organization.
- Eliciting context-specific quality indicators that can be applied to projects to identify potential risk areas, and which can be refined by capturing feedback from the teams and objective measures of impact.

- Creating automated approaches to data collection, reporting, and analysis that can greatly reduce the time and effort required for the organization to gain insight about their projects.
- Using innovative visualization tools that allow organizations to intuitively gain an understanding of the important points, including tools such as the CodeVizard application that CESE has helped develop. CodeVizard automatically analyzes and provides an interactive visualization of the whole history of a software project, allowing developers to explore how often quality indicators have been fulfilled and what corrective actions have been taken.

In accomplishing all of those goals with Keymind, CESE is applying technologies that resulted from several NSF-funded research projects as well as internal research undertaken in partnership with our sister institute, IESE. Through their application in the context of a highly-mature customer with a commitment to software quality, this work has also provided peer-reviewed results that add to the state of the art in the area.

CESE in Figures

CESE experienced significant growth in its revenues in 2010 vis à vis 2009. This was due to important new project wins in NASA's SGSS project described above, as well as in that organization's Software Assurance Research Program; to new projects with the Food and Drug Administration; and to new industrial projects in the medical and automotive industry. At the time of this report, final year-end figures for CESE were not available, but projections based on data through June 2010 suggest that third-party revenues will be approximately 10% larger than those of 2009, becoming the best to-date since CESE was founded. Retained earnings are also expected to show a significant increase.

University Partners

- University of Maryland at College Park
- University of Maryland at Baltimore County
- Mississippi State University
- University of Kaiserslautern

Other Partners

- Axiom Resource Management, Inc.
- BAE SYSTEMS
- CSC, Inc.
- DAU – Defense Acquisition University
- Johns Hopkins University Applied Physics Laboratory
- NASA IV&V Center

Total revenue (in T US dollars).

Third-party revenue (in T US dollars).

Retained earnings (in T US dollars).
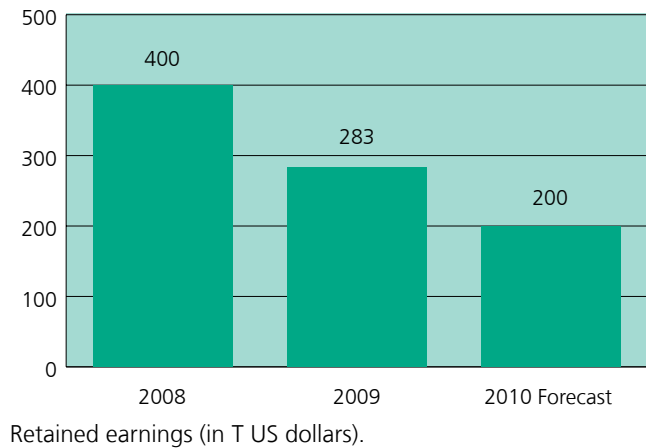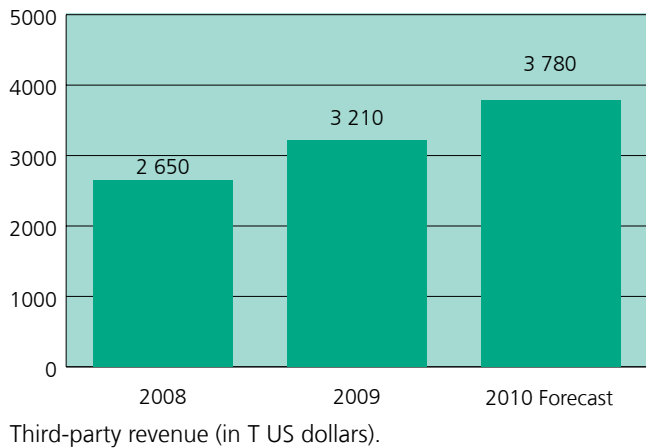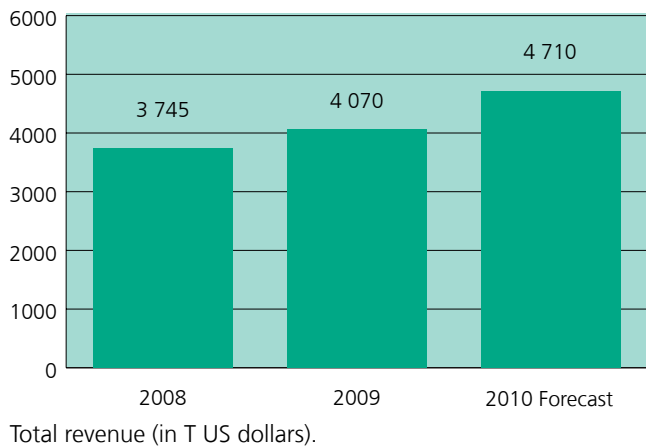
FRAUNHOFER PROJECT CENTER ON TRANSPORT AND LOGISTICS IN AUSTRALIA

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Further Information

Living Lab Homepage
www.futurelogisticslivinglab.com.au

Nine months ago, the Fraunhofer Institute for Experimental Software Engineering (IESE) and the National Information and Communication Technology Research Centre of Excellence in Australia (NICTA) founded the "Fraunhofer Project Center on Transport and Logistics" in Sydney, Australia in order to perform joint project activities. The aim of the project center is to transfer current research results in the areas of ICT for logistics, intelligent transportation, and traffic management into industry and thus to further advance the state of the practice. IESE and NICTA have been collaborating successfully for quite some time and continually strive to further strengthen their relationship.

From the perspective of information and communication technology, the classical transport and logistics industry is considered one of the rather conservative industries. At this time, ICT is being mainly used as a means to an end in this industry, and not as a driver for innovations and new business models. Some companies do manage to establish new methods and technologies in their area of influence, but they are unable to enforce long-term systematic improvements across the entire industry. The existing organizational structures are often not very conducive to process-oriented thinking; the interaction in the transport of goods is only rarely documented in processes, best practices, or structured organizational networks. Still, the transport and logistics industry does have a good environment for future-oriented new technologies. Also, there exists a willingness to change and thus an awareness of the benefits that an integrated, intelligent approach will bring in terms of future business models.

The Fraunhofer Project Center constitutes an innovation initiative aimed at offering solutions for some of the current and future challenges faced by the transport and logistics industry. To achieve this goal, the Project Center is collaborating with research and industry to develop innovative systems, products, and processes aimed at opening up new markets for transport and logistics products and services. The focus is on the exploration of key scenarios that enable users to gain experience with new technologies and products. This includes improving the efficiency of supply chains by means of transport management, intelligent infrastructures and linked sensors, as well as logistics planning and control systems in accordance with the principles of the Internet of Things and Services.

The focus of Fraunhofer IESE is on the area of software and business process modeling, particularly in methods for the development of information systems, embedded and software-intensive systems, as well as in the empirical evaluation of these methods. Furthermore, Fraunhofer IESE has domain knowledge and experience in the areas of IT for logistics, information systems,

Future Logistics Living Lab

as well as automotive and transportation systems. NICTA's contributions to the Project Center include methods and techniques in the areas of optimization, future Internet, machine learning, and software architecture in order to address the challenges in the area of transport and logistics.

The first project of the Project Center is the Future Logistics Living Lab, which was founded jointly with SAP Research Australia. The goal of the Living Lab is the prototype realization of novel systems, products, and processes in logistics together with partners from research and industry. This will enable the products and services offered by the Project Center to be made available to potential customers, which will make it possible to address new markets. This will be done in the form of practice-oriented demonstrators, which will strongly interact with industry and with users on the one hand, but which will also be characterized by the needs and requirements of industry and users on the other hand. At the moment, the Living Lab comprises more than 14 partner organizations, including national and international major players such as Linfox, DHL Express, and Ericsson.

FRAUNHOFER PROJECT CENTER ON SOFTWARE AND SYSTEMS ENGINEERING IN BRAZIL (UNDER NEGOTIATION)

Director: Prof. Dr. Manoel Mendonça, UFBA
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The EU and the Federal Republic of Germany have identified Brazil as one of the upcoming partners for high-tech collaboration. This interest was expressed politically during the state visit of the Minister of Education and Research of the Federal Republic of Germany, Prof. Schavan, to São Paulo, Brazil, in March 2009. Prof. Dieter Rombach took part in Prof. Schavan's delegation and met representatives of universities, government, and industry there. The Fraunhofer-Gesellschaft, as Germany's and Europe's largest organization for applied research, has responded and plans to increase its presence in Brazil by establishing a Fraunhofer Project Center on Software and Systems Engineering in Bahia.

The Brazilian partner is the Federal University of Bahia (UFBA), the leading university in the Brazilian State of Bahia. The university has a very active Software Engineering Laboratory (LES) with eleven researchers with PhD degrees, who have published close to 300 papers in the last five years (http://les.dcc.ufba.br). The laboratory is part of a Computer Science Department that offers bachelor and graduate programs (master and doctoral) in the area, and is well known for the excellence of the professionals it provides to the market. The department is now actively seeking to improve its ties with industry. Starting this decade, the interaction between LES and the industry has been rising steadily. In recent years, researchers from LES have developed several R&D projects with the energy and IT industries. In this context, it is worth mentioning projects like a concerted initiative for a CMMI Level 2 qualification of local companies (some of which have already succeeded in achieving CMMI appraisals Level 3) and the development of the National Fuel Quality Monitoring System for the National Oil and Gas Regulation Agency.

The university believes that a partnership with Fraunhofer will take the level of interaction with the industry to a level of world class excellence and the Government of the State of Bahia has demonstrated great interest in proactively supporting the initiative. A Memorandum of Understanding has already been signed between Fraunhofer IESE, UFBA, and the State Government aiming to create and establish a Fraunhofer Project Center in Bahia's technological park.

The goal of the Fraunhofer Project Center in Bahia will be to expand the activities of LES beyond its academic and scientific activities to act as a strong source of new technologies and solutions to the industry inside and outside the country. The joint work of LES and Fraunhofer IESE will enable, facilitate, and accelerate the development of innovative solutions on software and systems for the Brazilian industry. The competencies of the two partners are complementary: Fraunhofer IESE has much experience in applied research and technology transfer, an item that the Brazilian partners lack and are eager to acquire. Government incentive programs and strong growth of the local industry will help the partners to successfully acquire R&D projects. According to Prof. Manoel Mendonça, the future head of the Fraunhofer Project Center at UFBA in Bahia, the partnership with Fraunhofer IESE is seen as being of strategic relevance for consolidating the state's expertise on software and systems engineering by both the State Government and the University Administration.

The Fraunhofer Project Center in Bahia will be open to other universities across Brazil. Some of them have already manifested interest in becoming associated partners to the initiative. Some of the technical areas in which the project group will work include:

- Software engineering methods and processes for critical systems
- Architecture (e.g., product lines, SOA) for large systems
- Maintenance, evolution, and reengineering of large systems
- Decision support systems for the energy industry (oil, gas, and electricity)
- Product and process certification for suppliers of eGovernment systems
- Software technologies for assisted living systems
- Development of laboratories and/or large-scale field studies for evaluating assisted living concepts and technologies

NUTES –
BRAZIL'S ANSWER TO HEALTH ISSUES

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Collaboration Partners

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Ministério da Saúde do Brasil
http://www.saude.gov.br

The acronym "NUTES", which may not sound very scientific at first glance, stands for "Núcleo de Tecnologias Estratégicas em Saúde", meaning "Center for Strategic Technologies in Health Care". The establishment of this center is being funded by the Brazilian government. The choice of location fell on Campina Grande in the state of Paraíba in order to improve the rather weak local economic situation. The goal is to improve the quality of software-intensive medical products. This goal also envisions that the center shall perform the certification of software-intensive medical products.

In Brazil, the certification of medical products was only introduced by the Brazilian Ministry of Health in 1993. Since then, the certification process for hardware has been improved significantly, but software as an integral part of modern medical products and, beyond that, the development that software itself can be a medical product has not been taken into account yet in the certifications performed to date. Including software in safety-oriented development does not only mean developing software safely, but also means, in particular, developing safe software. In other words: If you want to develop software in a structured and engineering-style manner, there is no escaping the topic of risk management of software-intensive systems. General due diligence and international standards such as IEC 62304 cover this by demanding a structured process and by also referring to ISO 14971, which demands systematic risk management.

In order to master this challenge, the project partner relies on Fraunhofer IESE, which is considered as an important competence carrier in the area of software and systems engineering for medical products and is one of the leading institutes when it comes to the risk management of software-intensive systems.

The task of the scientists and engineers of IESE is to package the requirements on the development and certification of software-intensive medical products within a relatively short project duration in such as way that NUTES will be enabled to certify software in accordance with the state of the practice and pertinent standards.

However, there are not only technical issues that must be mastered in the context of this project. The cultural differences and the distance to the customer also constitute interesting additional conditions for the project. Thanks to several Brazilian scientists working at Fraunhofer
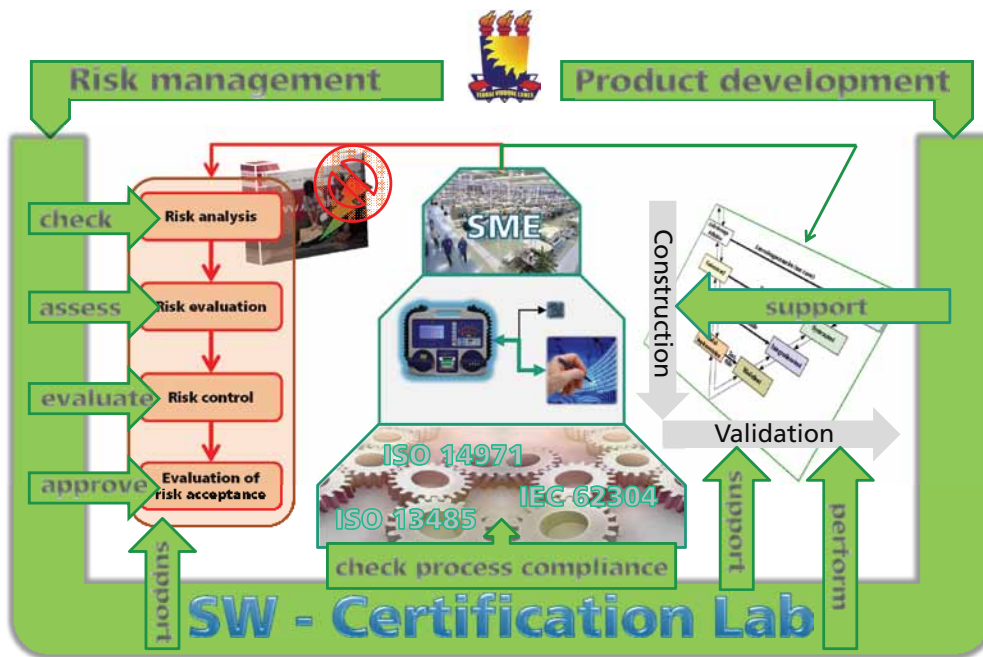
Work areas of the software validation and certification laboratory – NUTES.

IESE, there are no difficulties in overcoming these challenges. At IESE, collaboration between staff from different nationalities and cultures is rather the norm than the exception.

"In the NUTES project, issues must be dealt with effectively and efficiently", says project leader Sören Kemmann. This also includes that the goal is not only to answer the question of "What" must be done, but also to look at the "Why" and the "How". Previous projects have shown, for example, that providing guidance to a company on how to reflect on its own on the topic of "standard-conformant development" has increased flexibility and efficiency when it comes to implementation in the company. Effectiveness and efficiency also mean that we are not striving to provide off-the-shelf solutions, but rather that results are delivered that are adapted individually and precisely to the needs of the project partner. This is the only way to avoid iterations for adaptations and rework right from the start.

So you see: These challenges are just in the spirit of Fraunhofer.

Further Reading:

QUANTITATIVE SOFTWARE ENGINEERING IN JAPAN

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INFORMATION-TECHNOLOGY
PROMOTION AGENCY, JAPAN

Growing international competition and globalization are increasingly motivating companies and research institutes to collaborate in implementing innovations. However, this is a major challenge. Have you ever experienced

… that innovations quickly disappeared again after their introduction and that old habits regained control?

… that technology transfer failed because successful implementation requires much more than technical solutions alone?

… that technology transfer in a company was not supported because its contribution to the business goals was not clear?

How software engineering innovations can be implemented successfully has been shown by the Process Management division of Fraunhofer IESE with the introduction of quantitative software management methods in Japan. Since 2004, numerous novel software engineering methods have been developed together with the Japanese Software Engineering Center (IPA/SEC) and have been introduced successfully in many companies and organizations in Japan.

One example is the CoBRA method for the management of large software projects. By using this method, cost-related risks can be avoided, cost drivers can be identified, and software projects can be planned more accurately. By making systematic use of expert knowledge, the method can even be used in situations where only very few data are available. In the meantime, CoBRA has become a widely used software management method in Japan and is very popular. The path to this success is characterized by the following phases:

- Survey regarding existing practices and needs on the Japanese market
- Adaptation of the method and systematic piloting in Japanese companies
- Extension of the method with processes for introduction and usage
- Development of tool support
- Roll-out support with trainings, tutorials, workshops, and books
- Large-scale dissemination and systematic impact analysis
- Formation of a user community with regular meetings in Japan

In addition to the technical competence in the area of quantitative software engineering, other strengths of IESE are also being employed: Our evaluation competence helps to perform solid evaluations of a technique, adapt it to constraints, and integrate it into processes. Another important factor are our many years of experience with projects in Asia. Many other quantitative software engineering methods, such as quality modeling, quality risk management, goal-oriented software measurement, data analysis, and business alignment have been and continue to be transferred by IESE in Japan. Other important partners in addition to IPA/SEC are the Japanese aerospace agency JAXA (Japan Aerospace Exploration Agency) as well as Mitsubishi Research.

SYSTEMATIC SOFTWARE ENGINEERING FOR IT SYSTEMS IN JAPAN

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High-quality, innovative information systems are needed all around the world. It therefore comes as no surprise that Fraunhofer IESE supports customers in many different countries in the systematic engineering of large-scale information systems. We provide training in our innovative information systems development methodologies and help to transfer them into industrial practice by applying our Fraunhofer IESE methods in our customers' industrial settings. Many of our projects take place in European countries. But we also transfer our systems engineering competence to companies on other continents such as Australia or Asia. As a representative of our projects outside Europe, we here present our collaboration project with Fujitsu Labs in Japan.

Fujitsu is a leading provider of ICT-based business solutions for the global marketplace. With approximately 173,000 employees supporting customers in 70 countries, Fujitsu combines a worldwide corps of systems and services experts with highly reliable computing and communications products and advanced microelectronics to deliver added value to its customers.

Fujitsu Labs, with about 1,300 employees, is the R&D provider for the future and current business of the Fujitsu Group. Fujitsu Labs must make effective and efficient methodologies and technologies available to meet the future challenges faced by Fujitsu business units.

Since 2006, Fraunhofer IESE and Fujitsu Labs have been collaborating in joint research and technology transfer projects. This collaboration started with projects in the area of requirements engineering, especially in the area of requirements specifications, non-functional requirements, requirements reviews, and traceability of requirements. In 2010, the collaboration was extended to include the topics of architecture, usability & user experience, as well as requirements elicitation. Fujitsu Labs recently announced that the tailored Fraunhofer IESE methodologies had been transferred successfully to the Fujitsu business units by Fujitsu Labs.

Collaboration Partner

Fujitsu
www.fujitsu.com/

SOFTWARE ARCHITECTURE FACILITATING FUTURE BUILDING ARCHITECTURE – FINLAND

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Matthias Naab

Tekla is a Finnish company developing software products for the engineering and construction market. Companies in more than 100 countries use Tekla software to design and analyze models of buildings with state-of-the-art features. Driven by the increasing possibilities of constructing more complex and fancy buildings, the Tekla software also has to cope with more complex models and must provide new ways of interacting with the software. Tekla offers products and solutions covering the whole lifecycle of building information models, which were used, for example, for the construction of the Olympic stadium in Beijing.

Tekla Structures is one of Tekla's key products. It has been very successful for more than 15 years now. In order to maintain its great market position, Tekla is continually improving the software in terms of new features and invests into high quality. In order to ensure that maintenance costs will remain moderate, Tekla performed an architecture evaluation together with Fraunhofer IESE and in cooperation with R&D Ware Oy, a Finnish software engineering consulting company. The architecture evaluation results allow Tekla to make improvement efforts in a very dedicated and focused manner. Tekla also develops new products aimed at other user groups, and in doing so, follows an agile software development process. Addressing the high quality requirements and the issue of optimal alignment with existing Tekla products poses numerous architectural challenges. Fraunhofer IESE has supported Tekla in aligning its architecture practices and its agile development process. For this purpose, IESE's architecture method ACES was tailored to Tekla's context and introduced via a combination of tutorial and coaching. The architecture work is organized in a Scrum-like approach for good alignment with the development and continuous progress. Tekla's architects have successfully adopted this approach, which has resulted in more predictable product quality.

"Collaboration with Fraunhofer IESE experts was really useful for us. With theoretical and practical examples they helped us to understand how we can improve our way of doing architecture work and to build capabilities for the future. Tekla is happy with the co-operation and will continue working with Fraunhofer IESE in the future."
Timo Rihtniemi, Manager Product Architecture at Tekla

Collaboration Partners

Tekla
www.tekla.com

R&D Ware Oy
www.rdware.com

Further Reading:
Business Area Information Systems

Tekla Structures is one of the leading products in building information management. It enables the design and analysis of building models with state-of-the-art features.
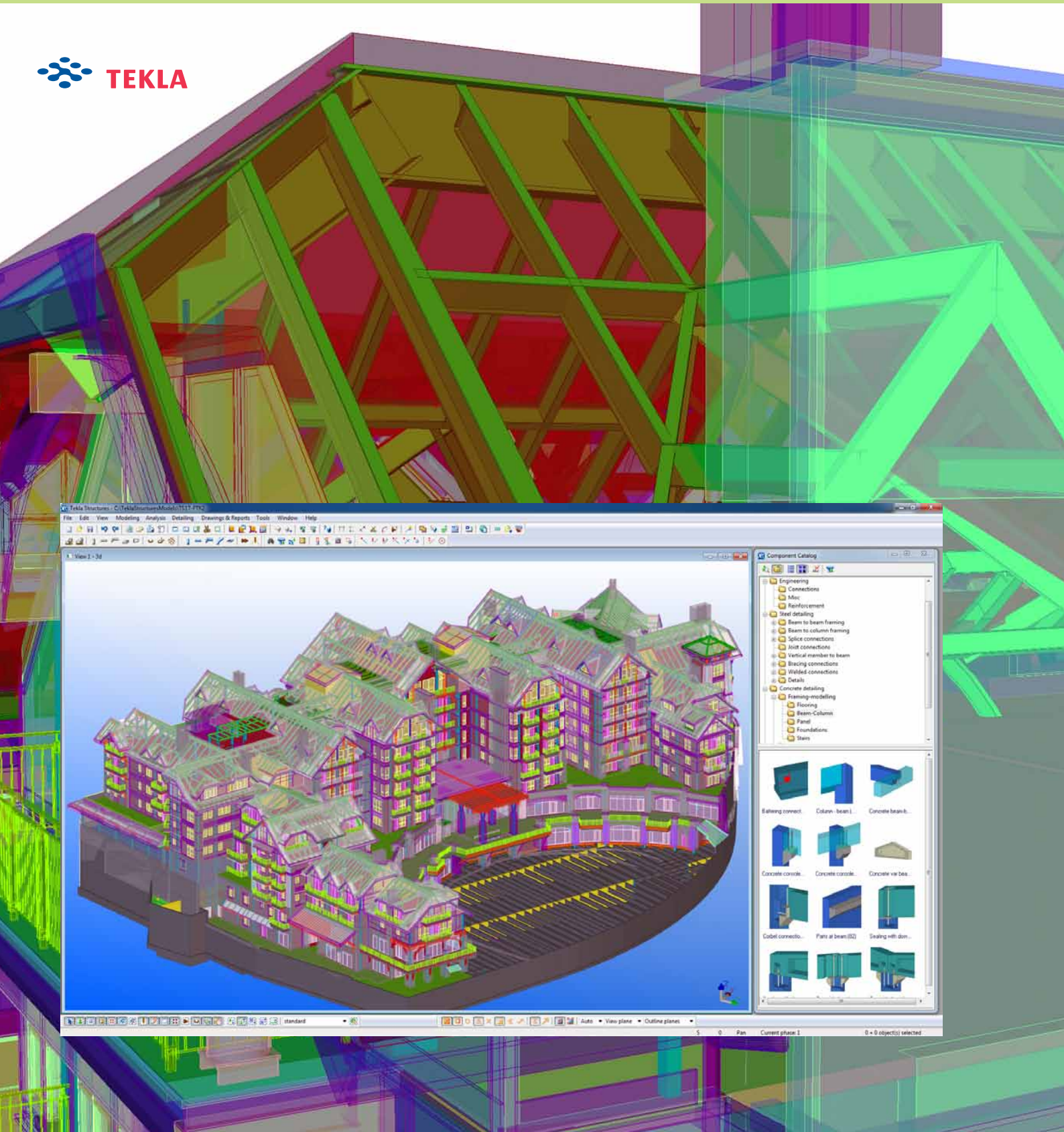
TEKLA

CONTACT

HOW TO FIND US
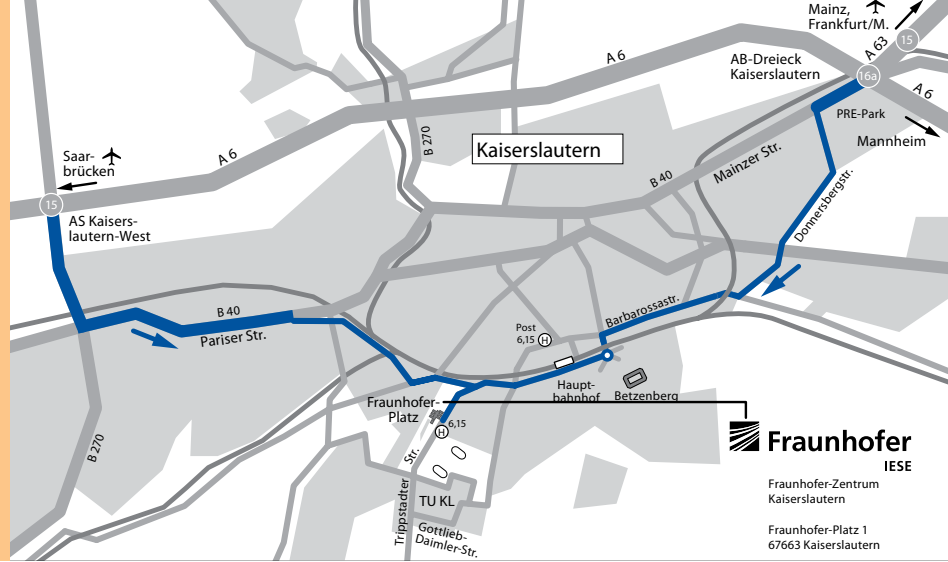
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By car

Coming from the West on Autobahn A6, take the exit Kaiserslautern-West (15), then go towards downtown and follow the signs towards the university. Before you get to the university, you will reach the building complex of the Fraunhofer Center a few hundred meters down Trippstadter Strasse, on the right side of the street.

Coming from the East on Autobahn A6, go to the Autobahn Interchange ("Autobahndreieck") Kaiserslautern, and take the exit Kaiserslautern-Centrum (16a). Then first follow the signs towards Betzenberg Soccer Stadium, then towards the university. It is best to use the detour behind the train station via Zollamtstrasse; at the end of the street, continue straight ahead into Trippstadter Strasse. The building complex of the Fraunhofer Center is located approx. 500m down the street on the right side.

Getting there by means of electronic navigation:

Since most likely, the Fraunhofer-Platz is not yet listed in most electronic navigation systems, we recommend using "Trippstadter Strasse 125" as the destination instead. The Fraunhofer Center is located directly across the street..

By rail and bus

Proceed to the main train station, Kaiserslautern Hauptbahnhof, and then either take a taxi or take TWK city bus no. 106 (towards Mölschbach) or no. 115 (towards Universität), getting off at the stop "Fraunhofer-Zentrum".

By air

From Frankfurt Rhein Main Airport, either by train (approx. 2 hours) or by rental car (approx. 1.5 hours).

MARYLAND
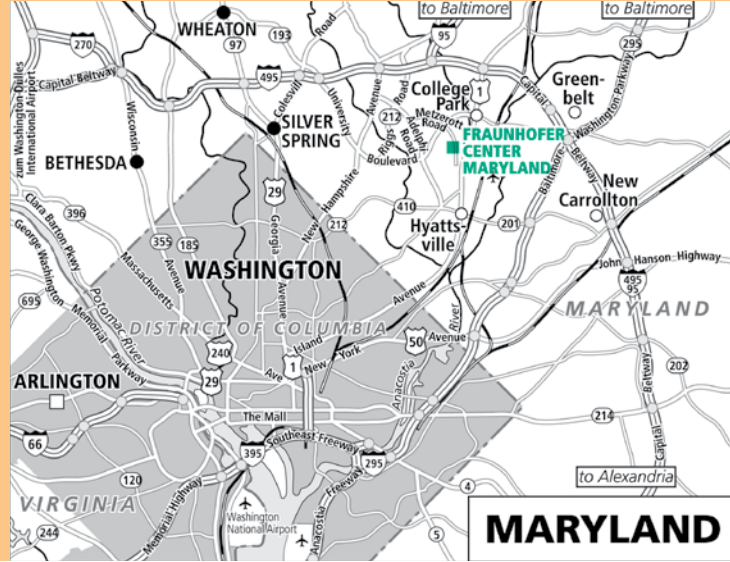
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By Car

Directions from the North

Take Interstate 95 (I95) South (East part of Washington Beltway, I495). Take Route 201, Kenilworth Avenue exit. At the end of the exit ramp, go right.

Continue past the light for Paint Branch Parkway / Good Luck Road through one more light. Turn right at light for River Road. After crossing over a small bridge, turn right onto University Research Court.

Our building is at the end of University Research Court on the right. Go in the front doors in the center of the building. We are on the first floor, past the elevators, and to the left.

Directions from the South – traveling northbound on Interstate 95 (I95)

Take I95 North to the Washington Beltway – I 495, going North or towards College Park. Take the exit for Route 50, going west, towards Washington, DC. Take the exit for Route 410, Veterans Highway. At the end of the exit ramp, go right. Continue on 410, crossing through the traffic light at Route 450. The road will come to a "T", turn left, following the signs for 410. You will pass under the Baltimore/Washington Parkway and through several lights.

At the light for Route 201 Kenilworth Avenue, turn right.

Turn left onto River Road.

After crossing over a small bridge, turn right onto University Research Court.

Our building is at the end of University Research Court on the right. Go in the front doors in the center of the building. We are on the first floor, past the elevators, and to the left.

Directions from the Washington, DC area

Take DC-295 North, following signs for the Baltimore/Washington Parkway. Exit at Riverdale Road/Route 410, turning left onto Riverdale Road, which becomes East-West Highway. Go to Route 201 Kenilworth Avenue and turn right.

Turn left onto River Road.

After crossing over a small bridge, turn right onto University Research Court.

Our building is at the end of University Research Court on the right. Go in the front doors in the center of the building. We are on the first floor, past the elevators, and to the left.

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By Car
The entrance to the Australian Technology Park car park is from Henderson Road, Eveleigh. A Pay and Walk ticketing system has been installed for your convenience. Collect a ticket from the boom gate and drive through to the car park located on ground floor of 8 Central Avenue (Media City Building).

Event/ Visitor car parking is available at 8 Central Ave (Media City Building). Collect a ticket from the boom gate and drive through to the Car Park, located at Ground Floor, 8 Central Ave.

By Rail
CityRail operates frequent train services between Redfern Station (adjacent to the Australian Technology Park) and other major Sydney stations including Central, Town Hall, Wynyard and Circular Quay.
For information about travelling by rail, including timetable information, call the Transport Infoline on 131 500 or visit www.131500.com.au

From Redfern Station
Exit via Platform 10 at Redfern Station. Walk past the WaterTower apartment block and follow the walkway through to the Australian Technology Park. Pedestrian access to the Locomotive Workshops are through Bays 1, 4 and 8. For information relating to specific building and tenant location, enter through the side door of Bay 1 and proceed to ATP Precinct Management offices, located on Level 1/Bay 4 Atrium or phone (02) 9209 4220 for further assistance.

By Bus
There are frequent bus services to the Australian Technology Park from the city and Sydney's domestic and international airport. The bus stop closest to the Australian Technology Park is on the corner of Boundary and Regent Street. For bus timetables call the Transport Infoline on 131 500 or visit www.131500.com.au .

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- Automation and Plant Engineering
- Medical Systems

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1604   Michael Ochs

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  Finance, ERP/Software, Telecommunication
- eGovernment
- Health Care

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(German)

☐ Annual Report 2010/2011 of Fraunhofer IESE, print version
(English)

☐ Annual Report 2010/2011 of Fraunhofer IESE, CD-ROM
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☐ Short films of Fraunhofer IESE, DVD, German

☐ Short films of Fraunhofer IESE, DVD, English

☐ Fraunhofer IESE: Overview

☐ The Fraunhofer-Gesellschaft from A-Z

☐ Annual Report of Fraunhofer-Gesellschaft

☐ STI Software Technologie Initiative Kaiserslautern e. V.

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with included Appendix and other publications (press releases,
previous Annual Reports) are available at

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APPENDIX

NETWORK IN SCIENCE AND INDUSTRY

INDUSTRIAL PARTNERS¹

- ::: tsm total-sourcing-management, Nuremberg
- 1&1 Internet AG, Karlsruhe
- 4Soft GmbH, Munich
- a 3 systems GmbH, Zweibrücken
- Ab.Acus srl, Milan, Italy
- ABB AG, Mannheim
- Absint Angewandte Informatik, Saarbrücken
- Accellere GmbH, St. Augustin
- Acciona Infrastructuras, Alcobendas, Spain
- actano GmbH, Munich
- ADACORE SARL, Paris, France
- Adam Opel GmbH, Rüsselsheim
- Airbus Deutschland, Hamburg
- Alcatel SEL AG, Stuttgart
- ALTEC Information and Communication Systems S.A., Athens, Greece
- andrena objects ag, Karlsruhe
- Ansaldo Sts, Genova, Italy
- Art of Technology AG (AOT), Zurich, Switzerland
- Astrium, Paris, France
- Atlas Elektronik GmbH, Bremen
- Atos Origin Sociedad Anónima Española, Madrid, Spain
- Audi AG, Ingolstadt

- Audi Electronics Venture GmbH, Gaimersheim
- Axpo Holding, Basel, Switzerland
- B2M Software AG, Karlsruhe
- BASF SE, Ludwigshafen
- B. BRAUN AVITUM AG, Melsungen
- BearingPoint GmbH, Berlin
- Beecon GmbH, Karlsruhe
- Bernafon AG, Bern, Switzerland
- BMW Group Forschung und Technik GmbH, Munich
- Bosch Rexroth Electric Drives and Controls GmbH, Lohr a. Main
- BrandMaker GmbH, Karlsruhe
- British Telecommunications Plc, London, UK
- Büren & Partner Software Design GbR, Nuremberg
- C/S Enformasyon Teknolojileri Limited Sirketi, Ankara, Turkey
- Capgemini sd&m AG, Munich
- CAS Software AG, Karlsruhe
- CF Consulting Finanziamenti Unione Europea s.r.l., Milan, Italy
- CIBEK technology + trading GmbH, Limburgerhof
- Comlet Verteilte Systeme GmbH, Zweibrücken
- CON.ECT Eventmanagement GmbH, Vienna, Austria

- Continental Teves AG & Co. oHG, Frankfurt
- ConWeaver GmbH, Darmstadt
- Corisecio GmbH, Darmstadt
- CosmosDirekt, Saarbrücken
- Critical Software, Coimbra, Portugal
- Daimler AG, Ulm
- Danieli Automation, Buttrio, Italy
- Dassault Systèmes, Suresnes, France
- DCON Software & Service AG, Kaiserslautern
- Degudent GmbH, Hanau-Wolfgang
- DELPHI France, Tremblay, France
- Deutsche Bahn AG, Berlin
- Deutsche Lufthansa AG, Frankfurt
- Deutsche Telekom AG (T-Com), Darmstadt
- Díaz & Hilterscheid Unternehmensberatung GmbH, Berlin
- Dräger Medical AG & Co. KG, Lübeck
- EADS Deutschland GmbH, Munich
- ELA Medical SAS, Montrouge, France
- Elektrobit Automotive GmbH, Erlangen
- ESG Consulting GmbH, Fürstenfeldbruck
- ESRI Geoinformatik GmbH, Kranzberg

- EUROCAT GmbH, Darmstadt
- Europäisches Microsoft Innovations Center GmbH, Aachen
- EUROSEC GmbH, Kronberg
- EWM HIGHTEC WELDING GmbH, Mündersbach
- Eyeled GmbH, Saarbrücken
- FIDUCIA IT AG, Karlsruhe
- Finanz Informatik GmbH & Co. KG, Frankfurt
- Ford Forschungszentrum Aachen GmbH, Aachen
- Fredhopper, Amsterdam, Netherlands
- Fujitsu Laboratories of Europe Ltd., Hayes, UK
- GAD eG, Münster
- Gasanstalt Kaiserslautern AG, Kaiserslautern
- Globus SB-Warenhaus Holding GmbH & Co. KG, St. Wendel
- HegerFerrit GmbH, Enkenbach-Alsenborn
- Hella KGaA Hueck & Co, Lippstadt
- Hispano-Suiza, Colombes, France
- Hocoma AG, Volketswil, Switzerland
- Hottinger Maschinenbau GmbH, Mannheim
- HYDROMETER GmbH, Ansbach
- Hyperware, Munich
- ICT Solutions AG, Trier
- IDS Scheer, Saarbrücken

1) Industrial Partners are located in Germany unless stated otherwise.

- IHK Darmstadt Service GmbH, Darmstadt
- IHK Zetis GmbH, Kaiserslautern
- imbus AG, Möhrendorf
- IMC AG, Saarbrücken
- Indra Software Labs, Madrid, Spain
- Infinion Technologies, Neubiberg
- INFORA GmbH, Berlin
- Information Society Open To ImpairmentS (E-ISOTIS), Athens, Greece
- Insiders GmbH, Kaiserslautern
- INSPIRE AG, Paderborn
- intelligent views gmbh, Darmstadt
- Inter online Cooperación 2001, Avilés, Spain
- itelligence AG, Bielefeld
- itestra GmbH, Kaufering
- itk Engineering AG, Herxheim
- iXtronics GmbH, Paderborn
- John Deere European Technology Innovation Center, Kaiserslautern
- John Deere Moline Technology Innovation Center, Moline, USA
- Josef Witt GmbH, Weiden
- KEIPER GmbH & Co. KG, Kaiserslautern
- KOBIL Systems GmbH, Worms
- Krauss-Maffei Wegmann GmbH & Co. KG, Kassel
- KSB Aktiengesellschaft, Pegnitz

- Kugler Maag + Comp. Ltd. & Co. KG, Kornwestheim
- KUKA Systems GmbH, Augsburg
- LogControl GmbH, Pforzheim
- Lotterie-Treuhandges. mbH Hessen, Wiesbaden
- LTi DRiVES GmbH, Lahnau
- Lucent Technologies Network Systems GmbH, Nuremberg
- market maker Software AG, Kaiserslautern
- maxess systemhaus gmbh, Kaiserslautern
- MB-technology GmbH, Sindelfingen
- Medcom Gesellschaft für medizinische Bildverarbeitung mbH, Darmstadt
- Messier-Bugatti, Velizy-Villacoublay, France
- Metropolregion Rhein-Neckar GmbH, Mannheim
- Microsoft Deutschland GmbH, Unterschleißheim
- mineway GmbH, Saarbrücken
- Mitsubishi Research Institute Inc. (MRI), Tokyo, Japan
- Montimage, Paris, France
- Motorola GmbH, Traunstein
- MPDV Mikrolab GmbH, Römerberg
- Münchner Rückversicherungs-Gesellschaft AG, Munich
- Netbiscuits GmbH, Kaiserslautern
- Nokia Networks GmbH, Düsseldorf

- Ontoprise GmbH, Karlsruhe
- OrgaTech Unternehmensberatung, Lünen
- PEPITe S.A., Angleur, Belgium
- Philips Consumer Lifestyle Advanced Technology, Eindhoven, The Netherlands
- Philips Electronics Nederlands B.V., Eindhoven, The Netherlands
- PikeTec GmbH, Berlin
- Porsche engineering Group GmbH, Weissach
- Porsche Informatik GmbH, Bergheim, Austria
- proALPHA Software AG, Weilerbach
- PRO DV Software AG, Dortmund
- psb intralogistics GmbH, Pirmasens
- PSL, Medellín, Colombia
- PTV Planung Transport Verkehr AG, Karlsruhe
- PWD GmbH Personalwirtschaftliche Dienste, Klein Offenseth-Sparrieshoop
- R&D-Ware Oy, Espoo, Finland
- Ricoh Company Ltd. Tokyo, Japan
- Robert Bosch Cara Multimedia GmbH, Hildesheim
- Robert-Bosch GmbH, Stuttgart
- Roche Diagnostics GmbH, Mannheim
- Rolls-Royce plc, Derby, UK
- Sagem Défence Sécurité, Paris, France

- SAP AG, Walldorf
- Schalker Eisenhütte Maschinenfabrik GmbH, Gelsenkirchen
- Schenker AG, Essen
- Schneider Electric GmbH, Seligenstadt
- Secorvo Security Consulting GmbH, Karlsruhe
- SEEBURGER AG, Bretten
- SHE Informationstechnologie AG, Ludwigshafen
- SIEDA GmbH, Kaiserslautern
- Siemens AG, Munich
- Siemens Healthcare Diagnostics Products GmbH, Schwalbach
- Siemens Information Systems Limited, Mumbai, India
- Siemens VDO Automotive AG, Babenhausen
- Sirrix AG, Saarbrücken
- Software AG, Darmstadt
- Sopera GmbH, Bonn
- Sportbund Rheinhessen, Mainz
- SQS Software Quality Systems AG, Cologne
- Süddeutsche Klassenlotterie (SKL), Munich
- Sysgo AG, Klein-Winternheim
- Technische Werke Kaiserslautern Versorgungs-AG, Kaiserslautern
- Terex Demag GmbH, Zweibrücken
- Testing Technologies IST GmbH, Berlin
- Testo AG, Lenzkirch

- THALES, Neuilly sur Seine, France
- TKMS Blohm+Voss Nordseewerke GmbH, Hamburg
- T-Mobile International AG & Co. KG, Bonn
- TNM Software GmbH, Neunkirchen
- TQsoft GmbH, Berlin
- T-Systems GEI GmbH, Aachen
- T-Systems Multimedia Solutions GmbH, Dresden
- TÜV SÜD Automotive Gmbh, Munich
- TXT e-solutions Spa, Milan, Italy
- Tynos, Bremen
- UAB Algoritmu Sistemos, Vilnius, Lithuania
- UT GESTION TIC ECOPET-ROL, Bogotá, Colombia
- VDA Verband der Automobilindustrie, Frankfurt
- Vermon SA, Tours, France
- Vision Tools Bildanalyse Systeme GmbH, Waghäusel
- Volkswagen Aktiengesellschaft, Wolfsburg
- VTI Technologies OY, Vantaa, Finland
- WIKON Kommunikationstechnik GmbH, Kaiserslautern
- XI'AN TYPICAL EUROPE GmbH, Kaiserslautern
- XING AG, Hamburg
- ZEA Partners, Louvain-la-neuve, Belgium

NATIONAL RESEARCH PARTNERS

- Arbeitsgruppe Softwaretechnik, Universität Bremen (Software Engineering Research Group, University of Bremen), Bremen
- CyberForum e.V., Karlsruhe
- DESY Deutsches-Elektronen Synchrotron, Hamburg
- Deutsches Forschungszentrum für Künstliche Intelligenz GmbH (DFKI) (German Research Center for Artificial Intelligence GmbH), Kaiserslautern
- Deutsche Hochschule der Polizei (German Police University), Münster
- Fachbereich Gestaltung, Folkwang Hochschule (Department of Design, Folkwang University of the Arts), Essen
- Fachbereich Maschinenbau, Fachhochschule Kaiserslautern (Department of Mechanical Engineering, Kaiserslautern University of Applied Sciences), Kaiserslautern
- Forschungszentrum Informatik (FZI) (Research Center for Information Technologies), Karlsruhe
- Fraunhofer-Verbund Informations- und Kommunikationstechnik (IuK) (Fraunhofer Information and Communication Technology Group), Berlin
- Georg-August-Universität Göttingen (Georg-August-University Göttingen), Göttingen

- Hamburger Informatik Technologie-Center e.V., Universität Hamburg (Computer Science Technology Center of Hamburg, University of Hamburg), Hamburg
- Hochschule der Medien (Stuttgart Media University), Stuttgart
- Hochschule für Technik und Wirtschaft des Saarlandes (University of Applied Science), Saarbrücken
- Institut für Informatik IV, Technische Universität München (Institute for Computer Science, TU München), Munich
- Institut für Technische und Betriebliche Informationssysteme, Otto-von-Guericke-Universität Magdeburg (Department of Technical & Business Information Systems, Otto von Guericke University), Magdeburg
- KIT Karlsruher Institut für Technologie (Karlsruhe Institute of Technology), Karlsruhe
- Lehrstuhl für Software Systeme, Universität Duisburg-Essen (Institute for Computer Science and Information Systems, University of Duisburg-Essen), Essen
- Oldenburger Forschungs- und Entwicklungsinstitut für Informatik-Werkzeuge und -Systeme OFFIS e.V. (Oldenburg Research and Development Institute for Computer Science Tools and Systems), Oldenburg

- Regierungspräsidium Gießen (Gießen Regional Administrative Authority), Gießen
- Rheinisch-Westfälische Technische Hochschule Aachen (RWTH Aachen University), Aachen
- Technische Universität Berlin
- Technische Universität Clausthal (Clausthal University of Technology), Clausthal
- Technische Universität Darmstadt (Technical University of Darmstadt), Darmstadt
- Technische Universität Dresden (Technical University Dresden), Dresden
- Technische Universität Kaiserslautern (University of Kaiserslautern), Kaiserslautern
- Technologie-Initiative SmartFactory KL e.V., Kaiserslautern
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- Universität Stuttgart (University of Stuttgart), Stuttgart
- Universität Würzburg (University of Würzburg), Würzburg
- VDI/VDE Innovation + Technik GmbH (VDI - The Association of German Engineers), Berlin
- Westpfalz-Klinikum GmbH, Kaiserslautern

INTERNATIONAL RESEARCH PARTNERS

- AGE - The European Older People's Platform, Brussels, Belgium
- Aristotle University of Thessaloniki, Thessaloniki, Greece
- Bay Zoltan Foundation for Applied Research, Budapest, Hungary
- Budapest University of Technology and Economics, Budapest, Hungary
- Building Research Establishment, Watford, UK
- C-Base, Center for Empirically Based Software Engineering, Maryland, USA
- Centre d'Excellence en Technologies de l'Information et de la Communication (CETIC), Charleroi, Belgium
- Centre National de la Recherche Scientifique, Paris, France
- Centro Ricerche Fiat, Torino, Italy
- Chalmers Tekniska Hoegskola Aktiebolag, Göteborg, Sweden
- Congregazione Suore Infermiere dell' Addolorata "Ospedale Valduce", Como, Italy
- Consiglio Nazionale delle Ricerche, Rome, Italy
- DEMOKRITOS, National Centre for Scientific Research, Aghia Paraskevi Attikis, Greece
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- Fundación Vodafone España, Madrid, Spain
- Gazi Üniversitesi, Ankara, Turkey
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- Heriot-Watt University, Edinburgh, UK
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- Institut National de Recherche en Informatique et Automation, Le Chesnay, France
- Institut National Polytechnique de Toulouse, Toulouse, France
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- ITRC Software Process Improvement Center, Korea Advanced Institute of Science and Technology, Daejon, Republic of Korea

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- Japan Manned Space Systems Corporation, Ibaraki, Japan
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- Kungliga Tekniska Högskolan, Stockholm, Sweden
- Laboratory for Software Engineering Decision Support, University of Calgary, Calgary, Canada
- Latvijas Universitates Matematikas un Informatikas Instituts, Riga, Latvia
- Linköpings Universitet, Linköping, Sweden
- Lulea Tekniska Universitet, Lulea, Sweden
- Medical University of Graz, Graz, Austria
- National College of Ireland, Dublin, Ireland
- National ICT Australia (NICTA), Australian Technology Park, Eveleigh, Australia
- National Technical University of Athens, Athens, Greece
- Norsk Regnesentral/Norwegian Computing Center, Oslo, Norway
- Norwegian University of Science & Technology, Trondheim, Norway
- Office National d'Etudes et de Recherche Aérospatiales, Chatillon, France
- Politechnika Warszawska, Warsaw, Poland
- Politecnico di Milano, Milan, Italy
- Scuola Superiore di Studi Universitari e di Perfezionamento Sant'Anna, Pisa, Italy

- SEARCH-LAB, Security Evaluation Analysis and Research Laboratory Ltd, Budapest, Hungary
- SEERC, Thessaloniki, Greece
- SQI Software Quality Institute, Griffith University, Brisbane, Australia
- Stichting Centrum voor Wiskunde en Informatica, Amsterdam, The Netherlands
- Stiftelsen SINTEF, Trondheim, Norway
- The University of Newcastle upon Tyne, Newcastle upon Tyne, UK
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- Universidad Rey Juan Carlos, Mostoles, Spain
- Universidade Estadual da Paraíba, Campina Grande, Brazil
- Università degli Studi di Trieste, Trieste, Italy
- Università di Bologna, Bologna, Italy
- Università di Pisa, Pisa, Italy
- Universiteit Maastricht, Maastricht, The Netherlands
- Universitetet I Oslo, Oslo, Norway
- University of Manchester, Manchester, UK
- Vienna University of Technology, Vienna, Austria
- VTT Electronics, Oulu, Finland

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INTERNATIONAL SOFTWARE ENGINEERING NETWORK (ISERN)

- Aalto University School of Science and Technology (TKK), Finland
- ABB Corporate Research, USA
- Avaya Labs, USA
- Blekinge Institute of Technology, Sweden
- COPPE/Rio de Janeiro Federal University, Brazil
- Fraunhofer Center for Experimental Software Engineering Maryland, USA
- Fraunhofer Institute for Experimental Software Engineering, Germany
- Free University of Bolzano-Bozen, Italy
- Information-technology Promotion Agency, Japan
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- Japan Manned Space Systems Corporation JAMMS, Japan
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- Microsoft Research, USA

- Nara Institute of Science and Technology, Japan
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- North Carolina State University, USA
- Northrop Grumman, USA
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- NTT Data Corporation, Japan
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- University of Calgary, Canada
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- University of Hawaii, USA

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- University of Maryland-College Park, USA
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- University of Oslo, Norway
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- University of Sheffield, UK
- University of Southern California, USA
- University of Technology Sydney, Australia
- University Politecnico di Torino, Italy
- University of Uruguay (ORT), Uruguay
- Vienna University of Technology, Austria
- VTT Electronics, Finland

VISITORS HOSTED

Dr. Yan Liu, ERCIM Fellow, Associate Professor, School of Software Engineering, Tongji University, Shanghai, China, June 15, 2009 - June 15, 2010

Dr. Shashidhar Kodamballi, ERCIM Fellow, General Motors R&D, India Science Lab, Bangalore, India, October 1, 2009 - September 30, 2010

Prof. Dr. José Carlos Maldonado, Prof. Dr. Ellen Francine Barbosa, Prof. Dr. Kalinka Regina Lucas Jaquie Castelo Branco, Prof. Dr. Edson dos Antos Moreira, Prof. Dr. Paulo César Masiero, Prof. Dr. Onofre Trindade Júnior, Institute of Mathematics and Computer Science, University of São Paulo / National Institute of Science and Technology - Critical Embedded Systems, São Carlos, Brazil, April 12-14

Prof. Leon Osterweil, Director, Laboratory for Advanced Software Engineering Research (LASER), University of Massachusetts Amherst, Amherst, USA, July 7

Mrs. Sylwia Kopczyńska, Faculty of Computer Science, Software Engineering Group, Poznań University of Technology, Poznań, Poland, September 1 - December 15

Dr. Dimitris Dranidis, South-East European Research Institute, Thessaloniki, Greece, September 23-24

Prof. Dr. Omer Faruk Bay, Dr. Meltem Baturay, Gazi University, Ankara, Turkey, September 23-24

Dr. Eduardo Garcia Marino, Ramon Gonzalez, Inter Online Cooperacion, Avilés, Spain, September 23-24

Dr. Jürgen Börstler, Umea University, Umea, Sweden, September 23-24

Dr. Akihiko Obata, Senior Researcher, Knowledge Technology Laboratory, Fujitsu Laboratories Ltd, Kawasaki, Japan, September - December 2010

Prof. Dr. Rupak Majumdar, Scientific Director, MPI-SWS, Max-Planck-Gesellschaft, Kaiserslautern, December 13

Mr. Yusaku Nakata - Executive Director, Information-technology Promotion Agency; Mr. Joji Tateishi - Senior Vice President, Software Engineering Center, Information-technology Promotion Agency; Mr. Katsutoshi Shinatni - Chief Advisor, Software Engineering Center, Information-technology Promotion Agency; Mr. Yasuhiro Kikushima - Deputy Chief Information Officer at National Personnel Authority; Research Fellow at Software Engineering Center, Information-technology Promotion Agency; Mr. Norifumi Nomura - General Manager at Consulting Department, Solutions Business Promotion Division, ITOCHU Techno-Solutions Corporation; Mr. Hisayoshi Adachi - Senior Manager, Corporate SEPG, Denso Corporation, Tokyo, Japan, January 26, 2011

PROFESSIONAL CONTRIBUTIONS

LECTURING ASSIGNMENTS

Becker, M.:
Lecture
Product Line Engineering, Computer Science Department, University of Kaiserslautern
Winter 2010/2011

Dörr, J.:
Lecture
Requirements Engineering, Computer Science Department, University of Kaiserslautern
Winter 2009/2010
Winter 2010/2011

Eschbach, R.:
Lecture
Methoden der Soft Control, Electrical and Computer Engineering Department, University of Kaiserslautern
Summer 2010

Hussain, T.:
Lecture
Steuerungstechnik (Logic Control), Electrical and Computer Engineering Department, University of Kaiserslautern
Winter 2010/2011

Lecture
Methoden der Soft Control, Electrical and Computer Engineering Department, University of Kaiserslautern
Summer 2010

Kuhn, T.:
Lecture
Operating Systems, Computer Science Department, University of Kaiserslautern
Summer 2010

Liggesmeyer, P.:
Lecture
Sicherheit und Zuverlässigkeit eingebetteter Systeme, Computer Science Department, University of Kaiserslautern
Winter 2009/2010
Winter 2010/2011

Liggesmeyer, P.:
Lecture
Qualitätsmanagement von Software und Systemen, Computer Science Department, University of Kaiserslautern
Winter 2009/2010

Liggesmeyer, P.:
Lecture
Software-Entwicklung 2, Computer Science Department, University of Kaiserslautern
Winter 2010/2011

Liggesmeyer, P.:
Lecture
Software-Qualitätssicherung, Computer Science Department, University of Kaiserslautern
Summer 2010

Maier, A.:
Lecture
Barrierefreiheit / Software Ergonomie und Usability, Computer Science Department, Hochschule Mannheim
January 22 & June 23, 2010

Münch, J.:
Lecture
Empirical Model Building and Methods (2+1), Computer Science Depart-

ment, University of Kaiserslautern
Summer 2010

Lecture
Process Modeling (2+1), Computer Science Department, University of Kaiserslautern
Summer 2010

Putz, W.:
Lecture
XML-Sprachfamilie, Computer Science Department, Hochschule Darmstadt
Winter 2009/2010
Winter 2010/2011

Riegel, N.:
Single Lecture
MSE Praktikum, University of Kaiserslautern & Fraunhofer IESE (Master of Software Engineering)
September 15 & 16, 2010

Rombach, D.:
Lecture
Grundlagen des Software Engineering (in English), Computer Science Department, University of Kaiserslautern
Winter 2009/2010
Winter 2010/2011

Bachelor Project
Grundlagen des Software Engineering (in English), with Prof. Liggesmeyer & Prof. Poetzsch-Heffter, Computer Science Department, University of Kaiserslautern
Summer 2010
Summer 2011

Lecture
Software Project and Process Management; Computer Science Department, University of Kaiserslautern

Summer 2010
Summer 2011

Lecture
Requirements Engineering, Computer Science Department, University of Kaiserslautern
Winter 2009/2010
Winter 2010/2011

Lecture
Product Line Engineering, Computer Science Department, University of Kaiserslautern
Winter 2009/2010
Winter 2010/2011

Lecture
Empirical Model Building and Methods, Computer Science Department, University of Kaiserslautern
Summer 2010
Summer 2011

Master Project
Software Engineering: Software Evolution, Computer Science Department, University of Kaiserslautern
Winter 2009/2010
Winter 2010/2011

Master Project
Software Engineering: Team-based Software Development, Computer Science Department, University of Kaiserslautern
Winter 2009/2010
Winter 2010/2011

Trapp, M.:
Lecture
Automotive Software Engineering, Computer Science Department, University of Kaiserslautern
Summer 2010

EDITORIAL BOARDS

Bomarius, F.:
Member, Editorial Board, Ph.D. Theses in Experimental Software Engineering, Fraunhofer IRB Publishing Company, since 2001

Dörr, J.:
Journal Reviewer, Business & Information Systems Engineering, since 2010

Liggesmeyer, P.:
Editor, it – information technology,
Oldenbourg-Verlag, München, since 2003

Member, Editorial Board, Lecture Notes in Informatics (LNI), Gesellschaft für Informatik GI, Springer, since 2003

Editor, Informatik – Forschung und Entwicklung, Springer, since 2000

Member, Editorial Board, Ph.D. Theses in Experimental Software Engineering, Fraunhofer IRB Publishing Company, since 2004

Luiz, T.:
Coordinating Editor, Medizinische Gefahrenabwehr, since 2009

Münch, J.:
Co-Guest Editor, Software Process Improvement and Practice Journal,
John Wiley and Sons, 2006

Member, Editorial Board, e-Informatica, since 2006

Rombach, D.:
Associate Editor, IEEE Transactions on Software Engineering, since 2003

Associate Editor, International Journal of Empirical Software Engineering, Springer-Verlag, since 1996

Member, Editorial Board, International Journal of Software Process:
Improvement and Practice, John Wiley and Sons, since 1994

Member, Editorial Board, Informatik: Forschung und Entwicklung,
Gesellschaft für Informatik GI, Springer, since 1993

Editor, Editorial Board, Ph.D. Theses in Experimental Software Engineering, Fraunhofer IRB Publishing Company, since 2000

Member, Editorial Board, International Journal of Software and Informatics, Institute of Software, Chinese Academy of Sciences, Bejing, since 2007

Wessner, M.:
Member, Editorial Board, Journal of Educational Multimedia and Hypermedia, Association for the Advancement of Computing in Education, Chesaspeake, USA, since 2005

COMMITTEE ACTIVITIES

Adam, S.:
Member, Program Committee, 11th Workshop on Business Process Modeling, Development and Support (BPMDS 2010), 22nd International Conference on Advanced Information Systems Engineering (CAiSE'10), Hammamet, Tunisia, June 7-8

Member, Review Committee, International Journal of Information System Modeling and Design (IJISMD), Special Issue on Drivers of Business Process Development: Business, IT, Compliance

Becker, M.:
Member, Program Committee, 1st International Workshop on Formal Methods in Software Product Line Engineering, 14th International Software Product Line Conference (SPLC 2010) Jeju City, South Korea, September 14

Dörr, J.:
Co-Organizer & Member, Program Committee, Workshop CreaRE, Refsq 2010, Essen, Germany, June 30 - July 2

Co-Organizer & Member, Program Committee, Workshop RESC-RE in Small Companies, Refsq 2010, Essen, Germany, June 30 - July 2

Member, Program Committee, Product Line Requirements, RefsQ 2010, Essen, Germany, June 30 - July 2

Member, Program Commitee, NFPinDSML, Models 2010, Oslo, Norway, October 3-8

Elberzhager, F.:
Member, Program Committee, Software Process and Product Improvement (SPPI), 36th Euromicro Software Engineering and Advanced Application (SEAA), Lille, France, September 1-3

Eschbach, R.:
Member, Program Committee; Chair, 6th Workshop on Advances in Model Based Testing (AMOST 2010), 3rd IEEE Interational Conference on Software Testing (ICST 2010), Paris, France, April 6

Member, Program Committee, 3rd Workshop on Model-based Testing in Practice, in conjunction with the 6th European Conference on Modelling Foundations and Applications (ECMFA 2010), Paris, France, June 15-18

Member, Program Committee, The Second International Conference on Advances in System Testing and Validation Lifecycle, VALID 2010, Nice, France, August 22-27

Member, Program Committee, 2nd International Workshop on Formal Methods and Agile Methods, 8th IEEE International Conference on Software Engineering and Formal Methods (SEFM 2010) Pisa, Italy, September 13-18

Förster, M.:
Member, Program Committee; 21st IEEE International Symposium on Software Reliability Engineering (ISSRE 2010), San Jose, USA, November 1-4

Jedlitschka, A.:
Member, Program Committee, RESER Workshop held in conjunction with ICSE 2010, Cape Town, South Africa, May 1

Member, Steering Committee, PROFES 2010, Limerick, Ireland, June 21

Member, Program Committee, ESEM 2010, Bolzano, Italy, September 16-17

Member, Steering Committee, PROFES 2011, Torre Canne, Italy, June 20-22, 2011

Chair, IASESE 2011, Banff, Canada, September 21, 2011

John, I.:
Member, Program Committee, Workshop PIK - Produktlinien im Kontext, Software Engineering 2010, Paderborn, Germany, February 22-26

Member, Program Committee, 14th International Software Product Line Conference, SPLC 2010, Jeju Island, South Korea, September 13-17

Member, Program Committee, WI - Wirtschaftsinformatik, Zurich, Switzerland, February 16-18, 2011

Klaus, A.
Member, Program Committee; Research Institute Liaison Chair, The Second International Conference on Advances in System Testing and Validation Lifecycle, VALID 2010, Nice, France, August 22-27

Knodel, J.
Member, Program Committee, 14th European Conference on Software Maintenance and Reengineering (CSMR 2010), Madrid, Spain, March 15-18

Member, Program Committee, 17th Working Conference on Reverse Engineering (WCRE 2010), Boston, USA, October 13-17

Chair, Doctoral Symposium, 15th European Conference on Software Maintenance and Reengineering (CSMR 2011), Oldenburg, Germany, March 1-4, 2011

Kuhn, T.
Member, Program Committee, SAM Workshop 2010, Oslo, Norway, October 4-5

Member, Program Committee, SDL Forum 2011, Toulouse, France, July 5-7, 2011

Liggesmeyer, P.
Member, Program Committee, 3. Workshop zur Software-Qualitätsmodellierung und -bewertung, SQMB 2010, Paderborn, Germany, February 22-23

Member, Program Committee, Modellierung 2010, Klagenfurt, Austria, March 24-26

Member, Program Committee, Innovation Forum Embedded Systems, Munich, Germany, April 10

Track Chair, 2. Konferenz Software-Technologien und -Prozesse, STeP 2010, Furtwangen, Germany, May 6

Track Chair, International Workshop on Digital Engineering, IWDE 2010, Magdeburg, Germany, June 14

Member, Program Committee, Conquest 2010, Dresden, Germany, September 20-22

Luiz, T.:
Member, Plenum, Medikamentengabe im Rettungsdienst, Mainzer Gespräche, Mainz, Germany, April 28

Münch, J.
Co-Organizer, SQMB '10, Paderborn, Germany, February 22

Member, Program Committee, SMEF 2010, Rome, Italy, June 10-11

Member, Program Committee, PROFES 2010, Limerick, Ireland, June 21-23

Member, Program Committee, ICSP 2010, Paderborn, Germany, July 8-9

Member, Program Committee, REMIDI 2010, Princeton, USA, August 23

Member, Doctoral Symposium, ICGSE 2010, Princeton, USA, August 23

Member, Program Committee, ICGSE 2010, Princeton, USA, August 23-26

Member, Program Committee, EuroSPI 2010, Potsdam, Germany, September 1-3

Member, Program Committee, Software Process and Product Improvement (SPPI), 36th EUROMICRO Conference on Software Engineering and Advanced Application (SEAA), Lille, France, September 1-3

Co-Organizer, ISERN Industry Session (Software Factory), ISERN 2010, Bolzano, Italy, September 14

Member, Program Committee, 2nd Intl. Workshop on Formal Methods and Agile Methods (2010), Pisa, Italy, September 17

Member, Program Committee, Vorgehensmodelle in der Praxis, 5. Workshop GI-Tagung Informatik, Leipzig, Germany, September 27 - October 1

Member, Program Committee, LESS 2010, Helsinki, Finland, October 17-20

Co-Organizer, ISDE 2010, Heronissou, Crete, Greece, October 24-25

Member, Program Committee, MetriKon 2010, Stuttgart, Germany, November 10-12

Member, Program Committee, IWSM 2010, Stuttgart, Germany, November 10-12

Member, Program Committee, Mensura 2010, Stuttgart, Germany, November 10-12

Co-Organizer, 20th Intl. Workshop on Software Measurement, IWSM/MetriKon/Mensura 2010, Stuttgart, Germany, November 10-12

Co-Organizer, SQMB '11, Karlsruhe, Germany, February 1, 2011

Member, Program Committee, ICSSP 2011, Honolulu, USA, May 2011

Member, Program Committee, 3rd Intl. Workshop on Formal Methods and Agile Methods (FM + AM 2011), Limerick, Ireland, June 20-21, 2011

Member, Program Committee, PROFES 2011, Torre Canne, Italy, June 21-23, 2011

Member, Program Committee, Software Process and Product Improvement (SPPI), 37th EUROMICRO, Oulu, Finland, August 20 - September 2, 2011

Member, Program Committee, MetriKon 2011, Kaiserslautern, Germany, November 1, 2011

Co-Organizer, DASMA MetriKon 2011, Kaiserslautern, Germany, November 16-18, 2011

Putz, W.:
Session Chair, Activity Management Services, AALIANCE Conference, Malaga, Spain, March 11-12

Member, Program Committee, AALIANCE Conference, Malaga, Spain, March 11-12

Rombach, D.:
Chair, Steering Committee, ISERN Workshop Series, Kaiserslautern, Germany, 2010

Co-Organizer, Dagstuhl Workshop on "New Frontiers for Empirical Software Engineering", Dagstuhl, Germany, March 22-24

Schwarz, R.:
Member, Program Committee, 4th International Conference on Information Security and Assurance (ISA 2010), Miyazaki, Japan, June 23-25

Member, Program Committee, First International Conference on Security-enriched Urban Computing and Smart Grid (SUComS), Daejeon, Korea, September 15-17

Member, Program Committee, 2010 International Conference on Security Technology (SecTech 2010), Jeju Island, Korea, December 13-15

Trapp, M.:
Organizer, 1st Workshop on Critical Automotive Applications: Robustness & Safety, CARS 2010, Eighth European Dependable Computing Conference, EDCC-8 2010, Valencia, Spain, April 27-30

Member, Program Committee, 3rd International Workshop on Non-functional Properties in Domain Specific Languages, ACM/IEEE 13th International Conference on Model Driven Engineering Languages and Systems, Oslo, Norway, October 3-8

Member, Program Committee, 5th International Workshop Models@run.time, ACM/IEEE 13th International Conference on Model Driven Engineering Languages and Systems, Oslo, Norway, October 3-8

Villela, K.:
Member, Program Committee, SBQS 2010 (IX Brazilian Symposium on Software Quality), Belém, Brazil, June 7-11

Member, Program Committee, SBES 2010 (24th Brazilian Symposium on Software Engineering), Salvador, Brazil, September 27 - October 1

SCIENTIFIC AND TECHNOLOGICAL ADVISORY BOARDS

Dörr, J.:
Spokesperson (& Member), Gesellschaft für Informatik/ Fachgruppe Requirements Engineering, Germany, since 2010

Eschbach, R.:
Member, VDI-Fachausschuss "Qualitätssicherung für Software in der Medizintechnik", since 2008

Member, VDI/ VDE GMA Fachausschuss 1.50 Methoden der Steuerungstechnik, since 2008

Göpfert, B.:
Member, STAR-Anwenderbeirat, Munich, Germany, since October 2007

Hussain, T.:
Member, VDI/ VDE GMA Fachausschuss 1.50 Methoden der Steuerungstechnik, since 2008

John, I.:
Member, Steering Committee, SPLC Software Product Line Conference, since 2010

Kerkow, D.:
Member, VDI-Fachausschuss "Qualitätssicherung für Software in der Medizintechnik", Dusseldorf, Germany, since 2008

Member, Forum MedTech Pharma e.V.; Geschäftsstelle Bayern innovativ GmbH, Nuremberg, Germany, since 2008

Guest member, Normierungsgremium DKE, (VDE, DIN) UK 811.4, Frankfurt, Germany, since 2008

Klaus, A.:
Member, VDI-Fachausschuss "Qualitätssicherung für Software in der Medizintechnik", since 2009

Liggesmeyer, P.:
Member, Steering Committee, Gesellschaft für Informatik, Germany, since 1999

Chair, GI Special Interest Group "Softwaretechnik", Germany, since 1999

Spokesperson (& Member), Fraunhofer Allianz Embedded Systems, Germany, since 2010

Münch, J.:
Member, Committee, Diploma Thesis Awards, DASMA e.V., Germany, since 2005

Rombach, D.:
Coordinator, ISERN (International Software Engineering Research Networks), since 1996

Member, Advisory Board, Fraunhofer Center Maryland, College Park, USA, since 1998

Member, Advisory Board, Otto A. Wipprecht-Stiftung, Germany, since 1999

Member, Advisory & Expert Group for the Minister President of Rhineland-Palatinate, Germany, since 2002

Chair, Board, SEI Process Achievement Award, USA, since 2009

Chair, Committee, IEEE Harlan D. Mills Award, USA, since 2009

Member, Steering Committee, KIST (Korea Institute of Science and Technology) Europe Forschungsgesellschaft mbH, Korea, since 2006

Member, Scientific Advisory Board, NICTA (National Information and Communications Technologies Australia), Australia, since 2006

Member, Advisory Board, Business and Innovation Center (BIC), Kaiserslautern, Germany, since 2007

Member, Advisory Board, An-Institus fortis, Munich, Germany, since 2009

Schwarz, R.:
Founding Member, Committee, International Secure Software Engineering Council (ISSECO), Potsdam, Germany, since 2010

PARTICIPATION IN DELEGATIONS

Rombach, D.:
Member, Mayor of Kaiserslautern Delegation, Lord Mayor Dr. Klaus Weichel, Washington, DC/Chicago/ Moline, USA, August 28 - September 10

Member, Ciy of Kaiserslautern Business Delegation, Lord Mayor Dr. Klaus Weichel, Thiruvananthapuram/Kerala/ Kochi, India, January 16-19, 2011

MEMBERSHIPS IN INDUSTRIAL ADVISORY BOARDS

Münch, J.:
Member, Advisory Board, SASQIA / OrgaTech GmbH, Lünen, Germany, since 2006

Member, Advisory Board, ACCEL GmbH, Lünen, Germany, since 2006

Rombach, D.:
Member, Advisory Board, Stiftung der Gasanstalt, Kaiserslautern, Germany, since 2002

Member, Advisory Board, Stadtsparkasse Kaiserslautern, Kaiserslautern, Germany, since 2004

Chairman of the Board., 1. FC Kaiserslautern (Professional Soccer Club), Kaiserslautern, Germany, since 2008

MEMBERSHIPS IN PROFESSIONAL ASSOCIATIONS

AAL-Allianz

Access SOS Emergency

ACL – Association for Computational Linguistics

ACM – Association of Computing Machinery

AGBC – American-German Business Club Deutschland e.V.

AMS – American Mathematical Society

ASQF e.V. – Arbeitskreis Software-Qualität in Franken

BV-Päd. – Bundesverband der Diplom-Pädagoginnen und Diplom-Pädagogen e.V.

CAST e.V. – Competence Center for Applied Security Technology

CVC – Commercial Vehicle Cluster

DASMA – German Software Metrics and Effort Estimation Association

DGI – Deutsche Gesellschaft für Informationswissenschaft und Informationspraxis e.V.

DIN – Deutsches Institut für Normung

Förderverein Informatik TU KL/FIT

Fraunhofer Academy

Freundeskreis TU KL

gc-UPA – German Chapter of the Usability Professionals' Association

GDM – Gesellschaft für Didaktik der Mathematik

GFaI – Gesellschaft zur Förderung angewandter Informatik e.V.

GFFT – Gemeinnützige Gesellschaft zur Förderung des Forschungstransfers e.V.

GI – Gesellschaft für Informatik

idw – Informationsdienst Wissenschaft

IEEE – Institute of Electrical and Electronic Engineers

IMA – Institute of Mathematics and its Application

ISQI (Weit e.V.)

ISSECO – International Secure Software Engineering Council

IuK – Fraunhofer Information and Communication Group

LAP – Liberty Alliance Project

MedTech Pharma

OMG – Object Management Group

Open BC – Open Business Club

SafeTRANS – Safety in Transportation Systems

Science Alliance Kaiserslautern

STI – Software Technologie Initiative e.V.

Tekom – Fachverband für technische Kommunikation und Dokumentation

VDR – Verband Deutsches Reisemanagement e.V.

XING AG

KEYNOTES

John, I.:
"Introduction of Software Product Lines", WIRE 2010 - Workshop on Introducing Reuse in Enterprises, São Paulo, Brazil
June 28

Liggesmeyer, P.:
"Softwaretechnik für eingebettete Systeme - Herausforderungen der nächsten Jahre", Wissenschaftliches Kolloquium Softwaretechnik - Informatik - IT, Ruhr-Universität Bochum, Bochum, Germany
February 4

"Anspruch & Machbarkeit bei der Entwicklung hoch kritischer Softwaresysteme – und was man daraus für den „Normalfall" lernen kann", IQ Roadshow: "Wenn Sie sich Fehler nicht leisten können!", Logica GmbH, Stuttgart, Germany
October 12

"Anspruch & Machbarkeit bei der Entwicklung hoch kritischer Softwaresysteme – und was man daraus für den „Normalfall" lernen kann", IQ Roadshow: "Wenn Sie sich Fehler nicht leisten können!", Logica GmbH, Karlsruhe, Germany
October 13

"Anspruch & Machbarkeit bei der Entwicklung hoch kritischer Softwaresysteme – und was man daraus für den

„Normalfall" lernen kann", IQ Roadshow: "Wenn Sie sich Fehler nicht leisten können!", Logica GmbH, Mainz, Germany
October 28

"Anspruch & Machbarkeit bei der Entwicklung hoch kritischer Softwaresysteme – und was man daraus für den „Normalfall" lernen kann", IQ Roadshow: "Wenn Sie sich Fehler nicht leisten können!", Logica GmbH, Berlin, Germany
November 9

"Anspruch & Machbarkeit bei der Entwicklung hoch kritischer Softwaresysteme – und was man daraus für den „Normalfall" lernen kann", IQ Roadshow: "Wenn Sie sich Fehler nicht leisten können!", Logica GmbH, Hamburg, Germany
Novermber 10

"Architecture Visualization", Visual Analytics, DFG, Schloss Dagstuhl, Wadern, Germany
November 25

Münch, J.:
"Linking Software Development and Business Strategy through Measurement", Workshop on Leveraging Empirical Research for Software Business Success (EPIC 2010), Bolzano, Italy
September 15

Rombach, D.:
"Ambient Assisted Living - Technologie für den Menschen", 3. AAL Kongress, Berlin, Germany
January 26

PRESENTATIONS

Adam, S.:
"A Service-oriented View on Business Processes", Research Workshop Presentation, BPMDS @ CAiSE 2010, Hammamet, Tunisia, June 7

"Incorporating SPL Knowledge into a Requirements Process for Information Systems – An Architecture-driven Tailoring Approach", Research Workshop Presentation, PLREQ Workshop @ RefSQ 2010, Essen, Germany, June 29

"Improving SPL-based Information System Development Through Tailored Requirements Processes", Research Conference Presentation, Doctoral Symposium @ RE 2010, IEEE, Sydney, Australia, September 27

"ReqMan Returns - Mikroinvasiv zu maßgeschneiderten Re Prozessen", Industry Conference Presentation, ReConf Schweiz, Hood / HLMC, Zurich, Switzerland, October 7

Armbrust, O.:
"Determining Organization-specific Process Suitability", Conference Presentation, ICSP 2010, Paderborn, Germany, July 8

"Which Processes Are Needed in Five Years? Strategic Process Portfolio Management at the Japan Aerospace Exploration Agency (JAXA)", Conference Presentation, SPICE Days 2010, Stuttgart, Germany, June 22

Bauer, T.:
"SIMOTEST - SImulink MOdel-based TESTing tool", Industry Workshop Presentation, Software-Qualität - Testautomatisierung & domänenspezifische Sprachen, Fraunhofer IESE, Kaiserslautern, Germany, April 15

"SIMOTEST - A Tool for Deploying Model-Based Testing in Matlab/Simulink using IEEE 1641", Conference Presentation, MOTIP 2010, Fraunhofer FOKUS, Paris, France, June 15-16

"Systematisches Testen", Industry Seminar Presentation, EUROCAT-Testseminar, EUROCAT, Darmstadt, Germany, June 16-17

"Enabling statistical testing for component-based systems", Conference Presentation, MOTES 2010, GI, Leipzig, Germany, September 28

"Modellbasierte Verifikation sicherheitskritischer Embedded Software unter Berücksichtigung regulatorischer Anforderungen", Industry Workshop Presentation, Design&Elektronik-Entwicklerforum "Embedded Systems-Entwicklung", WEKA Fachmedien GmbH, Ludwigsburg, Germany, October 19-20

Becker, M.:
"Methoden des Produktlinienmanagements für Programmfamilien", Industry Seminar Presentation, DWT Symposium, Deutsche Gesellschaft für Wehrtechnik e.V., Wilhelmshaven, Germany, June 30 - July 1

"Product Line Tutorial", University Seminar, Product Line Tutorial, University of São Paulo, São Carlos, Brazil, July 1-7

"Addressing Safety in Software Product Line Engineering using Formal Methods", Workshop Presentation, 1st International Workshop on Formal Methods in Software Product Line Engineering, 14th International Software Product Line Conference (SPLC 2010) Jeju City, South Korea, September 14

Carbon, R.:
"Architectural Design for Flexibility and Buildability to Facilitate Evolution", Presentation, Design For Future 2010, Bad Honnef, Germany, May 3

Ciolkowski, M.:
"The Impact of Design Complexity on Software Quality - A Meta Analysis", Conference Presentation, IWSM/MetriKon/Mensura 2010, Stuttgart, Germany, November 12

"A Collaboration Model between Empirical Research and Practice -- A Position Statement", Workshop Presentation, EPIC 2010, Stuttgart, Germany, November 12

Dörr, J.:
"Systematische Erhebung und Spezifikation von Nichtfunktionalen Anforderungen für Gesamt- und Teilsysteme - ein Erfahrungsbericht", Presentation, DWT Symposium, Deutsche Gesellschaft für Wehrtechnik e.V., Wilhelmshaven, Germany, July 1

Eisenbarth, M.:
"Aufgabenorientiertes Erheben und Spezifizieren von Anforderungen mit Hilfe eines Entscheidungsmodells", Workshop Presentation, ReConf 2010, Hood Group, GfSE, iX, Munich, Germany, USA, March 15-18

"Requirements Engineering Best Practice Einführung in einer agilen Umgebung", Conference Presentation, Reconf Schweiz 2010, Hood Group, GfSE, iX, Zurich, Switzerland, October 7

Elberzhager, F.:
"Ensuring Quality Attributes with Goal Indicator Trees", Conference Presentation, SE 2010, Universität Paderborn, Paderborn, Germany, February 25-26

"Software Inspektionen", Industry Seminar Presentation, Medizintechnik Seminar, IESE & Eurocat, Stuttgart, Germany, June 16

"DEFECT - Tool-Supported Inspection Guidance (Work-in-Progress presentation)", Conference Presentation, EuroMicro, Lille, France, September 1-3

"Towards Reduction of Test Effort: Predicting Defect-Prone Code Classes and Expected Defect Types based on Inspection Results (Work-in-Progress presentation)", Conference Presentation, EuroMicro, Lille, France, September 1-3

"Goal Indicator Trees for Indicator-based Inspections (short presentation)", Conference Presentation, EuroMicro, Lille, France, September 1-3

"Using Inspection Results for Prioritizing Test Activities", Conference Presentation, ISSRE 2010, San Jose, USA, November 1-4

Eschbach, R.:
"Risk-based Statistical Testing: A novel approach for the reliability analysis of safety-critical embedded systems", Conference Presentation, Embedded World, Nürnberg-Messe GmbH, Nuremberg, Germany, March 2

"Risk-Based Testing of Automative Systems by Applying Model-Based Approaches", Industry Conference Presentation, Commercial Vehicle Symposium, ZNT in cooperation with DNT, Kaiserslautern, Germany, March 18

"Risikobasierte Software-Qualitätssicherung in der Medizintechnik", Conference Presentation, WUEMEK 2010, Fachverband biomedizinische Technik, Würzburg, Germany, May 3-5

Göpfert, B.:
"Marktrecherche in der Praxis am Beispiel des Fraunhofer IESE", Seminar Presentation, Fraunhofer Marketing Netzwerk: Seminar Marktrecherche, Darmstadt, Germany, April 27

Groß, A.:
"Aufgabenorientiertes Erheben und Spezifizieren von Anforderungen mit Hilfe eines Entscheidungsmodells", Workshop Presentation, ReConf 2010, Hood Group, GfSE, iX, Munich, Germany, March 15-18

"Perspective-based Specification of Efficiently and Effectively Usable Requirements Documents", Conference Presentation, Doctoral Symposium @ IEEE International Requirements Engineering Conference, University of Technology Sydney, Sydney, Australia, September 27

"An Experimental Comparison regarding the Completeness of Functional Requirements Specifications", Conference Presentation, IEEE International Requirements Engineering Conference, University of Technology Sydney, Sydney, Australia, September 29

Heidrich, J.:
"Measurement-based Alignment of IT Strategy and Business Goals", Tutorial, SPICE Days 2010, Stuttgart, Germany, June 21

"Cost Estimation, Benchmarking, and Risk Assessment using CoBRA®", Tutorial, CON.ECT Seminar, Vienna, Austria, Oct. 18-19

"Linking Software Development And Business Strategy Through Measurement", Tutorial, IWSM/Metrikon/Mensura, Stuttgart, Germany, November 11

Heintz, M.:
"The PENCIL Platform: Connecting learners, tutors, and tools", Presentation, 10th IETC, Bogazici University, Istanbul, Turkey, April 24-28

Hussain, T.:
"Automated Fault Tree Generation and Risk Based Testing of Networked Automation Systems", Conference Presentation, ETFA 2010, IEEE, Bilbao, Spain, Dec 12-16

Jedlitschka, A.:
"Empirical studies in industry", Workshop Presentation, ISERN 2010, Bolzano, Italy, September 13-14

"Evaluating a Model of Software Managers' Information Needs - An Experiment", Conference Presentation, Empirical Software Engineering and Measurement 2010, Bolzano, Italy, September 16-17

Jeswein, T.:
"A Pointer Network of Data Safes: Optimizing G2B Process Chains", Talk, Efficient & Effective eGovernment Workshop Programme, DG INFSO, European Commission, Brussels, Belgium, March 17

John, I.:
"Requirements Engineering meets Architecture - An Integrated Approach", Tutorial, ECSA 2010, Copenhagen, Denmark, August 23

Jung, C.:
"Practical Experience Gained from Modeling Security Goals: Using SGITs in an Industrial Project", Conference Presentation, Intl. Conf. on Availability, Reliability, and Security (ARES 2010), Krakow, Poland, February 15-18

"Practical Experience Gained from Modeling Security Goals", Workshop Presentation, SecSE Workshop, Fifth International Conference on Availability, Reliability and Security ("ARES – The International Dependability Conference"), Krakow, Poland, February 16

"Tool-Supported Inspections: Using Security Models as Reading Support for Defect Detection", Workshop Presentation, Second International Workshop on Security in Model Driven Architecture; University of Pierre & Marie Curie, in conjunction with ECMFA 2010 Sixth European Conference on Modelling Foundations and Applications; Paris, France, June 16

"Indicator-based Architecture-level Security Evaluation in a Service-oriented Environment", Workshop Presentation, MeSSa 2010 - 1st International Workshop on Measurability of Security in Software Architectures, co-located with ECSA 2010, Copenhagen, Denmark, August 23

Kemmann, S.:
"High Integrity Systems - An Overview", Industry Seminar Presentation, Visit of Brazilian Delegation, Fraunhofer IESE, Kaiserslautern, Germany, April 10

"Risikomanagement für Medizinprodukte-Software", Presentation, Messe Control 2010, Redaktionsbüro Technik-Querschnitte, Stuttgart, Germany, May 10

"Innovative Analysen und Verfahren in der Entwicklung und Qualitätssicherung von softwareintensiven Medizingeräten", Conference Presentation, FMedConf 2010, Healthcare Knowledge GmbH, Munich, Germany, October 10

Keuler, T.:
"Architecture meets Requirements Engineering - An Integrated Approach", Tutorial, 4th European Conference on Software Architecture, IT University of Copenhagen, Copenhagen, Denmark, August 23

Klaes, M.:
"3MQM: A Maturity Model for Model-based Quality Management", Workshop Presentation, SQMB 2010, held in conjunction with SE 2010, Paderborn, Germany, February 22

"Transparent Combination of Expert and Measurement Data for Defect Prediction – An Industrial Case Study", Conference Presentation, ICSE 2010, Cape Town, South Africa, May 6

"Defect Management Tutorial", Tutorial, SPICE Days 2010, Stuttgart, Germany, June 21

"How-To Evaluate Meta-Models for Software Quality?", Conference Presentation, IWSM/MetriKon/Mensura 2010, Stuttgart, Germany, November 10

Klaus, A.:
"Testmanagement - Was sind die richtigen Testfälle?", Workshop / Seminar Presentation, Q-Day 2010, Fraunhofer IESE, Kaiserslautern, Germany, March 24

Kleinberger, T.:
"Improving the end user experience in human-computer interfaces for elderly people", Presentation, Conference Ageing and Technology, Niedersächsischer Forschungsverbund GAL, Vechta, Germany, March 23-25

"Notfallprävention in der Praxis", Presentation, Konferenz Intelligente Technik für das Wohnen im Alter, TU Kaiserslautern, Lehrgebiet Stadtsoziologie, Kaiserslautern, Germany, April 22

Knodel, J.:
"Hilfe bei Architekturentscheidungen – Wie bewerte ich praktisch und schnell mein System?", Tutorial, SE 2010, Universität Paderborn, Paderborn, Germany, February 17

Lampasona, C:
"Goal-oriented Adaptation of Software Quality Models", Workshop Presentation, SQMB 2010, Paderborn, Germany, February 22

"Model-based Product Quality Evaluation with Multi-Criteria Decision Analysis", Conference Presentation, IWSM/MetriKon/Mensura 2010, Stuttgart, Germany, November 10

Liggesmeyer, P.,
"Vorstellung IESE", Presentation, SE 2010, Universität Paderborn, Paderborn, Germany, February 25

"Die Bedeutung von Software für Hochtechnologie-Branchen", Presentation, Vetreterversammlung 2010, Volksbank Kaiserslautern-Nordwestpfalz, Kaiserslautern, Germany, May 26

Professional Colloquium with the previous award winners of Ernst-Denert-Stiftung für Software-Engineering, Laudatio/Moderation, Honorary Doctorate Ceremony for Prof. Dr. Ernst Denert, TU Kaiserslautern, Kaiserslautern, Germany, July 2

"Software-Qualitätssicherung 1993 und heute", Presentation, Honorary Doctorate Ceremony for Prof. Dr. Ernst Denert, TU Kaiserslautern, Kaiserslautern, Germany, July 2

"Computer auf Rädern - Eine kurze Geschichte der Mobilität", Presentation, Lions Club Meeting, Lions Club Kaiserslautern, Kaiserslautern, Germany, December 14

Luiz, T.,
"How to optimize emergency management of stroke", Presentation, Arab Health, Dubai Health Authority, Dubai, United Arab Emirates, January 27

"Zum Problem des Notarztmangels - Konzeption und Ergebnisse eines Online-Erfassungs-, Anzeige- und Analysesystems in Rheinland-Pfalz", Presentation, 6. Treffen der wissenschaftlichen Arbeitsgruppe Notfallmedizin, Deutsche Gesellschaft für Anästhesiologie und Intensivmedizin, Kiel, Germany, February 1

"Das Rettungswesen in Deutschland - Historie, Gegenwart und Zukunft", Presentation, Informationsabend des Krankenhausfördervereins, Kreiskrankenhaus Rastatt, Rastatt, Germany, February 24

"MANV bei CBRN – Lagen", Presentation, Deutscher Interdisziplinärer Notfallmedizin Kongress, Bundesvereinigung der Arbeitsgemeinschaften Notärzte Deutschlands, Wiesbaden, Germany, February 25-27

"Notarzteinsätze in Pflegeeinrichtungen", Presentation, Deutscher Interdisziplinärer Notfallmedizin Kongress, Bundesvereinigung der Arbeitsgemeinschaften Notärzte Deutschlands, Wiesbaden, Germany, February 25-27

"Massenanfall von Verletzten", Presentation, Deutscher Interdisziplinärer Notfallmedizin Kongress, Bundesvereinigung der Arbeitsgemeinschaften Notärzte Deutschlands, Wiesbaden, Germany, February 25-27

"Lernen einmal anders: Serious games – Spielerisches Lernen in der Notfallmedizin", Presentation, Jahrestagung der agswn, Arbeitsgemeinschaft Südwestdeutscher Notärzte, Baden-Baden, Germany, March 3

"Hinweise zum Notarztein-satz bei geriatrischen Pati-enten", Presentation, Kom-paktseminar Notfallmedizin, Universität Ulm, Langenargen, Germany, March 21

"Psychosoziale Notfälle", Presentation, Kompaktsemi-nar Notfallmedizin, Universität Ulm, Langenargen, Germany, March 21

"Serious games in der Katas-trophenmedizin", Presenta-tion, Notfallmedizinisches Kolloquium, Universität München, Munich, Germany, June 13

"Logistik für die „Golden Hour", Presentation, Deut-scher Anästhesie Congress DAC 2010, Deutsche Gesell-schaft für Anästhesiologie und Intensivmedizin, Nurem-berg, Germany, June 19

"Gibt es einen „Notarzt-mangel" in Rheinland-Pfalz? Konzeption und Ergebnisse eines landesweiten web-basierten Erfassungs-, Anzeige- und Auswertesys-tems", Poster Presentation, Deutscher Anästhesie Con-gress DAC 2010, Deutsche Gesellschaft für Anästhesi-ologie und Intensivmedizin, Nuremberg, Germany, June 19

"Die demographische Ent-wicklung in Rheinland-Pfalz –was ist notfallmedizinisch relevant?", Presentation, Not-fallmedizinisches Landessym-posium, Ministerium des Innern und für Sport Rhein-land-Pfalz, Kaiserslautern, Germany, November 6

Mathew. V.:
"Current Trends in Test Automation: Research and Practice", Industry Seminar Presentation, BITKOM-Forum, BITKOM, Frankfurt, Germany, June 2

Münch, J.:
"Hybrid Estimation Modeling for Supporting Predictable IT and Innovation Manage-ment", Invited Talk, Univer-sity of Hamburg, Hamburg, Germany, April 26

"Linking IT Innovations and Business Strategy through Measurement", Invited Talk, University of Hamburg, Ham-burg, Germany, April 26

"Estimating the Effort Over-head in Global Software Development", Conference Presentation, ICGSE 2010, Princeton, NJ, USA, August 23

"What Should Software Engineers be Measuring in the Future?", Invited Panel Presentation, ISERN 2010, Bolzano, Italy, September 13

"Software Factor - The set-up of an empirical software engineering infrastructure of the 2010's", Joint Talk, ISERN 2010, Bolzano, Italy, Septem-ber 14

"Aligning Software-related Strategies in Multi-Organi-zational Settings", Confer-ence Presentation, IWSM/MetriKon/Mensura 2010 , Stuttgart , Germany, Novem-ber 11

"Linking Software Develop-ment and Business Strategy through Measurement", Tutorial, IWSM/MetriKon/Mensura 2010, Stuttgart, Germany, November 11

Naab, M.:
"Flexibility Engineering for SOA-based Information Systems", Workshop Presen-tation, Architecture Maintain-ability Workshop, Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany, June 8

Nass, C.:
"The Fulfillment of User Needs and the Course of Time in Field Investigation", Conference Presentation, CHI 2010, Atlanta, USA, January 12

"DESIGNi – A Workbench for Supporting Interaction De-sign", Conference Presenta-tion, NordiCHI 2010, Reykja-vik, Iceland, October 18

"Natural Interaction for Business Aplication - How to design touch interaction for productive daily work", Conference Presentation, ITS 2010, Saarbrücken, Germany, November 8

"Aus die Maus: Design für Natürliche Interaktion", Workshop Presentation, World Usability Day (WUD) 2010, Usability Profession-als' Association, Mannheim, Germany, November 11

Olbrich, S.:
"Are all Code Smells Harm-ful? A Study of God Classes and Brain Classes in the Evolution of Three Open Source Systems", Conference Presentation, ICSM 2010, IEEE/Politehnica University Ti-misoare, Timisoara, Romania, September 15

Riegel, N.:
"Integrating Prioritization into Business Process-driven Requirements Engineering", Workshop Presentation, Workshop RePriCo'10 in conjunction with REFSQ2010, Paluno, The Ruhr Institute for Software Technology, Univer-sity of Duisburg-Essen, Essen, Germany, June 29

Rombach, D.:
"Software Engineering Evidence", Lecture , Exzel-lenz-Studiengang "Software Engineering", Universität Augsburg / LMU München / TU München, Munich, Ger-many, June 21

Schwarz, R.:
"Einfluss von Security auf Safety", Workshop Presenta-tion, Workshop ViERforES Project, Otto-von-Guericke-University Magdeburg, Mag-deburg, Germany, February 25-26

Shahbaz, M.:
"Reverse Engineering ECUs of Automotive Components - A Case Study", Conference Presentation, 1st International Workshop on Model Inference in Testing, University of Grenoble, SAP Research, Trento, Italy, July 12-17

"Automatic Discovery of Unspecified Behaviors in Automotive Control Software", Conference Presentation, TAIC PART 2010, University of Sheffield, Cumberland Lodge, UK, September 3-5

"Learning Finite State Models of Observable Nondeterministic Systems in a Testing Context", Conference Presentation, ICTSS 2010, IFIP, Natal, Brazil, November 8-12

Simon, K.:
"IT-Sicherheitsüberprüfungen", Presentation, ATIS 2010, FhG, Wiesbaden, Germany, March 17-18

Trapp, Marcus:
"Fallstricke bei der Gestaltung von IT-Systemen: Erfahrungen und Lösungsmöglichkeiten", Presentation, NeueVerwaltung - 11. Kongress mit Fachmesse eGovernment, dbb Akademie, Leipzig, Germany, May 18

"May the App be with you", Presentation, World Usability Day (WUD) 2010, Usability Professionals' Association, Mannheim, Germany, November 11

"Software Engineering in der Praxis: Herausforderungen und Lösungen aus Sicht eines angewandten Forschungsinstituts", Invited Talk, Kaiserslautern University of Applied Sciences, Zweibrücken, Germany, December 14

Trapp, S.:
"Using Social Software for Collaborative Problem-Solving", Conference Presentation, E-Learning Baltics, Rostock, Germany, July 01

Trendowicz, A.:
"Software Product Quality Assessment - Hitting a Moving Target", Workshop Presentation, Qualitätsmaße in der Softwareentwicklung, SW Foren, Leipzig, Germany, October 28

Ünalan, Ö.:
"Werkzeugunterstütztes Anforderungsmanagement in einer verteilten Umgebung", Workshop Presentation, Reconf 2010, Hood Group, GfSE, iX, Munich, Germany, March 16

"Collaborative Requirements Engineering with Reqtify", Presentation, European Customer Forum - Dassault Systems, Chessy, France, November 24

van Lengen, R.:
"Ambient Assisted Living – Technologie bei drohender Selbstvernachlässigung?", Presentation, Deutsches Geriatrieforum, Diakonissen- und Markus-Krankenhaus, Frankfurt am Main, Germany, March 1

"Was kann IT zur Optimierung der Notfallversorgung beitragen?", Presentation, 6. Notfallmedizinisches Landessymposium Rheinland-Pfalz, Westpfalz-Klinikum GmbH, Kaiserslautern, Germany, November 6

Villela, K.:
"Evaluation of a Method for Proactively Managing the Evolving Scope of a Software Product Line", Conference Presentation, RefsQ 2010, LAAS, Essen, Germany, July 1

Webel, C.:
"SoKNOS from the Fraunhofer perspective", Presentation, Disaster Management Workshop, LAAS, Canberra, Australia, April 16

"Emergente Software: Enabler für Unternehmen der Zukunft", Presentation, Software-Cluster Forum, Darmstadt, Germany, August 25

"Software-Cluster: Softwareinnovationen für das digitale Unternehmen", Panel Presentation, Multimediakongress, Ludwigshafen, Germany, September 2

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INTERNAL AWARDS

Sören Kemmann
The Fraunhofer IESE Award
2009 for Project Excellence

Ralf Carbon
The Fraunhofer IESE Award
2009 for Research Excellence

Michael Kläs
The Fraunhofer IESE Award
2009 for Empirical Excellence

Jörg Dörr
The Fraunhofer IESE Award
2009 for Doctoral Theses
Excellence

Glib Kutepov
The Fraunhofer IESE Award
2009 for Master Thesis
Excellence

Dorothea Kilgore
The Fraunhofer IESE Award
2009 for Infrastructure Excel-
lence

EXTERNAL AWARDS

Jens Göddel
DASMA Diploma Thesis
Award for "Technical Support
for Adapting Software
Quality Models", supervisors
**Michael Klaes, Constanza
Lampasona, Dieter
Rombach**, November 2010

Tobias Janotta
3rd place, CAST IT Security
Award for Bachelor Theses,
"Computergestützte Analyse
von CISCO ASA Firewall-Kon-
figurationen", FernUniversität
Hagen, supervisors **Reinhard
Schwarz, Dieter Rombach**,
November 2010

**Rolf van Lengen, Thomas
Luiz**
Innovation Award from Volks-
bank Kaiserslautern-Nord-
westpfalz eG for "Serious
Games", December 2010

**Jürgen Münch, Jens
Heidrich, Henning Bartel**
Technology Innovation Award
from the Lotto Foundation
Rhineland-Palatinate, June
2010

Jürgen Nehmer
Medal of Honor of the
University of Kaiserslautern,
December 2010

Dieter Rombach
ACM Fellows Award, Associa-
tion for Computing Machine-
ry, November 2010