IESE

Fraunhofer Einrichtung Experimentelles Software Engineering

Annual Report 1998

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Annual Report of the Fraunhofer Institute for Experimental Software Engineering IESE 1998

Foreword

In early 1996, the Fraunhofer Institute for Experimental Software Engineering (IESE) was founded in Kaiserslautern. 1998 was the third year of continuing growth in industrial and public project acquisition. 1998 was marked by a reorganization of IESE to be prepared to better address industrial needs across major branches of industry in the future. Based on recommendations by an evaluation panel of internationally renowned software engineering experts, several new competence centers were added (e.g., learning organizations in software, training and continuing education); our marketing, acquisition, and project management capabilities were focused on major business domains (e.g., telecommunications, automotive, aerospace, banking/insurance/trade), the number of long-term strategic cooperations was extended (e.g., Deutsche Telekom AG, Markant AG, Allianz AG, Daimler-ChryslerAG), and our international network was strengthened (e.g., Fraunhofer Center for Experimental Software Engineering, Maryland, collaborations with major research organizations in Europe, USA, Japan, and Australia). Based on this reorganization

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- complemented by further strengthening of our human resources -, IESE is fit to play a major role in the fast evolving market of software engineering research and technology for the foreseeable future.

The institute grew out of the successful Software Transfer Initiative at the University of Kaiserslautern (STTI-KL), which was founded in 1993 under the sponsorship of the Ministry of Economic Affairs, Transportation, Agriculture, and Viniculture of the State of Rhineland-Palatinate. Within three years, IESE has established itself as one of the leading international competence centers for applied research, and has established strategic collaborations with major companies from the telecommunications, automotive, and banking/insurance industry. Special attention is being given to cooperation with small and mediumsize companies from the State of Rhineland-Palatinate.

Experimental Software Engineering employs experiments as an instrument for software technology transfer. Based on the recognition that well-understood and quantitatively manageable software development and maintenance processes need to be customized to a company's specific business goals and characteristics, new and innovative software technologies need to be carefully evaluated before being transferred into practice. After transfer, they need to be continuously optimized based on feedback gained from measurements.

The Fraunhofer IESE provides expertise not only in a wide range of innovative software engineering technologies, but also in approaches concerning the build-up of industrial improvement programs for continuous optimization (i.e., TQM, Kaizen) of software development processes.

Competences most sought after in 1998 included:

- development processes for certifiable high-quality software (special focus on requirements engineering, inspections/reviews, testing and object-oriented design);
- reuse-oriented development processes (special focus on product line approaches for creating software system variations, reengineering for leveraging existing assets);
- project planning, management and quality assurance approaches (specific focus on explicit process modeling, measurement and predictive models);
- approaches to support organizational learning within software organizations (specific focus on learning within and across projects, organization of best practices for reuse);
- programs for training and continuing education in software engineering (specific focus on training unemployed non-computer science university graduates, and on company-specific education programs).

Major accomplishments in 1998 included the further build-up of highly qualified personnel including about 20% international staff, a strong dominance of major international conferences in our core competence areas, a continuing high rate of renewal contracts with industry, the creation of the Fraunhofer Center for Experimental Software Engineering, Maryland (FC-MD) closely affiliated with the University of Maryland at College Park, and the establishment of SWA Software Akademie AG in Kaiserslautern for professional marketing and organization of our industrial training and education offerings. The Fraunhofer Center for Experimental Software Engineering, Maryland and IESE form a Virtual Institute in the sense that they coordinate their complementary research efforts and staff international projects jointly. SWA Software Akademie AG in Kaiserslautern is based on the IESE concept for "goal-oriented training and education".

Finally, I want to stress the high commitment and devotion of ALL employees to the mission of IESE. This commitment and devotion has been and will be the basis for our success. We would like to sincerely acknowledge the active support and guidance we received from the Fraunhofer Gesellschaft e.V. in Munich, the University of Kaiserslautern, the State of Rhineland-Palatinate, and our Advisory Board (Kuratorium).

This report is intended to provide you with an overview of our research and transfer work in 1998. Together with the distinguished members of our Advisory Board we are optimistic that we will continue on the successful path in the coming years.

Prof. Dr. Dieter Rombach
Director of Fraunhofer Institute for Experimental Software Engineering

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It doesn't take glasses or a magnifying glass to see that software has become a major asset in today's products and services. Rigorous Software Engineering methods are required to satisfy the increased requirements on quality, cost, and time-to-market, and to facilitate the transfer of future-oriented technologies. Software Engineering is, therefore, indispensable in research and practice as a supplier of quality-improving methods and future-oriented technology.

...transferring software competence...

Vision and Mission

Over the past decades, software has been introduced into almost all high-tech products and services. None of them can function without software anymore. An increasing number of features of these products and services are implemented in software. Consequently, for the majority of industries, for trade, banking, and other service domains, competitiveness and market success depend more and more directly upon their software engineering competence.

Our vision is that software competence will become the most valuable asset of all high-tech product and service branches. Such competence has to be built up, managed, and continuously developed according to well-defined strategic goals. More and more organizations will seek help regarding methods and techniques to identify, customize, continuously optimize, and strategically align their software engineering competence.

The mission of the IESE is to establish itself internationally as one of the top addresses both for researchers looking for collaboration in areas of applied software engineering research, and for companies looking for help with their software engineering problems and the continuing education and training of their software engineers.

Fraunhofer IESE is a competent partner in applied software engineering research, transfer of innovative software development technologies, consulting, and training as well as continuing (in-house) education. In order to live up to this expectation, the IESE continuously monitors customers' needs and strategic goals, investigates the most promising innovative software engineering techniques and methods available, develops their applicability for industrial-strength environments, and, finally, transfers them into industrial practice, thus building up the software competence sought after by its customers.

Building of the Fraunhofer Institute for Experimental Software Engineering in Kaiserslautern

International Activities

On February 25, 1998, the Fraunhofer Center Maryland (FC-MD) in College Park, USA, was opened officially. The ceremony took place on the campus of the University of Maryland, with which both the Executive Director Prof. Victor R. Basili and the Co-Director Prof. Marvin V. Zelkowitz are affiliated. Fraunhofer IESE at Kaiserslautern and FC-MD together form an international competence center for software engineering. The political dimension of this event was demonstrated by the presence of Maryland Secretary of State John T. Willis on the US side and Dr. Jürgen Rüttgers, Federal Minister of Education, Science, Research and Technology, and Prof. Jürgen Zöllner, Rhineland-Palatinate Minister of Education, Science and Continuing Education on the German side. In addition, the opening was attended by Prof. Kirwan, President of the University of Maryland, Dr. Polter, President of Fraunhofer USA and Vice President of Fraunhofer Gesellschaft e.V., Prof. Warnecke, President of the University of Kaiserslautern, Prof. Landfried, President of the Association of German Universities, and Prof. Rombach, Director of Fraunhofer IESE.

Dr. Dirk Meints Polter (Member of the Executive Committee of the FhG) signs the inauguration poster; on his right in order of appearance: Prof. Dr. Klaus Landfried (President of the HRK - Association of Universities and Other Higher Education Institutions in Germany), Prof. William E. Kirwan (University of Maryland), Prof. Dr. Günter Warnecke (President of the University of Kaiserslautern, Germany)

The opening of FC-MD was the response by two internationally leading software engineering research institutions in Germany (University of Kaiserslautern & Fraunhofer IESE) and the US (University of Maryland & FC-MD) to both the requests from globally operating companies from various branches (e.g., automotive industry, telecommunications industry) to provide research and technology support across continents, and the need for collaboration in a fast-evolving technology domain such as software engineering in order to maintain world-leading competence.

The focus on software engineering reflects the increasing importance of software and information technology in the growing markets of 'intelligent' products and services. As a result, companies in all branches see the necessity, not the option, to elevate their software development capabilities to a generally accepted level of engineering. More and more companies realize that software engineering competence is a prerequisite for maintaining existing markets as well as moving into new markets. In that sense, a competence center for software engineering is a major vehicle for boosting the economy and creating jobs.

A place where researchers of different disciplines can develop new ideas: location of the FC-MD, University of Maryland, College Park

Building an internationally leading competence center across the Atlantic requires a joint strategy for synergistic research as well as industrial collaborations. Based on the industrial model of 'Virtual Enterprises', the two partner institutions think globally in the sense that they plan research and competence development according to the respective strengths of each partner, but act locally in the sense that they adjust their transfer and collaboration approaches - including the use of native human resources - to the specific needs in each country. Consequently, FC-MD has to be a US organization with mainly US employees, as Fraunhofer IESE is a German organization with mainly German employees.

The Fraunhofer Virtual Competence Center for Experimental Software Engineering consisting of IESE and FC-MD requires an open and trusting relationship both at the leadership and scientist level in order to succeed. The chances for establishing such a culture are good based on the long-standing relationship between the two university research groups of Prof's Basili and Rombach. Prof. Rombach spent 8 years as a post-doc and professor at the University of Maryland before he moved to Kaiserslautern in 1992. Due to this long relationship, a joint vision and numerous personal relationships and collaborations exist.

The combination of basic research at a university and applied research and technology transfer in Fraunhofer IESE has elevated Kaiserslautern to one of the premier places for software engineering competence in Germany, if not in Europe. The creation of FC-MD forms a mirror environment at the University of Maryland. This joint organizational format - in addition to joint visions and backgrounds - enables easy exchange of personnel for both effective project staffing as well as human resource development for software engineering scientists.

This Virtual Competence Center can serve as a model for Fraunhofer and the entire scientific community for how to respond to the challenges imposed by globalization and knowledge explosion. The success of this Center will be measured by improved and faster research and competence development as well as increased and more successful industry collaborations. It is, thereby, not important which partner does more research or has more industry projects; it is important that the sum across both partner institutions is larger than the sum of what both could do individually.

Two heads, one vision: The Virtual Institute for Experimental Engineering - Vic Basili und Dieter Rombach looking ahead

Good wishes for a fertile partnership: Prof. Dr. Jürgen Zöllner (Minister of Education, Science and Continuous Education, State of Rhineland-Palatinate)

Globalization is absolutely essential: Dr. Jürgen Rüttgers (former Minister of Research and Technology, Federal Republic of Germany) with a message from the German government

Transfer Approach

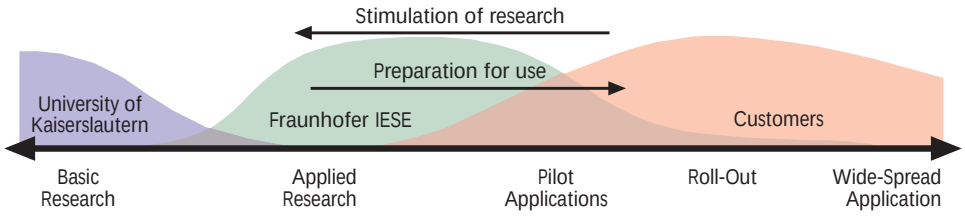
Since software development is a non-repeatable human-based endeavor, a single standard software engineering technology cannot fit all situations. We strongly believe that high-quality software can only be developed economically by using software engineering technologies tailored to the specific goals and characteristics of the particular development project.

Consequently, software engineering research and transfer need to be performed in an experimental context. Our experimental approach makes it possible to experiment with the technologies in use and thus helps to thoroughly understand their weaknesses and strengths. Technologies can also be tailored to the goals and characteristics of particular projects and organizations and can be packaged together with empirically-gained experience in order to enhance their reuse potential in future projects.

Technology transfer according to the experimental approach follows the following process:

- New promising technologies from academia or research results stimulated by industry demands are drawn from a rich body of basic research results from the highly-respected Computer Science Department at the University of Kaiserslautern, the special research institute (SFB 501), as well as from research collaborations with many other highly-renowned research institutes world-wide.
- Next, the new technologies and methods are experimentally evaluated in laboratory settings, introduced in carefully-selected pilot projects, evaluated in industrial-strength environments, and continuously improved.
- Such validated technologies are then disseminated as best practices to a wider range of customers.

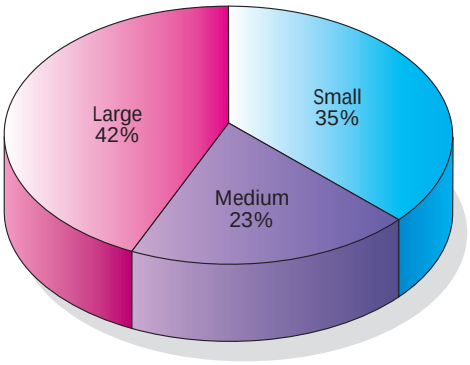
Software Technology Transfer Life Cycle



Customer Orientation

Our customers are companies from many different branches, of any size (see graphic below), and from a large number of countries. In order to service such a large variety of customers, we continuously build up and maintain domain knowledge in key application areas such as telecommunications, automotive systems, banking, insurance, and trade. We created a separate service center for small and medium-size companies that is now conducting cooperation projects with a significant number of local SMEs. We continue to hire scientists from foreign countries to staff international customer projects, and we hire experts with thorough industrial experience.

Number of Companies by Size



Company size is defined by number of employees

Small < 50
Medium < 500
Large >= 500

History

The foundations of the experimental approach to software engineering were laid in the Eighties at the Software Engineering Laboratory (SEL), a U.S. organization co-sponsored by NASA's Goddard Space Flight Center, the Computer Sciences Corporation, and the University of Maryland. The achievements within the SEL were recognized with the 1st IEEE/SEI Process Achievement Award in 1994.

In 1992, Prof. Dr. Dieter Rombach, an active SEL member, moved from the University of Maryland to the University of Kaiserslautern to head the new chair for (Experimental) Software Engineering in the Computer Science Department.

In 1993, he launched the Software Technology Transfer Initiative Kaiserslautern (STTI-KL), which adapted the experimental approach to the needs of German companies and performed numerous successful transfer projects. The STTI-KL was funded by the State Ministry of Economic Affairs, Transportation, Agriculture and Viniculture of Rhineland-Palatinate.

In 1995, the Fraunhofer-Gesellschaft decided to incorporate the successful STTI-KL as a new Fraunhofer Institute. The Fraunhofer Institute for Experimental Software Engineering (IESE) was born.

The IESE is headed by Prof. Dr. Dieter Rombach. In January 1996, the institute started with 14 scientists. As of December 1998, the IESE employed 75 scientists, 3 guest scientists, 14 non-scientific staff and 35 students and other employees. In January 1998, a sister organization of the IESE, the Fraunhofer Center – Maryland, in College Park, Maryland, USA was opened. This Fraunhofer Center, headed by Prof. Victor R. Basili, is aimed at increasing the research competence of IESE, aids in the acquisition of joint international industrial projects, and plays an important role as coordinator of the development of software engineering competencies in the State of Maryland.

...offering a unique approach...

University of Kaiserslautern, building 57, location of the Contact Office of Fraunhofer IESE

...maintaining international research collaborations...

Perspective and Agenda

The institute's strategy is to maintain its position as a leading international competence center in software engineering. As of today:

- we are coordinator and member of ISERN, the International Software Engineering Research Network, an international network with twenty-one members,
- we maintain an international working environment: about one fourth of our staff comes from abroad,
- we are attracting many well-known guest scientists who contribute significantly to the excellence of our institute,
- we have opened our sister institute FC-MD in the USA,
- we have started an SME center,
- we are starting to build a center for continuing education and training,
- we maintain a number of research collaborations with leading international technology transfer and research institutes,
- we are active in many conference committees and editorial boards of international journals.

We will continue and extend these activities.

Concrete next steps in realizing the institute's strategy are:

- Further build-up and continuous improvement of highly demanded competencies in:
  - quality and process engineering (quality improvement, quantitative and qualitative methods for empirical cost, risk, and quality modeling) and in
  - innovative software product engineering approaches (inspections, product line development, requirements engineering, reengineering and maintenance).
- Increased emphasis on Knowledge Management for learning software organizations.
- Concentration on key application domains (telecommunications, automotive systems, banking/insurance/trade).
- Extension of our independent service centers (SME center, training center).
- Foundation of a second sister institute in Asia.
- Intensification of research collaborations with international technology transfer and research and development institutes.

Competence in Research and Technology Transfer

Commemorative FC-MD Opening Poster depicting the many levels of German-American cooperation evident at the Fraunhofer Center for Experimental Software Engineering, Maryland

Competencies in an International Institute

The International Competence Center on Experimental Software Engineering consisting of IESE and FC-MD focuses on competencies in software engineering, both from a product and a process development perspective.

Major areas of competence in software product development include:

Systematic processes for developing certifiable high-quality software with an emphasis on inspections, testing, requirements engineering, and object-oriented design
(see page 28).

Reuse-oriented software development processes with an emphasis on product-line development, patterns, and frameworks
(see page 34).

Major areas of competence in software process development include:

Project planning, management and quality assurance approaches with an emphasis on explicit process modeling, measurement, and predictive modeling
(see page 38).

Approaches to support organizational learning within software organizations with an emphasis on learning mechanisms that work within and across projects, organizational forms that support learning across projects, and packaging of best software development practices for reuse (see page 44).

In addition, IESE is recognized for leading competence in training and continuing education in software engineering. Direct collaborations between IESE and FC-MD exist in the areas of inspection/reading techniques, object-oriented development and analysis, and reuse with patterns and frameworks. It is obvious that our internationally leading research and transfer reputation is the result of pooling our resources. Both IESE and FC-MD base their successful transfer strategy on jointly developed base concepts such as the transfer process QIP, the measurement approach GQM, and the organizational learning model EF (see page 50).

Besides the approaches, technologies and processes developed, the competence of IESE and FC-MD also depends highly on competent humans. It is obvious that the excellence of our personnel - and the speed of reaching such excellence - is based on their constant exposure to world-leading experts across our Virtual Competence Center, exchange visits, and cross-Atlantic collaborations.

In the following, the IESE competencies are presented. The FC-MD competencies are presented in a separate section. However, it must be clear that neither side would have reached the described level in isolation.

Competence Areas

In order to satisfy the needs of our customers, we build up, maintain, and continuously develop a complementary set of competencies, namely:

- application domain competencies
- software engineering competencies
- software technology transfer competencies.

Application Domain Competencies

Our current application domain competence knowledge is concentrated on telecommunications, embedded systems, especially automotive systems, and banking/insurance/trade.

Software Engineering Competencies

The following list provides brief definitions of our key competence areas in Software Engineering:

- Quality Software Development
  "Develop systematic approaches towards software development so as to achieve predictable quality within given time and budget constraints. Special emphasis is on requirements engineering, object-oriented approaches, and UML."
- Software Product Lines
  "Structure domain and design knowledge as well as software development know-how in a way that it can be easily understood, changed, and reused across families of systems."
- Quality and Process Engineering
  "Capture and analyze data from software development processes and artifacts, build models to monitor, control, and predict project costs, defects, and risks."
- Systematic Learning and Improvement
  "Implement effective Knowledge Management in software development organizations so as to systematically learn from experiences and improve operations wrt cost, risk, software defects, security, etc."
- Continuing Education and Training
  "Provide curricula for continuing education and life-long learning for software professionals and for re-education of engineers and scientists from other disciplines in software engineering."

Technology Transfer Competencies

Transfer of advanced industrial-strength software engineering technologies is the central task of the Fraunhofer IESE. We therefore maintain a transfer-oriented network of collaborations with technology providers, such as universities, with research and development departments of large organizations, with providers of tools that support our technologies, and with strategic partners that otherwise support our work.

Competence gained from collaboration with these providers enables the IESE to conduct technology transfer projects with customers, i.e., the users of our technology.

On the technology side, we
- monitor the latest developments,
- identify promising technologies, and
- experimentally evaluate and improve on them to create industrial-strength technologies.

On the customer side, our competencies are
- to identify strengths and weaknesses of organizations,
- to define strategic improvement goals with our customers,
- to implement continuous improvement programs,
- to set up means to monitor progress of the changes introduced, and
- to capture and store experiences made.

Collaborations

The IESE conducts collaborations with technology providers, technology-transfer customers, and strategic partners. The overall goal is to identify, further develop, and put into industrial practice software engineering technology so as to increase the competence of our customers.

International Research

Among the international cooperations in applied software engineering research, the International Software Engineering Research Network (ISERN) with about 21 members from research and industry plays a prominent role. ISERN is a forum for applied software engineering research with members from Europe, America, Asia, and Australia. It maintains high-level contacts to leading international companies in the embedded systems domain such as AT&T, Motorola, Nokia, Ericsson, NTT, Matsushita, Hitachi, and DaimlerChrysler.

Publicly-funded Collaborations

Collaborations exist with many publicly-funded consortia aimed at either software engineering technology advancement or dissemination of best practices. Publicly-funded projects can be devoted to research and development as well as technology transfer. Often, additional bilateral industrially-funded collaborations result from performing these projects. Public project sponsors include the Government of the State of Rhineland-Palatinate, the Federal Government of Germany, and the European Commission.

Industrially-funded Collaborations

The 29 industrial collaborations with 20 companies in 1997 were extended to 54 industrial collaborations with 49 companies in 1998, not including further industrial collaborations in the context of publicly-funded projects.

The cooperation partners of the Fraunhofer IESE range from very large global players to very small companies. They can be roughly grouped into four categories:

- Large national and international companies that seek help in their mid- to long-term endeavor of quality improvement in software development.
- Large national and international companies that can afford their own R & D departments and that search for competent research partners.
- Medium-size companies that want to set up improvement programs but are usually under very tight budget and schedule constraints.
- Small companies that need ready-to-use, evaluated technologies which yield short-term return on investment.

In addition to bilateral cooperations, IESE and FC-MD have jointly started a multi-national consortium of international companies – the Software Experience Center (SEC), in which, by now, six member companies have teamed up to advance their software engineering competencies on a global scale, i.e., across different sites and business units and in collaboration with other leading companies in the scene as well as other application domains.

Offerings

To developers of software, we offer:

- the evaluation of software development practices,
- the construction of customized quality improvement systems,
- the introduction and optimization of engineering-based, state-of-the-art software development processes,
- support towards development of certifiable software,
- preparation for auditing or certification,
- continuing training and education of software engineering professionals.

To users of software, we offer:

- help in purchasing software,
- independent support for monitoring software development contracts.

To small and medium-size enterprises (SMEs), we offer individual assistance and "products" tailored specifically to their needs.

Our services are offered by means of:

- goal-oriented transfer projects,
- long-term strategic research and development alliances,
- consulting,
- executive briefings,
- continuing training and education,
- studies and expert reports,
- state-of-the-art surveys,
- product evaluation,
- prototypical tools.

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Applied Research	Prof. Dr. Basili
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SEC Projects	Pajerski
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Consulting Center for SMEs	Dr. Hörmann
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Administrative Services	Halle
Library and Publication Services	Göpfert
Technical Services	Huber
Programming Services	Dr. Rösch
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Requirements Engineering	Dr. Paech
Software Design	Prof. Dr. Atkinson
Inspections and Testing	Prof. Dr. Atkinson
Software Product Lines (SPL)	Dr. Knauber
Product Line Approaches	Dr. Knauber
Reengineering	Girard
Distributed Reference Architecture	
Quality and Process Engineering (QPE)	Dr. Briand
Cost and Quality Engineering	Dr. El Emam
Process Engineering and Improvement	Dr. Verlage
Quality and Process Support Environments	Dr. Rösch
Systematic Learning and Improvement (SLI)	Dr. Bomarius
Experience Factory Technology	Dr. Althoff
Management of Improvement and Learning	Dr. Müller
Information Technology Security	Dr. Schwarz
Continous Education and Training (CET)	Dr. Ruhe
SE Education and Training	Dr. Ruhe
Company-Specific Education and Training	Dr. Ruhe
Training, Education, and Consulting Center	Dr. Hörmann

The International Institute

The International Institute for Experimental Software Engineering consists of two legally independent partner institutions, the Fraunhofer Center for Experimental Software Engineering, Maryland (FC-MD) at College Park, MD, and the Fraunhofer Institute for Experimental Software Engineering (IESE) at Kaiserslautern, Germany. They are both independent units under Fraunhofer USA, Inc. and Fraunhofer Gesellschaft e.V., respectively. Together they form the so-called Fraunhofer Virtual Institute for Experimental Software Engineering (FVIESE), coordinated by Prof's Basili and Rombach. On the next page you find the joint organigram indicating major areas of joint emphasis. Both units have contact offices coordinating the daily contacts and exchanges across the Atlantic, project groups cooperating on the SEC project (a consortium project on process improvement with several firms from both sides of the Atlantic), project groups focusing on local consulting business, and research and technology development departments/groups. The details of IESE and FC-MD are described in separate sections (IESE: page 22-52, and 62-87; FC-MD: page 54-60).

The Fraunhofer IESE

In the fall of 1998, the initial structure of Fraunhofer IESE was changed from a 2x2 matrix into a set of 5 complementary competence areas, each represented by one department, plus the new department Central Services that provides all administrative and infrastructure services to the institute. The reorganization was motivated by both the growth of the institute and the need to present the institute's competence areas in a more problem-oriented fashion. With the new structure in place, every department is better focused on the typical problem areas that our customers face. However, we continue to build project teams by tying together experts from different competence areas so as to optimally match our customers' needs.

Problem-oriented Research and Transfer Departments

The institute's software engineering competence is now being covered by five departments: Quality Software Development, Software Product Lines, Quality and Process Engineering, Systematic Learning and Improvement, and Continuing Education and Training.

Members of Central Services Department

1. Stephan Thiel
2. Sabine Peter
3. Sara Bügler
4. Frank Huber
5. Bertram Recktenwald
6. Markus Thum
7. Holger Neu
8. Brigitte Göpfert
9. Jörg Halle
10. Erik Dick

Quality Software Development
provides methods to build software in a systematic way, such that quality requirements can be guaranteed. Special emphasis is on object orientation in general and UML in particular.

Software Product Lines
extends the systematic development of quality software to the area of families of software systems, i.e., provides methods and tools that allow to analyze (wrt functionality as well as economy of scope), design, and implement a set of variants of software for a given application domain.

Quality and Process Engineering
provides the methods to instrument development processes in such a way that relevant attributes (cost, effort, defects, risk) can be measured and modeled so as to create means for managers and developers to understand, monitor, control, improve, and finally predict their software development processes.

Systematic Learning and Improvement
develops methods and tools to build up tailored knowledge management systems for software development organizations that help to capture and make explicit expert experiences, analysis results, and other sources of experiences, and packages them for reuse in other development projects.

Continuing Education and Training
develops education and training curricula for software professionals. The goal is to support life-long learning and further education close to the job for practitioners, and to re-educate unemployed scientists and engineers coming from other domains for new employment in the software business.

Consulting Center for Small and Medium-Size Enterprises

The general objective is to take care of the particular needs of small and medium-size companies in terms of industrial transfer projects, seminars, and workshops. The center works in close cooperation with the society "Software Technologie Initiative e.V." (STI). Together with STI, a seminar and workshop program is offered to the members and to the public. This includes topics such as "Requirements Engineering", "Configuration Management", "Software Project Management", "Inspections", and "Systematic Testing". In addition, five evening workshops on "Requirements Engineering" and three on "Software Quality Management" have been performed. In November 1998, a workshop on "Software-Qualitätsmanagement für den Mittelstand" was held with more than 60 participants.

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Public Relations/Marketing Center

The general objective is to inform media about Fraunhofer IESE activities with general concern, to provide the public with information material, to support marketing activities, to coordinate and execute presentations of the institute at exhibits and trade fairs, and to publish digital information (web site, multimedia). Other tasks include: responding to general requests, checking media for relevant information, and maintaining the corporate design of the institute in general. Specific activities in 1998 included the publication of the second annual report of the Fraunhofer IESE and the continuous build-up of a framework that supports the needs of effective public relations activities.

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5. Dorothea Kilgore

Contact Office to Fraunhofer Center for Experimental Software Engineering, Maryland (FC-MD)

The main general objective is to coordinate all IESE activities with researchers of the University of Maryland, respectively the Fraunhofer Center for Experimental Software Engineering, Maryland (FC-MD), and to support joint industry projects. In addition, the Contact Office provides services such as German-English translations and linguistic reviews of English-language publications. It also organizes monthly management meetings between the leadership of FC-MD and Fraunhofer IESE via video-conference, organizes visits from US colleagues, supports foreign IESE employees in settling in Germany, and organizes international student exchanges. Specific activities in 1998 included the preparation of the grand opening ceremony of the Fraunhofer Center for Experimental Software Engineering, Maryland (FC-MD) at the University of Maryland on February 25, 1998, with dignitaries from the State of Maryland, the German Federal Government, and the State Government of Rhineland-Palatinate, and the organization of a visit by a delegation from the Maryland Department of Business and Economic Development in June of 1998.

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Advisory Board

Contact Office to University of Kaiserslautern

The general objective is to provide visibility on campus, to manage the university affiliation, to provide on-campus laboratories for students employed by IESE, and to provide offices for IESE employees lecturing at the university and/or cooperating with on-campus research groups. Specific activities in 1998 included the processing of more than 20 diploma theses from IESE at the university, the organization of workshops for SMEs at the university, and the organization of guest lectures of IESE employees at the university.

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Research

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Alcatel/SEL

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Institute for Advanced Computer Science
Department of Computer Science
University of Maryland
USA
Also: Executive Director, Fraunhofer Center for Experimental Software Engineering, Maryland (FC-MD)

Prof. Dr. Manfred Broy
Institute for Computer Science
Technical University of Munich

Prof. Dr. Jürgen Nehmer
Vice-Chairman of the Advisory Board
Department of Computer Science
University of Kaiserslautern
Also: Member of the German Science Council (Deutscher Wissenschaftsrat)

Prof. Dr. Günter Warnecke
President, University of Kaiserslautern

Industry

Prof. Dr. Ernst Denert
Chairman of the Advisory Board
Speaker of the Management
sd&m GmbH & Co.KG
software design & management
also: Vice-President of GI - German Computer Society

Dietmar Freigang
Director, Information Systems
Allianz-Lebensversicherung AG

Günther Plapp
Technical Director
Robert Bosch GmbH
K3/LE

Monika Gonauser
Department Head
Siemens AG
ZFE ST ACS

Franz Mayer
Chairman of the Board of Directors
Markant-Südwest

Government

Brigitte Klempt
Director, Department of Research and Technology Transfer
Ministry of Education, Science and Continuing Education of the State of Rhineland-Palatinate

Dr. Ulrich Müller
Director, Department of Research, Technology, and Media
Ministry of Economic Affairs, Transportation, Agriculture and Viniculture of the State of Rhineland-Palatinate

Steffen Isensee
Director, Department of Computer Science Systems and
GMD (Society for Mathematics and Data Processing)
Federal Ministry of Education, Research, Science and Technology (BMBF)

Budget

Business		provisional
Income	**TDM**	**%**
Industrially-funded projects	2.454	26,1
Publicly-funded projects	1.400	14,9
Other Income	22	0,2
Public Grant (State of Rhineland-Palatinate)	4.565	48,6
Fraunhofer Funds (PROFIL, OEF, SEF)	928	10,1
	9.391	100,0

Expenses	**TDM**	**%**
Personnel	6.394	67,8
Miscellaneous	2.997	32,2
	9.391	100,0

Investments		provisional
Income	**TDM**	**%**
Public Grant (State of Rhineland-Palatinate)	861	100,0
	861	100,0

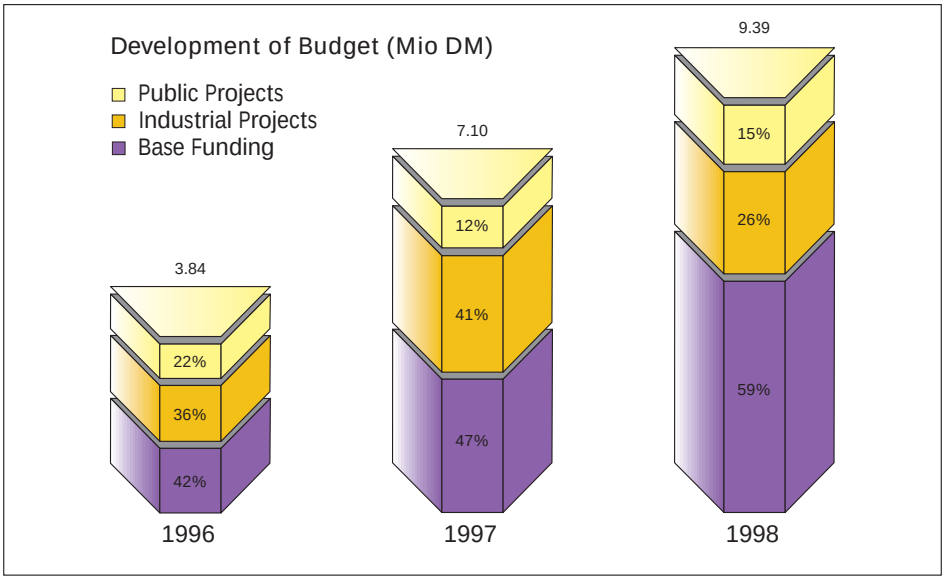
Expenses	**TDM**	**%**
	861	100,0

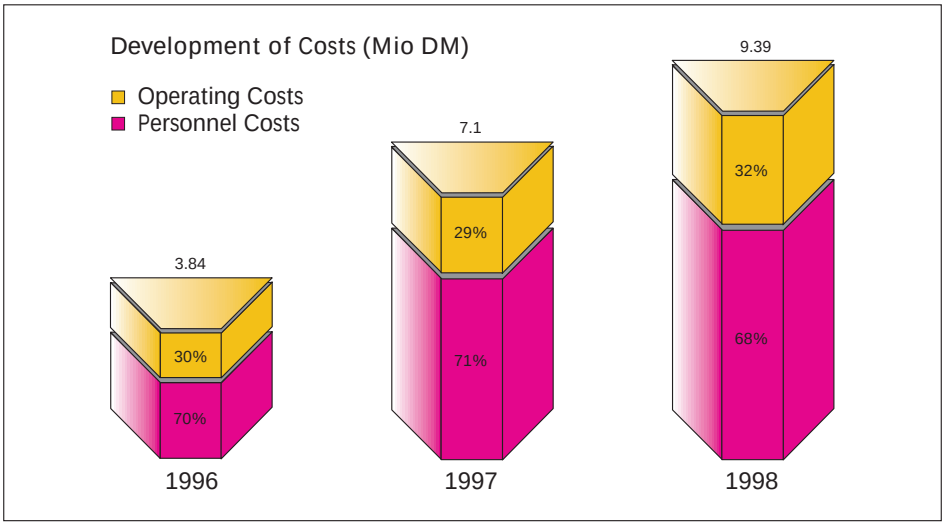
Personnel

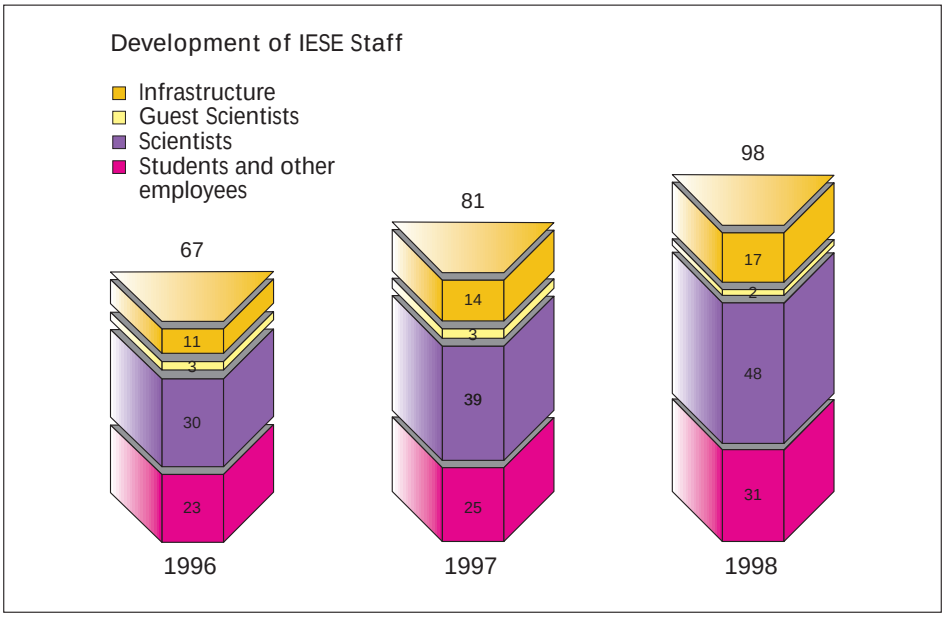
The growth in terms of staff was continued throughout 1998. By the end of 1998, the IESE employed 65 full-time employees, 2 guest scientists, 26 students, and 5 apprentices and trainees. Since at any point in time, approximately 20% staff comes from abroad, the institute maintains a unique international flavor. The plan is to grow to about 120 full-time employees by the end of the year 2000.

Personnel	as of 12/31/98
	Number
Scientists	48
Infrastructure	17
Guest Scientists	2
Students & other employees	31
	98

Development







Knowledge, experience, and know-how are the most important assets in the development of high quality software and in the optimal fulfillment of requirements. With a comprehensive portfolio of services and competencies,Fraunhofer IESE ensures that these assets are available to customers at any time.

Competence Areas and Projects

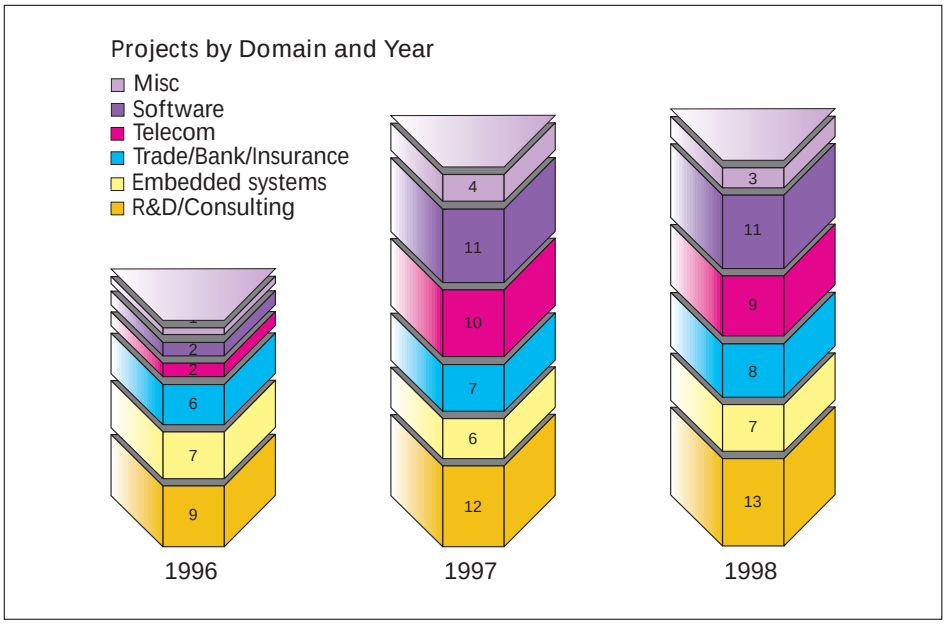
Research Mission

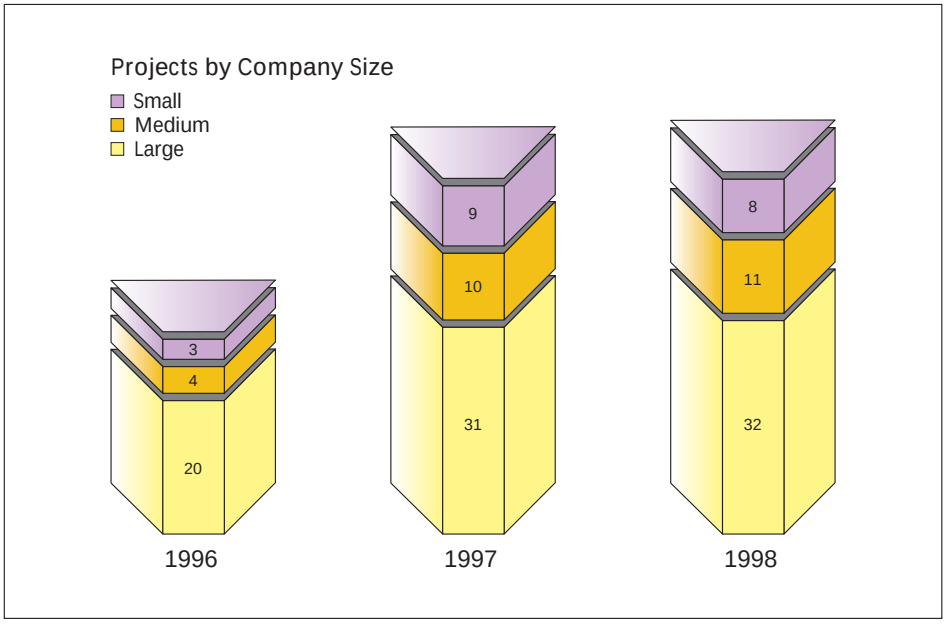
Our customers face large-scale quality, productivity, and time-to-market problems within their software divisions. They expect us to perform quick root cause analyses, propose adequate techniques, methods, and tools to mitigate the identified problems, and help integrate them into their software and business processes as manageable competencies.

To enable efficient and successful transfer, such technologies have to be rigorously evaluated under realistic conditions and properly packaged. In addition, once transferred, these technologies must be tightly controlled and managed for optimal use. That is, we must ensure that these technologies are properly used with respect to conformance to intended use, resource expenditures, organization issues, and quality objectives. Consequently, the core technical contribution of the IESE is to empirically characterize, validate, and package innovative software technologies for use in industrial-strength projects.

The IESE employs a mix of software engineers with an industrial background and renowned researchers. This enables us to both find industrial-strength solutions and to advance the state-of-the-art in software engineering in our core competence areas.

The following section is structured along these competence areas and lists sample projects within each competence area to illustrate the application of the respective competence. Of course, all projects draw from a set of complementary competence areas and therefore project teams are staffed from different areas in order to provide optimal competence profiles.





Quality Software Development

...introducing systematic development practices...

Quality is the critical property of a software system. Differing factors may affect the perceived quality of a system depending on the precise nature of the application domain. In the case of safety critical systems, for example, reliability and robustness are crucial aspects of quality, while in the case of a desktop development tool, responsiveness and extensibility are more likely to be of concern. The Quality Software Development (QSD) department develops and validates methods and tools for the cost-effective construction of quality software systems.

A common misconception is that quality can be "tested into" a software system after the bulk of the development work has been completed. In practice, however, defects detected late in the development life-cycle require such a significant redevelopment effort that they are rarely implemented. The cost-effective attainment of quality goals therefore requires the continuous and systematic application of appropriate engineering techniques at all stages in the development cycle, not merely in the typical "testing" phase.

The QSD department provides a portfolio of synergistic software engineering techniques that individually, or together, can help significantly improve quality software development in a cost-effective way. One unifying focus of the department is object technology: key elements supported and investigated by the department include the Unified Modeling Language, scenarios, use cases, patterns, components, and inspections.

The department is organized around the following groups:

Requirements Engineering

A requirements specification is the starting point for any large-scale software development project. Without a good specification it is extremely difficult, if not impossible, to develop quality software. This group therefore focuses on developing and supporting techniques for the capture, validation, and management of requirements. This includes both functional requirements, which define precisely what a system must do, and non-functional requirements, which describe the constraints on the design and the development process.

The group focuses on methods for capturing customer and software requirements with emphasis on incremental development, modeling, reuse, traceability, and validation. These methods are developed, tailored to specific application domains like information or embedded systems, and evaluated in experiments. Examples for such methods include approaches using business processes, scenarios or use cases, and formal description techniques like SCR.

Software Design

Once a satisfactory requirements specification has been created, it must be correctly translated into an executable form that effectively meets the needs and quality goals of the customer. This is the process of design. The software design group is concerned with the use of key implementation technologies for creating designs that represent the optimal balance between the system requirements (including quality goals) and the constraints of the available or chosen implementation technologies.

Key technologies supported and investigated by the group include object-oriented languages (particularly Java and C++), patterns, including architectural patterns, design patterns, and component technology (esp. CORBA, COM and JavaBeans).

One major emphasis of the group is on the synergistic interaction of these techniques to support the seamless mapping of requirements into implementation features. To this end, the group is leading the development of the SOUND method, which aims to support systematic object-oriented development using the principles of the Cleanroom approach, and the SORT technique, which enforces clean separation of refinement and translation activities through the provision of refinement and translation patterns.

Inspections and Testing

As a human intensive activity, software development is inherently error prone. To attain adequate quality, therefore, techniques are needed to identify and remove defects in software systems. This group focuses on two complementary defect reduction techniques: inspection and testing, which have been shown experimentally to complement each other. Inspections involve the static examination of software artifacts, while testing involves their dynamic execution under controlled conditions.

Inspections are particularly effective because they make it possible to identify and remove defects early in the development process before they have caused much damage. They are consequently applicable in all stages of development, including requirements analysis and design. The group focuses on one particularly powerful form of inspections, perspective-based inspection, based on the concepts of perspective-based reading.

The power of testing is that it is not only capable of uncovering defects in executable software artifacts, but it is also effective in demonstrating that the artifacts have reached a certain required level of quality. Particular foci of the group with respect to testing include the testing of object-oriented artifacts, and the statistical certification of component reliability.

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Department Head:
❷ Dr. Colin Atkinson (in 1998)
❹ Dr. Barbara Paech (starting in 1999)

Requirements Engineering:
❹ Dr. Barbara Paech
❺ Erik Kamsties

Software Design:
❷ Dr. Colin Atkinson
❶ Christian Bunse

Inspections and Testing:
❸ Oliver Laitenberger

Absent:
Andrea Coffey (Secretary)

SOUND - Systematic Object-Oriented Unified Development

Object technology offers numerous well-known advantages, but enhanced quality is not normally viewed as one of them. A high proportion of object-oriented systems still fails to work correctly, or does so in a way that falls short of the non-functional requirements. One of the major reasons for this problem is the lack of systematic, rigorous object-oriented methods. The SOUND project, lead by the QSD department, addresses this problem by integrating key software and quality engineering technologies from across IESE, to create a seamless, UML-based software development method.

SOUND Philosophy

Within the context of a sequential development process, the key techniques and models of object-oriented analysis and design have been understood for some time. Probably the most mature example of a strictly sequential object-oriented method is Fusion, which is as systematic as any object-oriented development method available to date. However, a "simple" waterfall process is inappropriate for anything but the smallest of systems. For medium or large-scale industrial projects it is necessary to iterate between the major development phases, and to assemble the software incrementally in terms of individually completed parts.

Unfortunately, existing strategies for the incremental assembly of object-oriented software tend to be very vague about how the separate increments should be related to one another, and how consistency should be maintained across distinct increments. Also, they often adopt purely functional increments, which can lead to suboptimal architectures and classes with low cohesion.

SOUND addresses this problem by explicitly including object increments in which iterations are achieved through hierarchic decomposition rather than functional slices. The combination of both yields the following advantages:

- the development process is architecture centric (assuming that the architecture is object-oriented),
- consistency between distinct increments is based upon the well-understood "contract" model of object interaction,
- the approach fits well with the basic tenets of components.

...creating UML-based methods...

A major risk of the incremental approach, however, is the occurrence of quality problems due to defects in the early components. This is where IESE's extensive quality engineering expertise comes in. SOUND mitigates the risk of quality problems in early increments by:

- exploitation of Cleanroom principles to guide the iterative process,
- the use of extensive quality modeling and engineering techniques based on UML analysis and design models,
- continuous and systematic perspective-based inspection of UML artifacts through the development process.

UML-based Development

One of the main differences between SOUND and other UML-based methods is that all diagrams are considered to be relative to a particular component, with the overall "system" simply being viewed as the top-level component. Figure 1 illustrates the set of UML diagrams used to fully describe a SOUND component. These are divided into two subsets: the specification subset that describes the externally visible properties of the component, and the realization subset that describes how the component is constructed from lower-level components.

The specification models describe the interface of a component from the three classic perspectives established by the OMT method and later consolidated by the Fusion method. A UML class diagram, of the kind illustrated in Figure 2, describes the important objects and relationships which the component manipulates; a UML statechart diagram captures the externally visible states of the component, and a set of Fusion-style operation schemata collectively describe the functional properties of a component.

Ensuring that all UML diagrams are defined in a uniform and localized way at all levels in a component hierarchy has several important benefits for a software development organization:

- It greatly simplifies the method by enabling the same concepts to be reused at all stages in the development process.
- It facilitates the interchange of components based on uniform and consistent interface definitions.
- It ensures complete and user-friendly documentation of a component for future maintenance and for publicizing in a library of reusable software.
- It enables an executing system to be viewed as simple component for inclusion in larger systems, and vice versa.

Project Status

In 1998, the underlying principles of the SOUND approach were consolidated, and key elements validated through peer review and publication. Currently, the approach is being documented in the form of a user's guide, and validated through extensive case studies.

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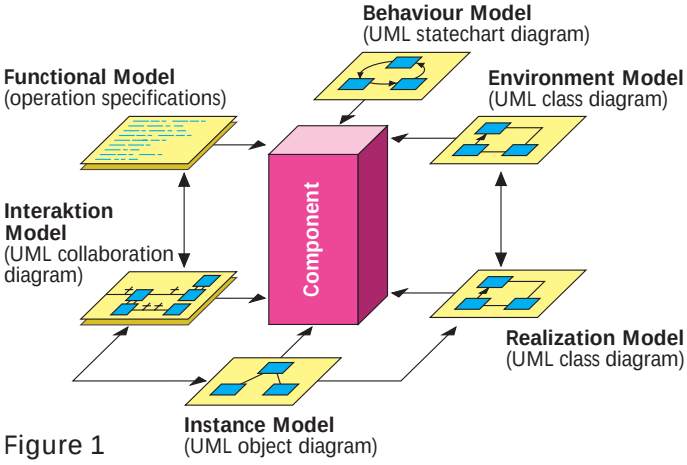

Figure 1

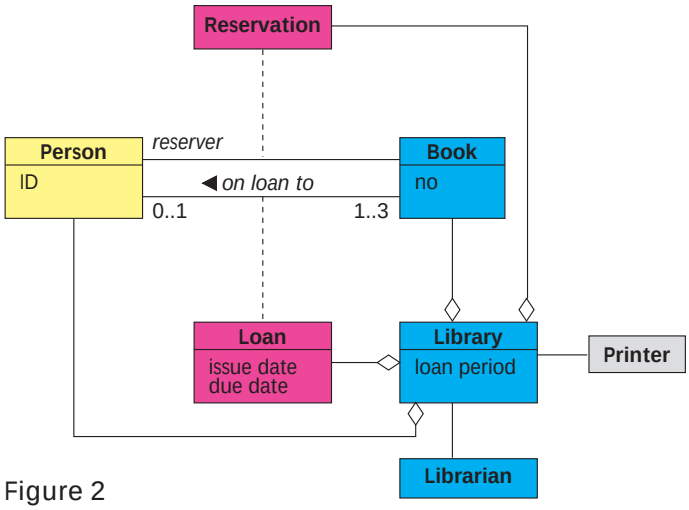

Figure 2

Efficiency Improvement of Software Development at the Space Infrastructure Division of DaimlerChrysler Aerospace AG

The continuously growing proportion of software in products and services in the aeronautics and space industry is of paramount importance for the systems built. Moreover, ever more stringent demands are placed on this type of software, such as mission criticality, complexity, or sheer size.

At the same time, DaimlerChrysler Aerospace (DASA) is exposed to substantial budget cuts in European space programs. Consequently, only fixed-price contracts are offered by the European Space Agency (ESA) and competition among providers increases. To remain competitive and satisfy customers, DASA launched improvement programs that are targeted at keeping tight schedules and improving productivity and quality.

At the Department of Orbital Systems and Operations in the Space Infrastructure Division at DASA, improvement goals were identified during the course of an earlier analysis by the Fraunhofer IESE and other external consultants.

Objective

The cooperation with Fraunhofer IESE was launched to tackle several identified improvement goals, in particular to:

(1) Detect defects earlier in the software development process, reduce cost, increase reliability and predictability.

(2) Capture and package experience of applying the introduced changes from software projects for reuse in future projects and across application domains (in cooperation with DaimlerChrysler Research, Ulm).

...detecting defects early...

Approach

Driven by goal (1), new software techniques, namely inspection techniques, were selected, customized to the particular needs of DASA, and introduced to the software development process. Inspections were applied to software development artifacts of early development stages to decrease defect rate, increase reliability and predictability, and cut costs for rework. Their performance was monitored by means of a tailored measurement program.

The data collected by means of the measurement program was supplemented by qualitative experience and observations made during the application of inspections. Both the quantitative data (and its interpretation acquired through feedback sessions) as well as the qualitative experience and observations were captured in the form of technology-oriented lessons learned (what can be improved?) and project-oriented result+success reports (what impact, e.g., in terms of number of defects found, had inspections on the projects?).

Results

Quality assurance has accepted the application of inspections as an integral part of their quality assurance activities. The inspection handbook supplied by Fraunhofer IESE as well as the online available lessons learned and result+success reports are used as reference sources.

Later the key parts of the inspection handbook, the lessons learned, and the result+success reports were repacked as Quality Patterns in the context of a study in cooperation with DaimlerChrysler Research, Ulm.

The explicit documentation of the above and their dissemination using the intranet is viewed as a first step in the long-term goal of establishing an Experience Factory at DASA.

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Object-Oriented Languages

Procedural and object-based programming languages such as C and Ada are frequently used for space system software development at ESA. Modern object-oriented (OO) languages such as Java, and new OO distribution technologies like CORBA promise to bring a number of advantages over the more traditional approaches, e.g., better maintainable and reusable systems. However, these OO technologies are not yet regularly applied in the context of embedded space software at ESA, so there is only limited experience concerning their applicability in that domain.

Objective

The main objective of this project is to arrive at informed recommendations for the use of object-oriented technologies for the development of space software systems at ESA.

In particular, it is of interest to which degree the choice of programming languages (C++ and Java) and the choice of distribution technology (CORBA, inter-process-communication, or threading) has an impact on the maintainability, reusability, and resource utilization of the resulting systems.

Approach

Six different versions of a subsystem of the international space station software are implemented. A threaded version, a version using communicating processes, and a version based on CORBA are each implemented both in Java and C++.

These six versions are then analyzed against specific criteria to get an indication of the quality of those systems in terms of their maintainability, reusability, and utilization of CPU time and storage usage.

...recommending OO technologies...

Resource utilization is directly measured by observing the executing systems. To analyze and compare the maintainability and reusability of the six systems, two state-of-the-art approaches are used and combined.

The first approach is the Software Architecture Analysis Method (SAAM), developed at the Software Engineering Institute, Pittsburgh. In this approach, a set of likely scenarios of future maintenance activities and reuse scenarios are identified. It is then investigated how well each of the six systems accommodates the scenarios, by determining for each scenario and system, which system classes have to be changed to accommodate the scenario, and how extensive these changes are.

The second approach is based on a static analysis of structural properties of each of the six systems. Coupling, complexity, and the size of classes were shown to be indirect indicators of maintainability and reusability. Suitable measures of these structural properties are identified and applied to each system.

To combine the results from both analyses, and come to final conclusions, we use the structural class properties to weight the extent of modification to classes. The underlying idea is that changes to a class with, say, low complexity, are likely to be easier to perform and therefore less critical than changes to classes with high complexity.

Results

Analysis of the systems is currently in progress. From the results of this analysis, we expect to learn more about the applicability of the mentioned OO technologies in the context of embedded space software systems, and a better understanding of the impact of the choice of programming language and distribution technology on the maintainability, reusability, and resource utilization of the software.

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...identifying commonalities in variants...

Enterprises often specialize in specific business areas where they accumulate experience and develop strategic know-how about the software products they develop. Often, clusters of these products share a set of similar core ideas, but the products themselves are diverse, in order to address the specific needs of different user groups, customers, or specific environments. These are variants of the same product.

In software development, contrary to other engineering disciplines, variants of a product are often treated as single systems with a unique design. That implies a lot of repeated effort, thus causing high development and maintenance costs, as well as long time-to-market. In addition, the quality of the product suffers.

The Software Product Lines department (SPL) develops and validates methods and techniques for systematically engineering product lines for software. Our approach is to integrate product variants that share some common functionality and purpose into an explicit line of products, and to engineer them around their commonalities and variabilities based on a coherent and efficient reusable architecture. This leads to a high level of reuse among these systems, thus reducing development and maintenance costs, decreasing time-to-market, and ensuring quality through the reuse of high-quality assets.
The SPL department is structured into the following groups:

Product Line Approaches

To transfer product line benefits from other engineering disciplines to software engineering, the product line approaches group (PLA) has developed the PuLSE™ method (Product Line Software Engineering). PuLSE™ provides a customizable framework for product line engineering that can be applied in different software development situations at different levels of integration. PuLSE™ makes it possible to manage product variability while minimizing effort duplication and maintaining an open and flexible design.

PuLSE™ covers the complete product line lifecycle, including the determination of an economically viable scope, the elicitation and articulation of the product line concepts and their interrelationships, the definition of a reference architecture for the product line, the instantiation of products from the architecture, and the evolution of the product line over time by managing the re-application of the above activities.

The PLA group defined PuLSE™ bottom-up based on experience from the application of other domain engineering approaches. Our industrial partners benefit from the strong domain engineering expertise of the PLA group, PuLSE™ being the state-of-the-art solution for current practice problems.

Distributed Reference Architectures

Reference software architectures are the key to successful software product lines. They support the generation of the anticipated variant systems by making explicit how existing and planned software parts have to be integrated. As a result of careful architecting after a domain modeling

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effort, reference architectures are one of the supporting assets in product line software development.

In practice, distributed systems have been gaining more and more importance. Developers have started to reuse existing components and connection mechanisms and thus rely on common standards like CORBA and DCOM.

In recognition of the significance of these emerging fields, the Distributed Reference Architecture group (DRA) has been recently set up to explore distribution aspects of software reference architectures within software product lines. Bundling knowledge about state-of-the-art solutions for typical problems, the DRA group is the competent partner for companies working in these fields.

Software Reengineering

The Software Reengineering group (REE) focuses on supporting product line concepts through exploiting the experience embodied in existing systems. For this purpose, the group is developing technologies to recover architectural and domain-specific information about existing systems.

When these technologies are applied to multiple systems from the same domain, they enable the identification of the similarities and variations among these systems - a key aspect of product line modeling.

In addition, architectural and domain-specific information can be combined with other reengineering technologies to extract valuable assets that can be reused in the development of new variants within the same product line - resulting in significant cost reductions.

In the more traditional field of reengineering, architectural and domain-specific information can provide better visibility and control over a successful single system suffering from an increase in maintenance and evolution costs.

Recovering a complete architectural and domain view of a system is not economically realistic. We use the business-driven evolution goals provided by the customer to select what information is actually needed. This leads to cost-effective results for our customers.

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❸ Dr. Peter Knauber

Product Line Aproaches:
❸ Dr. Peter Knauber
❺ Joachim Bayer
❷ Oliver Flege
❾ Roland Laqua
❽ Dirk Muthig
❶ Klaus Schmid
❹ Tanya Widen

Reengineering:
❿ Jean-François Girard
❻ Martin Würthner

Distributed Reference Architectures:
❼ Dr. Cristina Gacek

Absent:
Kerstin Walter (Secretary)

...addressing specific needs of trading companies

PuLSE™ – Product Line Software Engineering

The PuLSE™ method is being developed at IESE to support the construction, usage, and evolution of software product lines. PuLSE™ is divided into three elements: deployment phases, technical components, and support components.

The PuLSE™ deployment phases are logical stages a product line goes through. They describe the four activities performed to set up, use, and evolve the product line: First, the enterprise is baselined and PuLSE is customized accordingly to fit into the specific context of the enterprise (PuLSE Initialization, see graphic next page). Second, the product line infrastructure is constructed. Third, the infrastructure is used to create product line members. Fourth, the product line infrastructure is managed and evolved over time entering the construction and usage phases again.

The PuLSE™ technical components provide the technical know-how needed to operationalize the product line development; they are applied throughout the deployment phases. Different facets of a component may be used in more than one phase – though some components directly correspond to phases. There are six technical components (see graphic next page) addressing baselining of the enterprise context and customization of PuLSE™ (BC), scoping of the domain according to economic objectives (Eco), domain analysis and construction of a product line model (CDA), development of a reference architecture for the product line (DSSA), instantiation of the model and the architecture for a product line member (I), and evolution and management of the product line (EM).

There are support components providing customizations of PuLSE™ to major project categories, guidelines to set up and maintain the right organization structure for developing and managing product lines, and a method for evaluating the quality of product line conformance within an enterprise using PuLSE™.

One major advantage of PuLSE™ is its modularity, that is, elements of the method can be applied independently within an enterprise's software lifecycle. This modularity enables us to apply and validate most parts of PuLSE™ in some projects, while details of other parts are still being defined. Currently, PuLSE™ is being applied in the following projects: WWS2000 and Software-Variantenbildung.

Project WWS2000

WWS2000 is a software development effort of the Markant Südwest Handels AG, a trading company. Markant used commercial merchandising systems in the past, but decided to implement a new line of systems on its own. This decision was made because these systems would fit its needs better than commercial products, do so at a lower cost, and offer the opportunity for selling systems to trading companies with similar needs.

The objective of the project is to specify and develop a generic reference software architecture and an integrated set of reusable components. The reference architecture serves as a reuse infrastructure that enables the efficient creation of customized variants.

The role of the IESE within this project is to establish an efficient software development organization that will enable Markant to take advantage of the product line approach.

During the first project phase, the emphasis was on the development of a single system. The purpose was two-fold: First, to provide a quick replacement for a system that could no longer be maintained, and second, to gain experience with developing systems in the domain.

In the following phases, the emphasis shifted towards product line engineering. Customized PuLSE™ components have been used for this purpose.

Currently, PuLSE-Eco is being used to extend the scope of the product line beyond the boundary given by the systems that address the specific needs of Markant. A domain model covering the first two systems has been developed using PuLSE-CDA. New variants are being added incrementally. The specification and development of the reference architecture is being accomplished by applying PuLSE-DSSA.

The first instance of the WWS2000 shipped in 1998, another variant – for an external customer – is expected to be fielded in early 1999. These two systems laid the foundation for the domain model currently to be built. Preliminary analysis of two additional variants has been concluded, their integration into the domain model will be straightforward. The release of those systems is planned for late 1999.

Although the initial WWS2000 does not have a genuine reference architecture, it is capable of supporting elementary variability. To be able to meet the more demanding requirements of the future, work has started and is now continuing on the transition towards a real reference architecture.

Partners

Markant Südwest Handels AG
Markant Südwest Software und Dienstleistungs GmbH

Project Software-Variantenbildung

The objective of this project is to help Small and Medium Enterprises (SME) in the region benefit from the advantages of product line software engineering. Those benefits include reduced costs for development and maintenance, decreased time-to-market, increased reliability and quality, as well as faster introduction of new employees to the application area.

In the project Software-Variantenbildung (software variant building), the PuLSE™ method has been adapted to the specific situation of SMEs. Their characteristics include limited resources, the need to react flexibly to changes in the requirements of their customers, and short-term planning of projects. Depending on the domain and the specific situation of each enterprise, components of PuLSE™ are selected, customized, and applied. The final goal is to develop a reference architecture for each project partner to support current and potential future needs within the domain.

The domains addressed in the project are civil engineering, stock market, CAD systems, Case-Based Reasoning, human comfort modeling, and publishing.

The project is funded in part by the Ministry of Economic Affairs, Transportation, Agriculture and Viniculture of the State of Rhineland-Palatinate.

Partners

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MARKET MAKER Software AG
softTECH Software Technologie GmbH
tecInno GmbH
TECMATH GmbH & Co. KG
Viva Software GmbH

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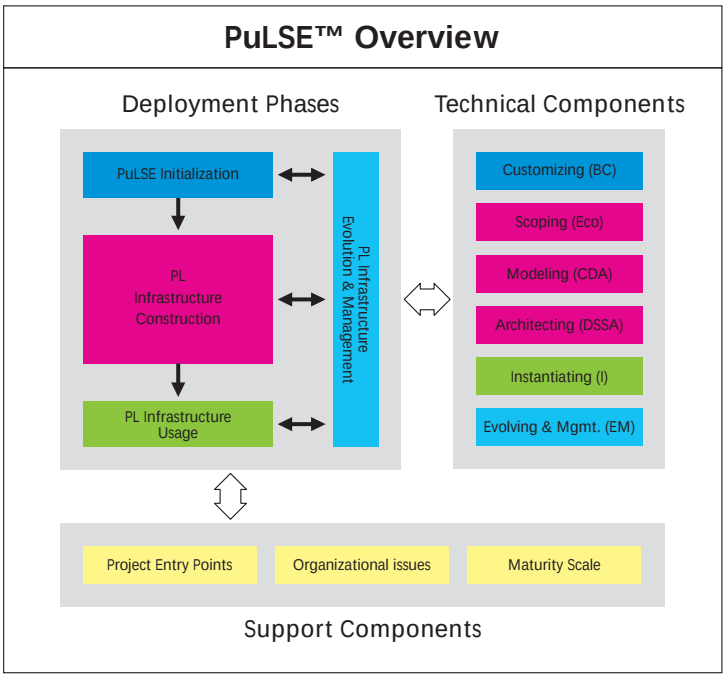

Quality and Process Engineering

The Quality and Process Engineering department aims at providing the technologies and methodologies to plan, control, and improve software development and maintenance processes. The aim is ultimately to increase productivity, reduce time-to-market, and improve the quality of software products.

In order to achieve the objectives stated above, we have adopted a three-fold approach:

(1) Develop efficient methods and techniques to elicit, describe, assess, and support actual software development processes.

(2) Provide methods and techniques to measure and model software development products, processes, and resources expended.

(3) Support all the activities mentioned above with effective tool environments to support quality and process engineering activities.

We place particular emphasis on developing solutions that are technically sound, optimal in their specific context of application, and tailored to our customers' expectations and needs.

...understanding, modeling, controlling...

The Quality and Process Engineering department is composed of the following groups:

Process Engineering and Improvement

The Process Engineering and Improvement group (PEI) aims at providing methods for process elicitation, modeling, and analysis so that specific process weaknesses and strengths may be identified. This is expected to naturally drive process improvement initiatives. We place particular emphasis on developing techniques to cope with real-scale, high-complexity processes and organizations.

Examples of technologies include the development of an environment to describe, visualize, and analyze software development processes. A web-based technology was also developed to document an organization's processes on its own intranet in a way that supports the efficient performance of distributed, large-scale development and maintenance processes.

Examples of methods include the elicitation methods to characterize the processes in place in an organization and assess them. The assessment of processes can be performed at different levels of abstraction. At the highest level, Fraunhofer IESE has developed a SPICE-based (ISO/IEC upcoming standard) assessment method. At lower levels, techniques based on defect root cause analysis and defect classifications have been devised to identify problems at a lower level of granularity.

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❽ Bernd Freimut
❼ Michael Ochs
❸ Dietmar Pfahl
❺ Jürgen Wüst

Not on the picture:
Khaled El Emam
Janne Järvinen

Process Engineering and Improvement:
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⓫ Ulrike Becker-Kornstaedt
⓮ Andrew Beitz
❹ Dirk Hamann

Quality and Process Support Environments:
⓬ Dr. Peter Rösch
⓭ Ralf Kempkes
⓯ Dr. Louise Scott
❻ Jörg Zettel

⓾ Kerstin Walter (Secretary)

Cost and Quality Engineering

The Cost and Quality Engineering group (CQE) focuses on ways to build quantitative models aimed at the monitoring, evaluation, and prediction of software attributes such as productivity, maintainability, reliability, and related software risks. This implies the use of measurement, statistical modeling, and many other experimental techniques.

For example, we help customers identify important cost and risk factors in their development environment. Based on such an analysis, we help them build cost and risk models in order to facilitate decision making during project bidding and planning.

Other examples include the construction of models for assessing or predicting the quality of software products in order to (1) benchmark and compare them, (2) identify weaknesses in the processes that produced them, or (3) make optimal decisions regarding their inspection or testing.

CQE can address a wide range of problems through efficient and rigorous quantitative techniques that help make software engineering a real engineering discipline.

Quality and Process Support Environments

The Quality and Process Support Environments (QPS) group aims at providing automated support for all the quality and process engineering activities described above.

Two main integrated environments are being continuously evolved by QPS:

Spearmint™ (Software Process Elicitation, Analysis, Review and Measurement in an INTegrated Modeling Environment): Spearmint aims at describing, visualizing, and analyzing real-scale software development processes. It takes into account the specific needs of software development and software process engineers (see screenshot below as an example).

Smarties (Systematic Measurement Toolset for Improving and Engineering Software Development): Smarties aims at helping people specify and plan measurement programs, which in turn will help them plan, control, and improve their development processes. The planning of measurement programs is performed in the context of a specific development process, explaining the necessary connection between Smarties and Spearmint.

The concurrent use of Spearmint and Smarties assists customers in dealing with the complexity of understanding, planning, and controlling real-scale software development processes.

Both Spearmint and Smarties are designed for use in real process improvement projects and are based on robust, portable technologies, including Java, web-interfaces and object-oriented databases. The picture on the bottom of the left page shows a screenshot of the Spearmint main window.

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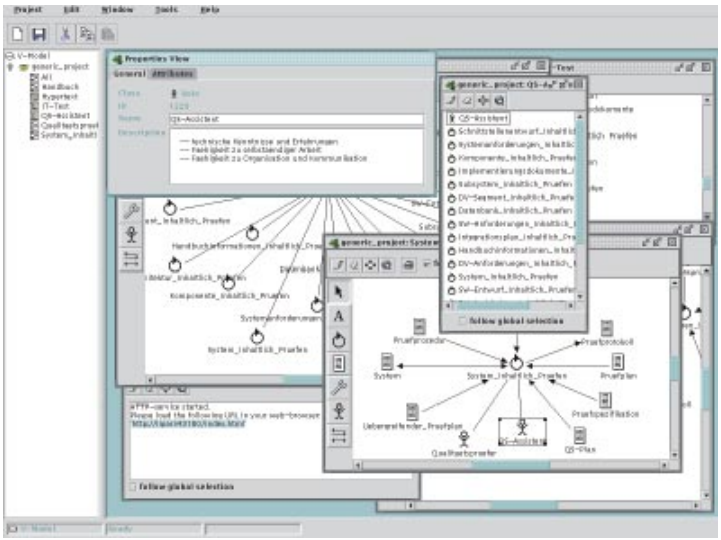

Screenshot of the Spearmint main window

Developing a Costing and Sizing Estimation Procedure

Despite fierce competition that begs for precise cost estimation and control, many organizations have not mastered cost estimation for their software projects yet. Cost estimates are frequently inaccurate and are not repeatable. Such uncertainty diminishes an organization's capacity to manage projects, to make competitive bids for fixed price contracts, and to assess potential suppliers' bids on a more objective basis. When there are estimation successes, they are due to the availability of highly skilled individuals at that point in time.

A common approach to build or augment cost estimation capabilities is to buy an off-the-shelf cost estimation tool and attempt to use it in projects. In many cases these tools fall into voluntary disuse because there has been no transition and institutionalization of cost estimation practices. In addition, generic tools do not always produce very accurate results, and most of them are not transparent.

To excel in cost estimation, it is necessary to implement repeatable cost estimation procedures that are customized for a particular organization's context. Furthermore, these need to be implemented as early as possible in a project's life cycle.

The Fraunhofer IESE is collaborating with DASA RIO6 in developing a cost estimation procedure for the proposal phase of their software projects. This is the earliest phase when the projects are still under bidding and when there is incomplete information about the software architecture and requirements. It is also a critical phase to ensure that bids are successful and that subsequent projects are profitable for the company.

...defining a costing procedure...

Objective

A primary objective of this study was to define a costing procedure that can be applied during the proposal phase of a software project. The procedure improves over existing procedures, especially in the area of risk analysis. A second objective was to define a software size measure that can be used during the early life cycle phases of a project (requirements engineering and high level design). Such a size measure would provide a foundation for subsequent data collection activities and empirical cost model construction.

Approach

Initially, a list of the most relevant cost drivers that affect software projects was identified. These were then represented in the form of a risk analysis form that is used during proposal writing. The form captures information about the value of the cost driver for that particular project, and its potential impact in terms of cost. This information is then used in a Monte Carlo simulation. The results of the simulation indicate the probability that the proposal will exceed the target price. In addition, various types of sensitivity analyses can be performed on the proposal cost estimate. Using this information, the proposal manager can redefine the proposal parameters to remain competitive and eventually become profitable. For the size measurement, elements that can be counted from early requirements and design documents were defined and validated. These elements provide the basis for early size measurement.

Results

The study resulted in a defined costing procedure and a prototype implementation on a commercial simulation engine. The whole procedure is easy to use, since it is an extension of the approach that is currently in use, and the tool also uses a common spreadsheet interface. Furthermore, the elements for early size measurement for software projects that are specific to DASA RIO6 projects have been defined.

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Tool Support for GQM-based Measurement Projects (GQM Tool)

Systematic and goal-oriented measurement helps to explain and identify variation and influencing factors of product quality and process efficiency. At Allianz Lebensversicherungs-AG, systematic measurement based on the GQM approach (Goal/Question/Metric) has been applied successfully for many years.

Objective

The purpose of the project can be described from two perspectives. First, Allianz Lebensversicherungs-AG wants to improve the efficiency of their measurement projects and decrease the maintenance costs by using computer-based tools during project planning, project performance, and project analysis. Second, Fraunhofer IESE (referred to as IESE below) wants to gain more insight into the applicability of tools supporting measurement projects and use this knowledge to build GQM support tools that can be used in the future for similar measurement projects with other partners of IESE.

Approach

The transfer project aims at implementing a small toolset for GQM-based project support. In the starting phase of the project, requirements from multiple projects have been collected and prioritized in the context of past measurement projects at Allianz Lebensversicherungs-AG. In parallel, specific use cases have been identified based on existing measurement project data and existing tools. This procedure helped us identify a core set of functionality which is to be provided after the first tool implementation phase in 1999. This core set of functionality

...implementing a toolset...

mainly addresses the need for GQM-based planning and performance of measusurement programs.

IESE builds upon the identified requirements and describes additional requirements that need to be fullfilled for future integration of analysis and reuse concepts and also for addressing the more general needs of measurement projects.

In the next project phase, during 1999, Allianz Lebensversicherungs-AG will implement a first version of the GQM tool providing core functionality. In parallel, IESE will build advanced prototype tools that address the need for future extensions. Based on the experiences of this first development phase, a joint development is planned.

Results

The most important results so far are a requirements document, which includes scenarios for the usage of the future tools, prototypic screen designs of the future prototype, and the design of a common database schema. Furthermore, we derived a template structure for the description of GQM plans which can be used to describe GQM plans in a uniform way, and which also contains information for performing standard analysis of measurement data.

This collaboration with Allianz Lebensversicherungs-AG has had a major impact on how IESE understands and defines the requirements for tool support in measurement projects. IESE has gained more insight into practical customer requirements.

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PROFES - PROduct Focused improvement of Embedded Software processes

For companies in competitive markets, the customer-perceived product quality is an important driving force behind the improvement of software development processes. Existing improvement approaches, however, are not really focused on product quality requirements. Usually, they are mainly based on capability maturity profiles of software development processes.

Advanced process improvement technology must give priority to company-specific product quality requirements. Process improvement actions should be derived from product quality goals and be based on state-of-the-art knowledge about product/process dependencies. Existing tools for process improvement, such as goal-oriented measurement and process assessment, should be integrated in order to support product-focused improvement effectively.

Objective

The objective of the PROFES project is to support industries that have strong product-related quality requirements, such as the embedded systems industry, with an effective improvement methodology that:

- focuses improvement actions on those elements of the software development process that contribute most to the critical product quality factors,
- combines and enhances the strengths of goal-oriented measurement, process assessment, product modeling, process modeling, as well as continuous learning and experience reuse,
- is validated through case studies that are performed in industrial environments.

Approach

PROFES provides a methodology for software process improvement that starts with the identification of company-specific product quality requirements. Process improvement actions are based on available knowledge about the impact of software processes on product quality. This knowledge is described using product/process dependency (PPD) models. PROFES investigates PPDs, collects them in the form of a PPD repository, and makes them available for improvement planning.

The PROFES improvement methodology offers comprehensive support for performing improvement programs and integrates state-of-the-art improvement technology (e.g., SPICE (ISO 15504) software process assessments and Goal/Question/Metric (GQM) measurement). It is validated through three industrial case studies at Dräger, Ericsson, and Tokheim.

Results

The main results from PROFES are:

- PROFES handbook and user manual, containing:
  - comprehensive documentation of the PROFES improvement methodology,
  - guidelines for the identification and usage of product/process dependencies,
  - advice for the integrated application of goal-oriented measurement, software process assessment, and experience reuse in software engineering;
- a web-based repository of product/process dependencies,
- a web-based repository with cost/benefit information about the PROFES improvement methodology,
- training and presentation material.

...focussing improvement efforts...

The complete collection of PROFES results will be released in the summer of 1999. Various intermediate results are already available from the PROFES web pages at www.iese.fhg.de/Profes.

ESPRIT Project No. 23239

Partners

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Ericsson Finland (FIN)
Etnoteam S.p.A. (I);
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Effectiveness and Efficiency of Inspections (EFFECT)

The ever increasing market pressure requires more and more effective and efficient ways of developing software. Therefore, the cost of defects (e.g., rework, operational failures) should be reduced. This can be achieved by detecting as many defects as possible early in the development cycle.

Software inspection is one method for detecting defects early and it should be as effective and efficient as possible. In collaboration with Siemens ZT SE 3 and Siemens ICN CA MS E we started to investigate the inspection processes at Siemens ICN CA MS E in order to optimize them with respect to their effectiveness and efficiency.

Objective

The purpose of the project is to analyze data from past projects at Siemens ICN CA MS E with respect to the inspection effectiveness and efficiency. Additionally, interviews are taking place to acquire and formalize expert judgement on the matter from experienced developers. Based on these analyses, decisions are made to better plan, control, evaluate, and improve inspections.

Approach

Based upon an analysis of the current inspection practice and data at Siemens ICN CA MS E, we proposed a set of techniques for assessing and improving the effectiveness and efficiency of the inspection processes.

Inspection and test data from past projects is analyzed to a) demonstrate the usefulness of the proposed techniques and b) to find out to which extent this data is usable for the techniques and how the existing data collection procedures can be improved.

We first develop appropriate definitions for efficiency by taking into account the economical aspect of inspections. Based on these definitions and the project data, we derive benchmarks for the purpose of evaluating future inspections.

Second, we identify the factors influencing inspection efficiency and effectiveness (e.g., product size and complexity, number of participants, inspection process, effort). This investigation is performed using statistical data analysis of the past projects as well as interviewing the project staff.

Finally, we investigate the existing data collection procedures at Siemens ICN CA MS E and identify potential improvement. Based upon this investigation, a practical handbook is developed on how to collect better defect and effort data and use them more effectively for the purpose of controlling, evaluating, and improving inspections.

Results

The results of this ongoing project will include:

- A benchmark for assessing the economic benefits of inspections. By means of this benchmark, different inspection practices can be compared and, thus, the more efficient inspection practice can be selected.
- An identification of factors influencing the effectiveness and efficiency of inspections. Based upon these results, it will be possible to make decisions on how to improve inspections.

...analyzing past projects...

- A handbook containing techniques for planning, controlling, evaluating, and improving inspections through measurement. The handbook will take into account the specific situation at Siemens ICN CA MS E and will provide tailored procedures for collecting and exploiting defect and effort data.

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Systematic Learning and Improvement

The department Systematic Learning and Improvement (SLI) develops and validates methods and techniques required to implement effective organizational learning and goal-oriented continuous improvement in the software area. Following the TQM-based *Quality Improvement Paradigm* (*QIP*), we help customers establish a software organization that is able to set quantifiable (improvement) goals, s<elect and take adequate actions towards reaching these goals, measure success, and systematically collect experience to promote learning.

Our overall approach is implemented on the organizational level by means of well-defined roles and processes. The separation of concerns into the software projects groups on the one hand and their support group on the other hand is significant for the organizational set-up. The former are responsible for performing software projects. The latter is concerned with the collection of relevant experience from the software groups, the preparation (i.e., structuring, documentation, and maintenance), and the feedback of experience to the software groups.

We call this an *Experience Factory (EF)*. The EF allows tacit knowledge of experts as well as experience hidden in processes and documentation to be made explicit so as to deploy it most effectively throughout the organization.

The department SLI is structured into the groups Experience Factory Technology, Management of Improvement and Learning, and Information Technology Security.

...aiming for perfection...

Experience Factory Technology

Companies that strive to become Learning Organizations often face the problem of information overflow. They do not know how to systematically identify, collect, and package information that would be of benefit if only it were easily accessible at the right place at the right time.

To benefit from the wealth of knowledge buried in piles of information, it is mandatory to structure information, provide a quick survey of available information, and guide users to useful information.

The Experience Factory Technology (EFT) group is developing the necessary tool support for the *Experience Factory.* The core of such a tool is the organizational memory, which we call the *Experience Base*. The Experience Base is integrated with an organization's information network, such as the intranet and data bases. The Experience Base stores diverse types of information, such as lessons learned from projects, best practices, process models, and application know-how in an easy-to-find and ready-to-use form.

We apply *Case-Based Reasoning* (CBR), which is a methodology that helps to solve problems in a very natural way. CBR emulates expert problem solving behavior: a new problem is solved by adapting solutions from similar past cases. CBR effectively supports knowledge storage and retrieval as well as learning, even for the casual user.

We integrate the Experience Base tightly with existing information sources and we use web technology to make the experience easily accessible.

Management of Improvement and Learning

Innovation, quality, and time-to-market are the three factors that determine competitiveness today. Reaching and keeping the leading edge requires exploration of the most valuable resource in a company – knowledge. The introduction of concepts for Learning Organizations faces many non-technical problems related to Business Process Improvement and Change Management. Moreover, the acquisition, storage, and distribution of experience still has a lot of open issues on the methodological level.

The Management of Improvement and Learning (MIL) group adapts and develops concepts for Learning Software Organizations. Based on the general idea of an Experience Factory, software process improvement is introduced in industry. A major topic is the identification, acquisition, and usage of experience in project organizations. Tailored solutions for experience processing are developed in close cooperation with

the EFT group and all other groups in the institute. This includes the definition of measures that allow to monitor business process performance and identify weaknesses and problems. This applies to software processes as well as to the knowledge management processes related to the Experience Factory.

Learning and improvement are not only applied in projects with external customers, but are also applied throughout all IESE projects. Thus, they complement the competence areas of all IESE departments and foster IESE-internal experience sharing.

Information Technology Security

In a networked world where frontiers become meaningless and information is just a mouse-click away, protecting a company's information assets while at the same time offering comprehensive response to legitimate requests is vital to survive competition. Current trends toward teleworking and teleconferencing, the introduction of electronic commerce, and the expanding use of telecommunication services create new opportunities, but also new threats.

The Information Technology Security (ITS) group assists an organization in precisely determining its security requirements, defining adequate security objectives, and closing existing security gaps.

To identify areas where assets are at risk, the organization's security policies are inspected. The IT system under study, its documentation and existing safeguards are reviewed. Guidelines for proper safeguarding and recommendations for the improvement of the organization's basic security strategy are derived from these investigations.

With their work the ITS group helps make a Learning Organization safer by protecting its essential assets – the information infrastructure.

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The Software Experience Center

The Software Experience Center SEC™ is a generic consortium set-up that has been conceived jointly by the IESE and its sister institute in the US, the Fraunhofer Center for Experimental Software Engineering, Maryland, as a framework to create SEC consortia.

Mission

SEC consortia are designed to bring together like-minded international companies for the purpose of an open experience exchange and for setting up and performing joint case studies and applied research projects. The main goal is to promote the extension of Learning Organization concepts to the software domain. The intended international set-up is expected to create insight into Learning Organization issues across different cultural environments.

Each SEC consortium provides a forum for its members to share their experience much more effectively than in a conference or workshop. In particular, there will be exchange on successful as well as less successful projects, on setting up and performing improvement programs, and on introducing and running Experience Factories. On a regular basis, the SEC members select topic areas from the software engineering domain that are most relevant to them for investigation within their consortium, thus setting the consortium's focus.

Implementation

Each SEC is a consortium of industrial members plus the Fraunhofer Institutes that together want to act as an Experience Factory. A consortium is governed by a consortium agreement that settles confidentiality issues and regulates the operation of the SEC. A steering committee, comprised of one representative per member, guides the consortium.

...sharing knowledge and experience...

The industrial members jointly fund the operations of their SEC consortium and are expected to make a mid-term commitment to the consortium. Each SEC comprises six to eight member companies. Each member subscribes to its SEC consortium agreement and in particular to the free mutual exchange of experience within the consortium for the purpose of accelerated learning.

Different SEC consortia do not interfere with one another, that is, confidentiality is guaranteed.

Role of the Fraunhofer Institutes

The Fraunhofer Institutes act as facilitators and bring added value to the SEC consortia. In particular, they:

- run the SEC consortia offices,
- plan, coordinate, and execute workshops for the SEC consortia,
- contribute tutorials, exploratory technology presentations, and experience reports to the workshops,
- collect experience in the course of bilateral projects with members and document it for dissemination within the consortium,
- maintain the SEC consortium's Experience Base, which makes the consortium's experience assets accessible to the members,
- maintain and provide access to a world-wide network of experts,
- deliver on-line services to the members, such as a web site with the SEC Experience Base, and a newsletter.

Status

In 1998, Fraunhofer IESE and the Fraunhofer Center for Experimental Software Engineering, Maryland designed and put together the first international SEC. The official start of this consortium was June 1st 1999. More SECs, national as well as international ones, are planned to be assembled in the future.

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Studies on Experience Factory Aspects

The installation of improvement programs in general and Experience Factories (EFs) in particular requires carefully designed change processes, strong management support, and early staff involvement. The generic EF concept has to be tailored to the specific needs of the company. At DaimlerChrysler AG, Corporate Research provides support for business units that want to install improvement programs. In an ongoing collaboration, which started in 1997, IESE has conducted several studies for DaimlerChrysler. Each study investigated a special aspect of the EF concept.

Objective

The purpose of the studies is to obtain guidelines for the instantiation of EFs in different environments. Since continuous software process improvement has to be embedded in the daily business processes, it has to consider existing organizational structures, available information technology, and specific needs of the business domain. All these factors affect the organizational set-up, the type of experience the EF has to process, the effort spent on acquiring, packaging, and storing experience, and the way different staff members access stored experience. The studies should reveal design alternatives and practical guidelines for EF implementation at DaimlerChrysler AG.

Approach

Every study focused on a special aspect of the EF concept. Application scenarios from the business units served as viewpoints to determine the environmental context in which the selected EF concept was discussed and restrictions for the applicability were outlined. Besides underpinning the theoretical concepts of the EF, the goal was to develop practical guidelines for DaimlerChrysler Corporate Research for the implementation of EFs in business units. Therefore, all studies were conducted in close cooperation with DaimlerChrysler, considering requirements and restrictions from the business units.

...providing guidelines for development practices...

Results

Three topics of the EF concept have been investigated in depth so far:

The Process of Experience Packaging

- This study focused on software inspections experience and how to use the Quality Pattern approach for packaging such experience. The study confirmed the basic idea of the Quality Pattern and helped to better understand its applicability. Guidelines for writing and maintaining Quality Pattern were developed.

Experience Factory Roles

- This study was an investigation of literature on existing EFs and EF-style organizations to extract the set of tasks common to EFs. The tasks found were consolidated and bundled into eight generic EF roles that are considered mandatory to operate an EF.

Alternatives for the Description of Experience

- This study investigated different approaches for structuring experience and presenting it to the user. For the study the Quality Pattern approach, Case-Based Reasoning (CBR), Product-Process Dependency Models, and GQM Abstraction Sheets were selected. In order to evaluate their utility, the different description alternatives were applied to different types of lessons learned and experience was related to various artifacts (e.g., process models, effort distribution models, and GQM plans), based on usage scenarios.

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...measuring development processes...

Process Improvement through Systematic Measurement (PRISM)

The increasing pace of the telecommunication business sector places more and more requirements on development efficiency and product quality. At Bosch Telecom GmbH, the development of a large telecommunication system was targeted for measurement-based improvement. The collaboration started in 1996 with a pre-study, followed by a pilot phase at the Frankfurt site, and has now been extended to three more development sites (Darmstadt, Düsseldorf, and Stuttgart).

Objective

The purpose of the project is two-fold. Bosch Telecom aimed at extending its strengths in goal-oriented measurement, while at the same time the development process had to be improved.

An assessment of the project organization, performed by a third party prior to this project, revealed that although the development process was already under control, gains could be achieved by introducing methods for process and product measurement. Consequently the transfer project with IESE was set up. The Goal/Question/Metric measurement approach was chosen. The customer's method specialists joined the project team from the very beginning. They were trained by IESE so as to later on deploy the method to other business units without the help of the IESE.

Approach

The transfer project aims at implementing the Experience Factory concept to support continuous improvement. During the pilot phase, methods and techniques were tailored and a set of tools and procedures was created. This phase also helped to create buy-in on the part of the developers for introducing measurement-based management practices. Right from the beginning, the participation of developers was considered indispensable for gathering knowledge about the actual software development process. Meanwhile, more than 80 developers are involved in the program.

Different types of feedback sessions were installed to interpret process data with the help of the developers. These sessions became the driving force of local, project-wide, and strategic improvements, and established close contact between the improvement team, developers, leaders, and managers. Well-defined responsibilities for improvement and change processes have been assigned to organizational units. A cross-department process group facilitates organizational learning and identifies common process patterns.

An Experience Base is under development. First assets are put into the structure, which is designed to be accessible through the intranet so that all stakeholders can easily share experience.

Results

The measurement program helped identify potential for improvement. Among other results, there is now a description of the actual software development process and a comprehensive documentation of the measurement activities including a user's guide to instruct developers about their role in improvement tasks. An intranet-based tool has been developed to facilitate data collection, management, and evaluation. IESE provided prototypes to evaluate alternative implementations.

The measurement program provides detailed insight into the actual performance of the development process and the quality of the product. Management can now relate failures and faults to phases. Effort data collected from the process is compared with schedules and capacity budgets to monitor the development activities and to detect deviations early on.

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SoftQuali

Competencies in sustained quality and productivity improvement are a critical factor in today's competition. In software industry, many questions concerning improvement of software processes and application of technologies are still open. To achieve top quality goals (i.e., flexibility of software processes and reliability of software products), the following questions have to be answered:

- What are the essential quality and productivity attributes and how can they be measured?
- What are the factors influencing quality and productivity and how can their influence be verified?
- How can quality improvement be achieved in an explainable and therefore repeatable way?
- How can experience acquisition be organized for cross-project reuse?

Objective

The project aims at creating the foundation of systematic quality improvement and at demonstrating the achievements in quantitative terms.

For industrial partners, concrete results for their quality improvement are essential. So, project work is centered around effects of systematic review and inspection techniques on reliability and flexibility of products and processes. For research partners, the main focus is on providing technologies for measurement-based, continuous quality improvement that allow the evaluation of their effects on quality attributes. Such technologies are a significant cornerstone for evolutionary learning.

...establishing adequate software know-how...

Approach

In this project, the Quality Improvement Paradigm (QIP), which is the basic concept for continuous quality improvement in software industry, served as the main guideline. QIP is strongly related to goal-oriented measurement. Thus, adequate measurement programs for the industrial partners were developed. Review and inspection techniques were selected based on their potential improvement gains throughout all stages of SW development. Combined with goal-oriented measurement, these techniques provide significant help in understanding and controlling the software process.

All experience gained from the application of this approach has been documented so as to foster continuous learning from experience according to the Experience Factory concept.

Results

Technologies for sustained quality improvement were transferred to the industrial partners. In pilot projects, goal-oriented measurement has been successfully applied at three sites. A set of factors influencing the product and process quality has been discovered and verified in the measurement programs.

Scenario-based reading techniques have been adapted to the needs of the industrial partners, and their effectiveness and efficiency have been validated. As a result, guidelines for the application of such techniques in different environments are now available.

The different types of experience related to goal-oriented measurement and application of review techniques have been described systematically. Prototypes for the representation of such experience have been developed and validated for packaging and reuse in an Experience Factory organization. The outcome of this activity is a set of technology packages available for project partners and the public domain.

SoftQuali is funded by the BMBF. It started in 1995 and will end in 1999.

Partner

Alstom Energietechnik GmbH
Allianz Lebensversicherungs-AG
DaimlerChrysler AG
Siemens AG
Fraunhofer IESE

Contact

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Continuing Education and Training

...training for technology transfer...

There is no successful technology transfer without preparatory training and education courses. Background, main contents, and implementation of the new technologies have to be explained for all the people involved. This must always be done in the context of the organization. The demand for both specific technology training and professional Software Engineering education is growing significantly. Human resources have become more and more the bottleneck for industrial growth.

The IESE education and training approach is based on a modular system of courses. The different modules can be classified according to the following schema:

- basics for software engineering (e.g., discrete math, logic, algorithms),
- principles and foundations of software product engineering (e.g., information hiding, data abstraction, traceability, reuse),
- principles and foundations of software process engineering (e.g., process modeling, measurement, experimentation, learning),
- techniques, methods and tools on product engineering (e.g., requirements engineering, design, quality assurance),
- techniques, methods and tools on process engineering (e.g., experience packaging, process improvement, quality management),
- empirical results (e.g., case studies, experiments, lessons learned) and industrial experiences for different domains (e.g., telecom, embedded systems, MIS).

Company-oriented education programs take into account actual and future trends in technology development. The mid-term or long-term education programs are composed of sequences of individual education and training courses. Each of these courses makes a well-defined and measurable contribution to the strategic objectives. They are based on the following principles:

- Existing modules have to be tailored according to the application domain.
- Upper exit level of the course must be chosen based on target qualification (e.g., software engineer, tester, developer).
- Lower entry level of the course is chosen based on candidate's qualification.
- Synergy with existing company education and training modules
- Integration of external competencies and presenters.

IESE offerings are directed both at individuals with different backgrounds and university degrees and at organizations of different size and domain. For all our offerings, web and multimedia technologies are becoming increasingly important. There is great variety in objective, style, and duration of these offerings:

- Tailored training courses which are
  - technology-oriented,
  - one to five days in duration,
  - at IESE or at the company,
  - during work-time,
  - complementing transfer of IESE competencies;

- Development and realization of company-specific continuing education programs with classification based on

  – contents: competence/job-oriented,
  – duration: varying between three months and two years,
  – location: at IESE, at PRE Holtzendorff park (starting January 1999) or partially at company,
  – organization: full-time or part-time and inclusion of other players (e.g., university, high-tech companies, other educational institutions).

- Executive management briefings

  – Overviews, tendencies, and most recent results in software engineering technologies are presented for upper executive management of companies.

- Education, training, and consulting for SMEs.

The general objective is to take care of the particular needs of small and medium-size companies. Industrial transfer projects for SMEs are conducted. The emphasis of the projects is on consulting with respect to base practices in Software Engineering such as Requirements Engineering, Systematic Testing, Inspections, etc.. Projects typically start with a short assessment phase and/or a kick-off workshop and afterwards concentrate on transferring methods into the customer company, training and coaching personnel, and troubleshooting during the application of the new methods in day-to-day business.

The Consulting Center works in close cooperation with the society "Software Technologie Initiative e.V." (STI) which, by the end of 1998, counted more than 30 member companies and organizations. In cooperation with STI, a variety of seminars and workshops have been offered. The topics covered in 1998 were Requirements Engineering, Systematic Testing, and Software Quality Management. In addition, the annual conference entitled "Software-Qualitätsmanagement für den Mittelstand" was held with more than 70 participants.

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Department Head:
❶ Dr. Günther Ruhe

Software Engineering Education and Training:
❶ Dr. Günther Ruhe
❷ Manfred Eberle
❼ Ines Grützner

Company-Specific Education and Training:
❶ Dr. Günther Ruhe (acting)

Training, Education and Consulting Center:
❹ Dr. Klaus Hörmann
❻ Maud Schlich
❺ Stefanie Mahler

❸ Cornelia Streb, Secretary

The Competence Center for Software Technology and Training (KSTW*)

In order to further intensify the training and consulting activities for SMEs, it was decided to start the Competence Center for Software Technology and Training (KSTW) as a satellite office in a newly constructed technology park in Kaiserslautern (PRE Holtzendorff Park). Preparatory actions took place in late 1998.

One major reason for this was the tremendous lack of qualified IT personnel in the region, which has turned out to be a major obstacle for further business growth. The same is true for the lack of methodical know-how in conducting IT projects, especially in software development. Typical weaknesses are problems with time, budget, and quality. These constitute severe problems for both business growth and competitiveness.

For these reasons, IESE took the initiative to start a qualification campaign together with the local Economic Development Agency "WFK Wirtschaftsförderungsgesellschaft Stadt und Landkreis Kaiserslautern mbH". As a consequence, the foundation of a professional education and training company was initiated (SWA Software Akademie AG). The goal was twofold:

- To offer high-quality training courses and seminars for IT personnel, and
- To offer courses of longer duration to enable university graduates of other disciplines to take over responsibilites in the IT business.

...initiating a qualification campaign...

SWA was designed to work in close cooperation with existing professional training providers and, in particular, with IESE/KSTW.

As a preparatory step to the foundation of SWA and the start-up of KSTW, the following studies were performed:

- More than 200 companies in the region were interviewed in order to find out their recruitement and training requirements in the areas of Software Development, Internet/Intranet/Multimedia, SAP, Databases, Operating Systems/Networks, and areas such as Sales/Customer Support/Project Management. Most of the companies had the highest demand in the areas of Software Development, Databases, and Sales/Customer Support/Project Management. The most prominent result was the demand for software developers/software engineers: Two thirds of the interviewees had an urgent demand for this job profile.
- To verify and, possibly, enhance this study, an additional internet study was performed. 221 online job advertisements were viewed with similar results and the same outstanding demand for software developers.
- In order to gather more detailed information in the area of Software Engineering, another 85 enterprises were interviewed. The purpose of this study was to find out their most urgent problem areas, their demand for Software Engineering competence, and which kind of competence they would expect (information, consulting, training, tool support). The interviewees reported problems mainly in documentation and requirements and requested competence in testing, requirements, documentation, design, and quality management, mainly of the type "information".

As one immediate result, a decision was made to design two different re-education courses for unemployed university graduates: Specialists for software documentation and OO software developers in the area of insurance. Both courses were prepared in close cooperation with companies that, for the most part, were recruited from the interviews. It was thereby assured that the participants would be precisely trained for the participating companies purposes, that all participants would go through an internship program and would, finally, have excellent job opportunities.

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* Kompetenzzentrum für Softwaretechnologie und Weiterbildung

Centers in the US show the international engagement of Fraunhofer-Gesellschaft. In the area of Software Engineering, the Fraunhofer Center for Experimental Software Engineering, Maryland is the competent partner for software developers and researchers in North America.

Fraunhofer-Center for Experimental Software Engineering, Maryland

Roots

In 1984, Dr. H. Dieter Rombach joined the department of Computer Science at the University of Maryland in order to work with Professor Victor R. Basili and the Experimental Software Engineering Group, and in 1985 he became a professor in the department. In 1992, Professor Rombach returned to Germany to assume the professorship in software engineering at the University of Kaiserslautern. In 1996, Professor Rombach became director of the new Fraunhofer Institute for Experimental Software Engineering.

About the same time, Fraunhofer Gesellschaft, the parent organization to the Fraunhofer Institutes, decided to establish linkages with universities in the United States and to foster collaborative activities with U.S. corporations. In 1994, the Fraunhofer Gesellschaft established Fraunhofer USA, with headquarters in Ann Arbor, Michigan, as the mechanism for this collaboration. Separate centers would be set up in the United States, each center affiliated with both a local American university and one of the Fraunhofer Institutes in Germany.

Happy about a dream fulfilled:
Prof. Dr. Vic Basili,
Executive Director of FC-MD

Prof. Rombach and Prof. Basili looked at the establishment of Fraunhofer USA as a means to continue their years of successful collaboration. Negotiations between these two principals and the Fraunhofer Gesellschaft, the state of Maryland, and the University of Maryland began in early 1997. Preliminary activities for this new Fraunhofer Center - Maryland began in October, 1997 and the first employees were added to the Fraunhofer payroll on January 1, 1998. On February 25, 1998, the Fraunhofer Center - Maryland had its official opening with attendees from Fraunhofer Gesellschaft, the German government, the State of Maryland, and University of Maryland officials.

In December, the Fraunhofer Centers adopted a new naming convention that highlights their areas of expertise. The Maryland Center became the Fraunhofer Center for Experimental Software Engineering, Maryland (FC-MD), thus further emphasizing its linkage with IESE. It is now a thriving member of the Fraunhofer USA family of centers.

Fraunhofer Locations in the United States

Paradox of a symbolic action:
Prof. Dr. Dieter Rombach cuts a ribbon and thereby establishes a connection between Kaiserslautern and Maryland. On his right: James T. Brady (Maryland Secretary of Business and Economic Development; on his left (in order of appearance): Prof. Dr. Vic Basili, Dirk Meints Polter, Joe Page (Ex-Mayor of College Park). Prof. Dr. Jürgen Zöllner watches the ceremony.

...improving the quality of software...

Vision and Mission

The Fraunhofer Center for Experimental Software Engineering, Maryland (FC-MD) is the first Fraunhofer USA unit in the US to specialize in software development and maintenance, with a focus on the use of experimental approaches to introduce innovative techniques into industry. FC-MD is a US, not-for-profit, software engineering applied research and technology transfer organization. Its primary focus is to improve the quality of software related products and services by working directly with organizations, learning about their particular business needs, and tailoring software improvement to those needs.

Staff of the Fraunhofer Center for Experimental Software Engineering, Maryland:
From left, front - Ron Lear, Vic Basili, Rose Pajerski
from left, back - Carolyn Seaman, Cheryl Wall, Marv Zelkovitz

Perspective and Agenda

Software development is an activity not often well understood, especially with respect to the role that software plays in a company's business strategy. Too often, software is late to deliver, over budget, and unreliable. Competitive companies are continually looking for ways to better control, manage, predict, and evaluate their software efforts. Standard solutions, such as ISO 9000 certification or a Software Capability Evaluation, are often proposed to these problems without an accompanying understanding of their effect on the business product. Companies need to adapt effective processes to their own environment and the FC-MD will use its expertise to help organizations customize solutions. FC-MD believes that its unique expertise and experience-based program combine to make it a market leader in the delivery of customized process solutions to companies.

FC-MD emphasizes software engineering, software development practices, and software processes using application development, feedback, and learning as the basis for improving software development technologies for its client organizations. By using this proven approach, the FC-MD enables its clients to become more competitive in critical information technology fields. Global, national, and Maryland-regional companies are all potential clients for FC-MD.

Negotiating contract issues between the FC-MD and University of Maryland (UM) representitives are (from left): Marv Zelkowitz (FC-MD), Brian Darmody (UM), Erica Magrum (UM), Herb Rabin (UM), and Vic Basili (FC-MD)

Competencies and Offerings

The Fraunhofer Center for Experimental Software Engineering, Maryland supports organizations committed to research and development in the discipline of software engineering and its enabling technology. It facilitates collaborative activities between these companies and the University of Maryland's Computer Science Department and other academic partners. The core competencies of FCMD lie in the areas of technology transfer and process and product improvement.

As technology transfer agents, FCMD facilitates transferring a specific process technology into a project using the following support activities:

- Provide an initial evaluation of client software environment and organization using questionnaires to qualitatively and quantitatively describe the project's software products and processes.
- Recommend a specific process technology to transfer into practice based on the business goals and problem areas identified. Integrate the new technology into the project's existing processes and provide technology training.
- Collect study data (objective measures and subjective impressions) from the project and analyze the impact of the new technology on both the product and the process. Tailor the resultant process based on feedback received and continue to evolve the technology for the organization from project to project.

Process and product improvement focuses on establishing Experience Factories in organizations and across an entire company. Support activities include the following measures:

- Characterize and evaluate client software environment by conducting a detailed software product and process survey. Evaluate the organization's business goals, structural elements, and infrastructure systems with respect to the Experience Factory model. Recommend new software development technologies and any organizational changes needed to facilitate the changes. Use and leverage existing processes by tailoring the new technologies to operate within the existing environment.
- Based on business goals and experimental plans, select pilot projects and provide technology training to study participants. Collect study data (objective measures and subjective impressions) from the projects and analyze the impact of the new technology on both the product and the process.
- Using the measures from multiple project applications of the new technology, build and/or refine the organization's models for errors, cost estimation, and schedule. Recommend further management measures and analysis techniques to assure the continuing success of the process changes.
- Support building local and companywide experience bases to allow the organization to transfer new technologies to other projects and divisions.

Scientific and Industrial Activities

FC-MD is actively supporting two major projects and developing proposals for others.

Software Experience Center

The goal of the Software Experience Center (SEC) consortium, a joint project with IESE, is to improve the software competencies and development practices of its member companies in a multi-step approach. The Fraunhofer organizations will organize and facilitate the exchanges of the SEC members to improve their capabilities as learning organizations to:

- establish an Experience Base (EB) for cross-company sharing and learning,
- consolidate the experiences of all the member organizations to distribute proven, effective technologies and measure their impact on process and product,
- freely exchange information across companies on how to build effective learning organizations, how to integrate the learning organizations with existing improvement efforts, and how to share best practices.

In 1998, the SEC project completed the pre-study phase with several companies. In 1999, the SEC project will move into active support of the member companies that join the SEC consortium. Please see page 46 for further information about this project.

Software Industry Consortium

The goal of the Software Industry Consortium (SWIC) Project, in conjunction with the Maryland Department of Business and Economic Development, is to provide a software engineering resource to assist Maryland organizations in advancing the practices of system and software engineering and in improving the quality of their software related products and services by:

- integrating research and experience into practical improvement,
- creating opportunities to develop and disseminate improvement practices,
- enhancing the competitiveness of member companies, especially small to mid-size companies,
- accelerating new software technology adaptation,
- leveraging member company experience
- promoting inter-corporate cooperation of member organizations,
- providing education and training.

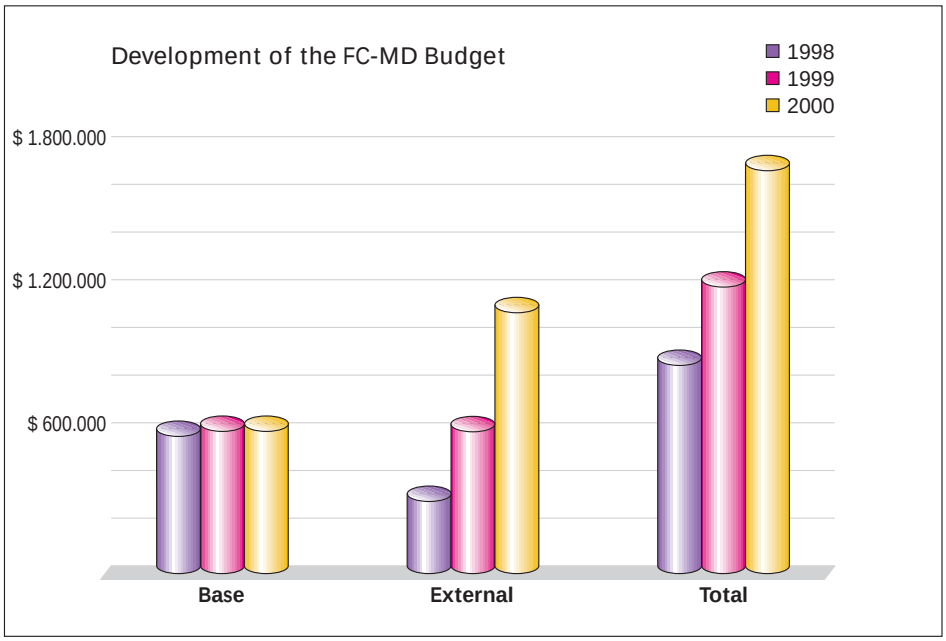
Project Proposals

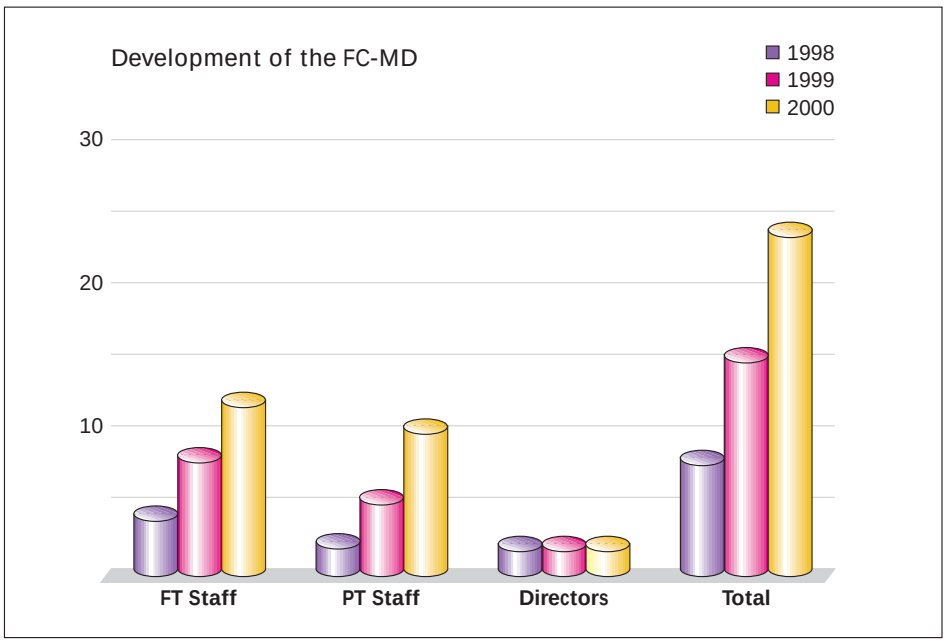
Proposals for additional work are being developed for data analysis and process and product improvement support for several organizations including the NASA Independent Verification and Validation Facility in West Virginia and the Data Analysis Center for Software in New York.

FC-MD in Figures

The Center has grown from three to eight staff members in 1998 and expects to double its size next year.

The Center generated over 35% of its revenue from new agreements with government and industry sources in the first year.





Steering Committee Board (initial Members)

Dr. Dirk Meints Polter
Senior Vice President
Fraunhofer-Gesellschaft

Dr. James D. Fielder Jr.
Acting Secretary
Maryland Dept. of Business & Economic Development

Professor Dieter Rombach
Director
Fraunhofer Institute for Experimental Software Engineering

Mr. Pete Bracken
CEO/President
ACS Incorporated

Mr. Lynn Wright
Vice President of
Engineering & Technology
Lockheed Martin Mission Systems

Mr. George Myerson
Vice President
Computer Sciences Corporation

Mr. Frank Herman
GEC-Marconi

General Emmett Paige, Jr.
President & Chief Operating Officer
OAO Corporation

Dr. Richard H. Herman
Dean, College of Computer, Math & Physical Science
University of Maryland

References

- ABB
- ACS
- Alcatel (F)
- ARINC
- Computer Sciences Corporation
- Computer Technology Associates
- DaimlerChrysler AG
- Diversified International Sciences Corporation
- Dyncorp
- Ericsson (S)
- GEC Marconi
- HCIA
- Litton Amecon
- Lockheed Martin
- Mantech
- Motorola (USA)
- OAO
- PSI
- Q-Labs, Inc. (USA)
- RSI
- Siemens AG
- Veda

- Maryland Department of Business and Economic Development

Research Partners

- Experimental Software Engineering Group, University of Maryland, Maryland
- NASA Independent Verification & Validation Facility, West Virginia
- Software Engineering Laboratory, NASA Goddard Space Flight Center, Maryland
- University of West Virginia

Membership in Professional Organizations

- Maryland High Technology Council
- Prince Georges County High Technology Business Council
- International Software Engineering Research Network (ISERN)
- Computer Research Association

Offering advice arround the table to FC-MD Execute Director Vic Basili (standing left rear) are FC-MD Steering Committee members: (sitting from left) Vernon Thompson (Maryland Department of Business and Economic Development), Lynn Wright (Lockheed Martin), James Fielder (Maryland Department of Business and Economic Development), Peter Bracken (ACS), Frank Herman (GEC-Marconi), George Myerson (Computer Sciences Corporation), Emmett Paige (OAO), Dieter Rombach (Fraunhofer IESE), Dirk Meints Polter (Fraunhofer USA), and (standing right rear) Richard Herman (University of Maryland)

Events

- Fraunhofer Center for Experimental Software Engineering, Maryland Grand Opening, February 25

  Special guests:
  - Dr. Dirk Meints Polter, President, Fraunhofer USA
  - Dr. Dieter Rombach, Director, Fraunhofer IESE
  - Dr. Jürgen Rüttgers, German Federal Minister of Education, Research, Science and Technology
  - Prof. Günter Warnecke, President, University of Kaiserslautern
  - John Willis, Maryland Secretary of State
  - James Brady, Maryland Secretary of Business and Economic Development
  - Dr. William Kirwan, President, University of Maryland

- 1st FC-MD Steering Committee Meeting, June 24

- 2nd FC-MD Steering Committee Meeting, December 16

Visitors Hosted

- Thomas McGibbon, ITT Industries, Data Analysis Center for Software, New York, USA, March 16

- Theo von Bomhard and Johannes Maier, Robert Bosch GmbH, Germany, March 18-19

- Ara Kouchakdjian, Software Engineering Technology, Inc./Q-Labs, August 31

- Dr. Louis Blazy, NASA IV&V Center, West Virginia, October 14

- Lars Halkjaer, SAXoTech A/S, Denmark, October 26

- Anthony Vernucci, MITRE, Virginia, September through December

Professional Activities

- M. Zelkowitz, Editor, Advances in Computers, Academic Press, London, volumes 46 and 47, 1998

- V. Basili, Program Committee, International Conference On Software Reuse, 97-98

- V. Basili, Program Committee, Achieving Quality in Software (AQUIS), 97-98

- M. Zelkowitz, Program Committee, 10th Software and Knowledge Engineering Conference, June 1998

- M. Zelkowitz, Program Chair, 5th International Symposium on Software Metrics, November 1998

- V. Basili, Chair, Workshop Symposium for IT A&D Program, October-November 1998

Presentations and Tutorials

- M. Zelkowitz, Florida Atlantic University, March 1998
- V. Basili, Keynote, SEPG'98, March 1998
- M. Zelkowitz, Keynote presentation, MITRE Software Engineering Symposium, April 1998
- V. Basili, University of California at San Diego, March 1998
- V. Basili, 20th International Conference on Software Engineering, ICSE'98, April 1998
- V. Basili, Washington DC Quality Assurance Association WDC-QAA, May 1998
- M. Zelkowitz, Panel Member, 10th Software and Knowledge Engineering Conference, June 1998
- R. Lear, Software Industry Consortium Kickoff, July 1998
- V. Basili and R. Pajerski, Experience Factory Tutorial, September 1998
- V. Basili and R. Pajerski, Software Experience Center, October 1998
- V. Basili, 23rd Software Engineering Workshop, NASA/Goddard SEL (SEL), December 1998

Publications

Tesoriero, R. and Zelkowitz, M.V.:
A Model of Noisy Software Engineering Data (Status report);
International Conf. on Soft. Eng., Kyoto, Japan, April 1998

Zelkowitz, M. V. and Wallace, D.:
Experimental models for validating computer technology;
IEEE Computer 31, 5, May 1998

Briand, L., Kim, Y-M., Melo, W., Seaman, C., and Basili, V.:
Q-MOPP: Qualitative Evaluation of Maintenance Organizations, Processes, and Products; Journal of Software Maintenance, Volume 10, no. 4, pp 249-278, July-August 1998

Seaman, C.B. and Basili, V.R.:
Communication and Organization: An Empirical Study of Discussion in Inspection Meetings; IEEE Transactions on Software Engineering, July-August 1998

Tesoriero, R. and Zelkowitz, M.V.:
WebME: A web-based tool for data analysis and presentation; IEEE Internet Computing, September 1998

Briand, L., Morasca, S., and Basili, V.R.:
Defining and Validating Measures for Object-based High-level Design; IEEE Transactions on Software Engineering, September-October 1998

Zelkowitz, M. V. and Wallace, D.:
Validating the benefit of new software technology; Software Quality Practitioner, November 1998

Mendonca, M.G., Basili, V., Bhandari, I. S., and Dawson, J.:
An Approach to Improving Existing Measurement Frameworks;
IBM Systems Journal, Vol. 37, No. 4, pp 484-501, November 1998

Basili, V.R., Lanubile, F., and Shull, F.:
Investigating Maintenance Processes in a Framework-Based Environment;
Proceedings of the International Conference on Software Maintenance (ICSM'98),
Bethesda, MD, November 18-20, 1998

Lanubile, F., Shull, F., and Basili, V.R.:
Experimenting with Error Abstraction in Requirements Documents; Proceedings of the Fifth International Symposium on Software Metrics,
Bethesda, MD, November 18-20, 1998

Zelkowitz, M. V., Wallace, D., and Binkley, D.:
The culture clash in software engineering technology transfer; NASA/GSFC Software Engineering Workshop,
Greenbelt, MD, December 1998

Appendix

Network in Science and Industry

Industrial Partners

- ABB
- Alcatel Alsthom (F)
- Alcatel-SEL
- Allianz Lebensversicherungs-AG
- AEG Energietechnik GmbH
- Bosch Telecom GmbH
- Brose GmbH & Co. KG
- DaimlerChrysler Aerospace AG
- DaimlerChrysler AG
- Deutsche Bank
- Deutsche Telekom AG
- DLR
- Dräger Medical Electronics (NL)
- Ericsson Eurolab Deutschland GmbH
- Ericsson (S)
- Ericsson (USA)
- Ernst Informatik GmbH
- Etnoteam (I)
- ESA European Space Agency
- KoDa Kommunikations und Datentechnik
- Kretz Software GmbH
- Lucent Technologies GmbH
- Markant Südwest Handels AG
- Markant Südwest Software- und Dienstleistungs GmbH
- Motorola (USA)
- Q-Labs, Inc. (USA)
- Q-Labs Software Engineering GmbH
- Robert Bosch GmbH
- Schlumberger RPS (F)
- Siemens AG
- Siemens (A)
- Siemens (N)
- Società Interbancaria per l'Automazione (I)
- softTECH - Software Technologie GmbH
- software, design & management GmbH & Co. KG
- tecinno GmbH
- Tecmath GmbH
- Testo GmbH & Co.
- Videotronic
- Viva Software GmbH
- VTT Electronics

National Research Partners

- University of Kaiserslautern, Kaiserslautern, Germany (formal affiliation agreement)
- Center for Learning Systems and Applications (LSA), University of Kaiserslautern, Germany
- Institute of Computer Science, University of Stuttgart, Stuttgart, Germany

International Research Partners

- Center for Advanced Empirical Software Research (CAESAR), University of New South Wales, Sydney, Australia (formal affiliation agreement)
- Centre de Recherche Informatique de Montreal (CRIM), Montreal, Canada
- European Software Institute (ESI), Bilbao, Spain (formal affiliation agreement)
- Experimental Software Engineering Group of the University of Maryland (UMD/ESEG), College Park, USA (formal affiliation agreement)
- Federal University of Santa Catarina, Florianopolis, Brazil
- Georgia Tech University, Atlanta, Georgia, USA
- GrafP Technologies Inc., Montreal, Quebec, Canada
- Instituto per la Ricerca Scientifica e Technologica (IRST), Trento, Italy
- Semantics Designs, Austin, Texas, USA
- Software Engineering Technology Inc. (SET), Knoxville, Tennessee, USA
- Software Engineering Institute (SEI), Carnegie Mellon University, Pittsburgh, Pennsylvania, USA (formal affiliation agreement)
- Swedish Institute of Production Engineering Research (IVF)
- Software Engineering Laboratory (SEL), NASA/Goddard Space Flight Center, Greenbelt, Maryland, USA
- Software Technology Transfer Finland, Espoo, Finland
- University of Oulu, Oulu, Finland
- University of Tennessee, Knoxville, Tennessee, USA
- VTT Electronics, Oulu, Finland

International Software Engineering Research Network (ISERN)

Coordinator of ISERN since 1996: Fraunhofer IESE

Members of ISERN:

- CSIRO; Australia
- DaimlerChrysler Research Center; Germany
- Fraunhofer Institute for Experimental Software Engineering; Germany
- Lucent Technologies - Bell Laboratories; USA
- Macquarie University; Australia
- Nara Institute of Science and Technology; Japan
- Norwegian University of Technology & Science; Norway
- NTT Data Corp.; Japan
- Quality Laboratories Sweden AB (Q-Labs); Sweden
- University of Bari; Italy
- University of Hawaii; USA
- University of Kaiserslautern; Germany
- University of Maryland at College Park; USA
- University of New South Wales; Australia
- University of Rome - Tor Vergata; Italy
- University of Strathclyde; Scotland; U.K.
- VTT Electronics; Finland

Visitors hosted

Professor Alfs T. Berztiss, University of Pittsburgh, USA, January 1 - April 30

Janne Järvinen, VTT Electronics, Finnland, January 1, 1998 - June 30, 1999

Alec Doring und Hakan Wickberg, IVF Centre for Software Engineering, Stockholm, Sweden, January 29

Rick Kazman, SEI Carnegie Mellon University Pittsburgh, PA, USA, February 18 and March

Audris Mockus, Lucent Technologies, USA, March 20-21

Michel Lavallee, CRIM Computer Research Institute of Montreal, Canada, March 27

Hajimu Iida, Information Technology Center, Nara Institute of Science and Technology, Nara, Japan, June 1 – November 30

Jerome Pesant, Ericsson/Montreal, Canada, June 2

Richard Webby, CAESAR, University of New South Wales, Sydney, Australia, July 15-17

Randy L. Hackbarth, Lucent Technologies, USA, August

Professor Brian Henerson-Sellers, University of SwinburneHawthorn, Australia, October 9

Horst Degen-Hientz, Q-Labs, Germany, November 2- 6

Risto Nevalainen, Software Technology Transfer Finland, Finland, November 2- 6

David Card, Software Productivity Consortium, USA, November 2- 6

Jack McGarry, Department of Defense, USA, November 2- 6

Gregory D. Abowd, Georgia Institute of Technology, USA

Letter from a Guest Scientist

Prof. Dr. Alfs Bertziss

A sabbatical leave should have two purposes. One is to provide a pause from day-to-day pressures in which to reexamine and integrate continuing work. The other is to become exposed to new ideas. I was very fortunate that my four months at IESE advanced both these purposes. Looking back can be done anywhere, but the beautiful surroundings of Kaiserslautern gave additional stimulation. As regards new ideas, there can hardly be a more suitable place than IESE. The only problem was that there was so much of interest going on. UML turned out to be the most appropriate topic to pursue, and there I could depend on the expertise of Colin Atkinson. After returning to Pittsburgh, I have looked at ways of effectively integrating UML into the requirements specification process. Right now I am working on developing "Requirements Engineering and UML," a course that I will be teaching at the University of Stockholm in May.

Professional Contributions

Lecturing Assignments at Universities

C. Atkinson
Lecture:
Object-Oriented Software Development
Department of Computer Science,
University of Kaiserslautern,
Winter Semester 1998/1999

K.-D. Althoff
Lecture:
Konstruktion wissensbasierter Systeme zur Entscheidungsunterstützung und Diagnose
Department of Computer Science,
University of Kaiserslautern,
Summer Semester 1998

K.-D. Althoff
Lecture:
Anwendungen Fallbasierter Systeme
Department of Computer Science,
University of Kaiserslautern,
Winter Semester 1998/1999

L. Briand
Lecture:
Empirical Foundations and Quantitative Methods for Software Engineering
Department of Computer Science,
University of Kaiserslautern,
Winter Semester 1998/1999

J.-M. DeBaud
Lecture:
Domain-Oriented Software Engineering
Department of Computer Science,
University of Kaiserslautern,
Summer Semester 1998

D. Rombach
Proseminar:
Software Engineering
Department of Computer Science,
University of Kaiserslautern,
Summer Semester 1998

D. Rombach
Lecture:
Software Engineering I,
Department of Computer Science,
University of Kaiserslautern,
Winter Semester 1997/1998 and
Winter Semester 1998/1999

D. Rombach
Project Course:
Software Engineering I,
Department of Computer Science,
University of Kaiserslautern,
Summer Semester 1998

D. Rombach, Günther Ruhe
Lecture:
Software Engineering II,
Department of Computer Science,
University of Kaiserslautern,
Summer Semester 1998

D. Rombach
Project Course:
Software Engineering II,
Department of Computer Science,
University of Kaiserslautern,
Winter Semester 1997/1998 and
Winter Semester 1998/1999

D. Rombach
Seminary:
Software Engineering,
Department of Computer Science,
University of Kaiserslautern,
Winter Semester 1998

Martin Verlage
Lecture:
Softwareentwicklungsprozesse und ihre Modellierung
Department of Computer Science,
University of Kaiserslautern,
Summer Semester 1998

Journal Editorships

L. Briand:
Empirical Software Engineering:
An International Journal

K. El-Emam:
Software Process Newsletter

D. Rombach:
IEEE Software Magazine

D. Rombach:
The Journal of Systems and Software

D. Rombach:
Informatik: Forschung und Entwicklung

D. Rombach:
International Journal of Software Process: Improvement and Practice

D. Rombach:
International Journal of Empirical Software Engineering
(Associate Editor for Europe)

Committee Activities

Atkinson C.:
Co-program Chair, 2nd International Enterprise Distributed Object Computing Workshop (EDOC '98)

Atkinson C.:
PC Member, UML'98 International Workshop

Bomarius, F.:
PC Member, Conference on Quality Engineering in Software Technology CONQUEST 98

Briand, L.:
Program Committee (PC) Member, IEEE Workshop on Empirical Studies of Software Maintenance WESS'98

Briand, L.:
Tutorial Chair, IEEE International Conference on Software Maintenance, ICSM'98

Briand, L.:
Steering Committee Member, International Conference on Software Maintenance, ICSM'98

Briand, L.:
PC Member, Empirical Assessment of Software Environment Technologies EASE'98

Briand, L.:
PC Member, IEEE International Symposium on Software Reliability Engineering ISSRE'98

Girard, J.-F.:
PC Member, Working Conference on Reverse Engineering WCRE98

Paech, B.:
PC Member, GI-Workshops "Anwendung von objektorientierten Entwicklungsstrategien und deren Unterstützung durch Vorgehens-modelle"

Paech, B.:
PC member, GI-Workshop Modellierung '99

Rösch, P.:
PC Member, IEEE International Conference on Software Engineering ICSE '98; Workshop on Software Engineering over the Internet

Rösch, P.:
PC Member, Asia Pacific Web Conference APWeb '98

Rombach, D.:
Chairman, Steering Committee ICSE (International Conference on Software Engineering), from 1996 to 1998

Rombach, D.:
Member, Technologiebeirat, Rheinland-Pfalz, since 1994

Rombach, D.:
Member, Supervisory Board of the German National Research Center for Information Technology (GMD), since 1996

Rombach, D.:
Member, Advisory Board of Q-Labs, since 1996

Rombach, D.:
Head of Scientific Advisory Board of SWA Software Akademie AG, Kaiserslautern, since 1998

Rombach, D.:
Senior Member, Institute of Electrical and Electronics Engineers (IEEE), since 1996

Ruhe, G.:
PC Member, 10th International Conference on Software Engineering and Knowledge Engineering SEKE'98

Ruhe, G.:
PC Member, Workshop on Heterogene Informationssysteme (GI-Jahrestagung)

Keynotes

Rombach, D.:
Experimentation as a Vehicle for Software Technology Transfer: A Family of Software Reading Techniques, FESMA '98 Conference, Antwerpen, May 1998

Rombach, D.:
Empirische Methoden: Voraussetzung für ingenieurmäßige Software-Entwicklung (eingeladener Festvortrag), 10-Jahres-Feier, Uni Stuttgart, Fakultät Informatik, Stuttgart, November 1998

Rombach, D.:
Testing and Inspections: A Historical Perspective (invited keynote), EuroStar98, München, December 1998

Presentations

Althoff, K.-D.:
Case-Based Construction of Knowledge-Based Systems for Implementing Learning Software Organizations (in German), Invited talk, University of Halle-Wittenberg, Germany, April 1998

Althoff, K.-D.:
Tasks and Possible Usages of an Experience Base (in German), SEF Project »Knowledge Management in the Healthcare Domain«, Stuttgart, Germany, May 1998

Althoff, K.-D.:
Case-Based Reasoning and Experimental Software Engineering, Invited talk, 3rd EWCBR98, Dublin, Ireland, September 1998

Althoff, K.-D.:
Concepts for Reuse in the Experience Factory and Their Implementation for CBR-System Development, 11th FGML98, Berlin, Germany, August 1998

Althoff, K.-D.:
Operationalizing Comprehensive Software Knowledge Reuse Based on CBR Methods, 6th GWCBR98, Berlin, Germany, March 1998

Atkinson, C.:
Supporting and Applying the UML Conceptual Framework, UML'98 International Workshop, Mulhouse, France, June 1998

Atkinson, C.:
Object Technology, 5 day STI Seminar, Kaiserslautern, Germany, Nov./Dec.1998

Atkinson, C.:
Using the UML in the Development of Mission and Safety Critical Systems: The SOUND Method, ESTEC Software Engineering Round Table, Noordwyk, Netherlands, November 1998

Atkinson, C.:
Systematic, Traceable Software Development, IESE-Review Meeting, Kaiserslautern, Germany, July 1998

Atkinson, C.:
Systematic Object-Oriented Software Development, Workshop Anwendung von objektorientierten Entwicklungsstrategien und deren Unterstützung durch Vorgehensmodelle der GI-Fachgruppen 5.1.1. und 2.1.9., Frankfurt, Germany, June 1998

Becker-Kornstaedt, U.:
Understanding, Controlling, and Predicting Software Cost at DASA RIO6; final presentation of the DASA project given by Ulrike Becker-Kornstaedt, Daimler-Benz Aerospace, Abt. Raumfahrtinfrastruktur, Bremen, Germany, March 1998

Birk, A.:
Product-Focused Process Improvement, Daimler-Benz AG, Forschung und Technik, Ulm, Germany, May 1998

Birk, A.:
Experience about SE Technologies and Their Application Contexts, University of Kaiserslautern, Kaiserslautern, Germany, October 1998

Birk, A.:
Experience Management for the Application of Software Engineering Technologies, University of Maryland, College Park, Maryland, USA, November 1998

Birk, A.:
Systematic Improvement of Software Engineering Processes, Frühjahrstagung Wirtschaftsinformatik, Hamburg, Germany, February 1998

Birk, A.:
Business Impact, Benefit, and Cost of Applying GQM in Industry, International Software Metrics Symposium, Bethesda, Maryland, USA, November 1998

Birk, A.:
Applications of Measurement in Product-Focused Process Improvement, International Software Metrics Symposium, Bethesda, Maryland, USA, November 1998

Bomarius, F.:
Effizientes Qualitätsmanagement bei der Software-Entwicklung, PPS-Strategie-Workshop, Centrum für Produktionstechnik Kaiserslautern CCK, Kaiserslautern, Germany, May 1998

Bomarius, F.:
Practical Experiences Regarding Inspections, Software Experience Center Meeting, Chicago, USA, October 1998

Bomarius, F.:
Process Improvement Methods - Integrating Approaches, Software Experience Center Meeting, Chicago, USA, October 1998

Briand, L.C.:
COBRA: COst estimation, Benchmarking, and Risk Analysis, IEEE International Conference On Software Engineering (ICSE), Kyoto, Japan, May 1998

Briand, L.C.:
Software Risk and Cost Analysis (Keynote), EASE Conference, Keele, U.K, April 1998

Briand, L.C.:
Acquisition and Integration of COTS in Software Systems (Panel presentation), IEEE International Conference on Software Maintenance (ICSM), Washington, D.C., USA, November 1998

Briand, L.C.:
Quality Modeling in Object-Oriented Systems, Invited presentation at NORTEL, Ottawa, Canada, November 1998

Briand, L.C.:
A Hybrid Method for Software Cost Risk Analysis, IEEE International Conference On Software Engineering (ICSE), Kyoto, Japan, May 1998

Briand, L.C.:
Using simulation to Build Inspection Efficiency Benchmarks, IEEE International Conference On Software Engineering (ICSE), Kyoto, Japan, May 1998

Briand, L.C.:
Building Resource and Quality Models for Software Inspections, IEEE International Conference On Software Engineering (ICSE), Kyoto, Japan, May 1998

Briand, L.C.:
Predicting Fault-Prone Classes with Design Measures in Object-Oriented Systems, 9th ISSRE '98, Paderborn, Germany, November 1998

Bunse, C.:
Verification of Object-Oriented Systems, Technical University Munich, Munich, Germany, January 1998

Bunse, C.:
Systematic Refinement and Translation in OO: The SORT Approach, 1st IESE PhD-Workshop, Kaiserslautern, Germany, November 1998

Bunse, C.:
Static Structure Diagrams, Lecture, University of Kaiserslautern, Kaiserslautern, Germany, November 1998

Bunse, C.:
Large Scale Development, STI Seminar Series "Objekttechnologie", Kaiserslautern, Germany, December 1998

DeBaud, J.-M.:
PuLSE - Product Lines for Software Systems, Daimler Benz, Ulm, Germany, May 1998

DeBaud, J.-M.:
PuLSE - Product Lines for Software Systems, Robert Bosch GmbH, Kaiserslautern, Germany, July 1998

DeBaud, J.-M.:
PuLSE - Product Lines for Software Systems, European Reuse Workshop, Madrid, Spain, November 1998

DeBaud, J.-M.:
A Method for Development of Software Reference Architectures, International Software Architecture Workshop'98, Orlando, Florida, USA, November 1998

DeBaud, J.-M.:
Identifying and Evolving the Scope of Software Product Lines, ERW'98, Madrid, Spain, November 1998

El Emam, K.:
Talk on the results of Phase 2 of the SPICE Trials, seminar organized by Software Technology Transfer Finland, Helsinki, Finland, March 1998

El Emam, K.:
Talk on the interim results of Phase 2 of the SPICE Trials, ISO/IEC JTC1/SC7/WG10 meeting, Venice, Italy, March 1998

El Emam, K.:
Talk on software benchmarking research activities and the application of the benchmarks, European Software Institute, Bilbao, Spain, April 1998

El Emam, K.:
Talk on the results of Phase 2 of the SPICE Trials, Deutsches Institut für Normung e.V. (DIN) NI-7.10, Köln, Germany, April 1998

El Emam, K.:
Talk on recent results from the SPICE Trials, Johannesburg, South Africa, May 1998

El Emam, K.:
Cost Implications of Interrater Agreement for Software Process Assessments, Lucent Technologies/Bell Labs, USA, June 1998

El Emam, K.:
Talk on software process modeling and assessment using ISO/IEC 12207 and ISO/IEC 15504 (TR-2), Deutsche Bank, Frankfurt, Germany, June 1998

El Emam, K.:
The Application of Capture-Recapture Models to the Control of Software Inspections, SEI Software Engineering Symposium, Pittsburgh, USA, September 1998

El Emam, K.:
The Application of Capture-Recapture Models to the Control of Software Inspections, National Research Council (Institute for Information Technology), Ottawa, Canada, September 1998

Flege, O.:
Tutorial on Basic Principles of Object-Oriented Programming, UML and Usage of Rational Rose, 2 Days of Training for Staff at Markant-Südwest Software und Dienstleistungs GmbH, Kaiserslautern, Germany, June 1998

Freimut, B.:
Quantitative Evaluation of Capture Recapture Models to Control Software Inspections, Annual Meeting of the ISERN'98, Naperville, Illinois, USA, October 1998

Freimut, B.:
A Comparison and Integration of Capture-Recapture Models and the Detection Profile Method, Ninth ISSRE'98, Paderborn, Germany, October 1998

Freimut, B.:
Quality Assurance Technologies for the EURO Conversion - Industrial Experience, Allianz Lebensversicherungs-AG, 2nd QWE'98, Brussels, Belgium, November 1998

Girard, J.-F.:
Applying File-based Information Flow and ASE Identification to a Legacy System, 6th Reengineering Forum at the 2nd CSMR, Florence, Italy, March 1998

Hamann, D.:
A Product-Process Dependency Definition Method, Workshop on Software Process and Product Improvement at the 24th EUROMICRO Conference, Västerås, Sweden, August 1998

Hamann, D.:
Experience with explicit modeling of relationships between process and product quality, 4th SPI'98, Monte Carlo, Monaco, December 1998

Hübsch, V.:
Studien zur Sicherheit der Vermittlungssysteme, Treffen des Arbeitskreises Netzsicherheit, Darmstadt, Germany, May 1998

Hübsch, V.:
Sicherheit digitaler Vermittlungssysteme, Präsentation bei o-tel-o, Düsseldorf, Germany, July 1998

Hübsch,V.:
Studien zur Sicherheit der Vermittlungssysteme, Treffen des Arbeitskreises Netzsicherheit, Darmstadt, Germany, September 1998

Kamsties, E.:
A Framework for Empirical Studies with Requirements Specification Techniques, RENOIR Research Training, Bommerholz, Germany, January 1998

Kamsties, E.:
Empirische Untersuchung von Ansätzen des Requirements Engineerings, RENOIR Meeting (co-located with GI Fachgruppentreffen 2.1.6.), Paderborn, Germany, September 1998

Kamsties, E.:
Requirements Engineering in Small and Medium Enterprises: State-of-the-Practice, Problems, Solutions, and Technology Transfer. 1st Conference on European Industrial Requirements Engineering, London, October 1998

Kamsties, E.:
Anforderungsanalyse und -spezifikation, STI-Seminar, Kaiserslautern, Germany, November 1998

Kamsties, E.:
Anforderungsanalyse und –spezifikation – Voraussetzung für Softwarequalität, STI-Jahrestagung, Kaiserslautern, Germany, November 1998

Kamsties, E.:
Requirements Engineering – Die Basis für Softwarequalität, 144. PTB-Seminar "Softwarequalitätssicherung in der Metrologie", Physikalisch-Technische Bundesanstalt Berlin, Germany, November 1998

Knauber, P.:
Entwicklung und Analyse von Software-Architekturen illustriert am Beispiel von Übersetzern, TU Darmstadt, Darmstadt, Germany, June 1998

Knauber, P.:
PuLSE - Product Lines for Software Systems, TLC, Frankfurt, Germany, June 1998

Knauber, P.:
PuLSE - Product Lines for Software Systems, Robert Bosch GmbH, Frankfurt, Germany, October 1998

Laitenberger, O.:
Fehlerreduktion durch Inspektionen, STI-Seminar, Kaiserslautern, Germany, April 1998

Laitenberger, O.:
Fehlerreduktion durch Inspektionen, STI-Seminar, Kaiserslautern, Germany, October 1998

Laitenberger, O.:
Studying the Effects of Code Inspection and Structural Testing on Software Quality, The Ninth ISSRE'98, Paderborn, Germany, November 1998

Laitenberger, O.:
Evaluating the Usefulness and Ease of Use of a Web-Based Inspection Data Collection Tool, Software Metrics Symposium, Bethesda, Maryland, USA, November 1998

Paech, B.:
Requirements Management, Seminar Steuergeräte-Design im Automobilbau und in der Industrieautomation, Essen, Germany, November 1998

Pfahl, D.:
Integration of System Dynamics Modeling with Descriptive Process Modeling and Goal-Oriented Measurement, First Workshop on ProSim'98, Silver Falls, Oregon, USA, June 1998

Rombach, D.:
Positionierung des BMBF-Leitprojekts Systemtechnik Automobil, TU München, Munich, Germany, January 1998

Rombach, D.:
Continuous Improvement of Software Development Competence: Prerequisite for Future Competitiveness, Espoo & Oulu, Finland, February 1998

Rombach, D.:
Software-Prozeßverbesserung: Strategische Notwendigkeit für alle Branchen, SQM 1998, Köln, Germany, April 1998

Rombach, D.:
Workshop und Ausstellung zur Informationstechnik im Unternehmen der Zukunft, Universität Kaiserslautern, Kaiserslautern, Germany, May 1998

Rombach, D.:
Die Bedeutung von Experimenten im Software Engineering, Daimler-Benz AG, Stuttgart, Germany, June 1998

Rombach, D.:
Innovationen im Software-Entwicklungsprozeß – Anforderungsprofile und Schlüsselfähigkeiten, Robert-Bosch Kolloquium, Stuttgart, Germany, July 1998

Rombach, D.:
Experimentieren: Prototyping bei der Prozeßverbesserung, Softwaretechnik '98, Paderborn, Germany, August 1998

Rombach, D.:
3. Kuratoriumsvortrag, Kaiserslautern, Germany, September 1998

Rombach, D.:
Innovationen im Software-Entwicklungsprozeß – Anforderungsprofile und Schlüsselfähigkeiten, Robert-Bosch Kolloquium (RK 015), Stuttgart, Germany, October 1998

Rombach, D.:
Softwaretechnologie: Entscheidender Faktor für Wirtschaftswachstum, Jahrestagung der FhG Fraunhofer Gesellschaft e.V., Darmstadt, Germany, October 1998

Rombach, D.:
Software-Qualitätsmanagement – Überblick, STI-Jahrestagung, Kaiserslautern, Germany, November 1998

Rösch, P.:
The Spearmint Approach to Process Definition and Process Guidance, Workshop on Software Engineering over the Internet at the 20th ICSE'98, Kyoto, Japan, March 1998

Ruhe, G.:
How to Make Sense of Empirical Software Engineering Data – An Integrated Approach, IESE Workshop, Kaiserslautern, Germany, November 1998

Ruhe, G.:
How to Make Sense of Empirical Software Engineering Data – An Integrated Approach, Ericsson Projektbesprechung, Helsinki, Finland, October 1998

Ruhe, G.:
How to Make Sense of Empirical Software Engineering Data – An Integrated Approach, SEKE'98, San Francisco Bay, USA, June 1998

Ruhe, G.:
Measurement-based Improvement at Allianz Life Insurance, BLANKO'98, Oulu, Finland, October 1998

Ruhe, G.:
Panel Discussion: Knowledge Management in Empirical Software Engineering, SEKE'98, San Francisco Bay, USA, June 1998

Ruhe, G.:
Learning from Empirical Software Engineering Data: Prediction of Module Criticality, KISS'98, Kilpisjärvi, Finland, March 1998

Ruhe, G.:
Experimental Software Engineering: Theory and Applications, ESE, Helsinki, Finland, March 1998

Ruhe, G.:
Systematische Qualitätsverbesserung durch zielorientiertes Messen und Bewerten sowie explizite Wiederverwendung von Software-Entwicklungs-Know-how, BMBF Statusseminar, Bonn, Germany, March 1998

Ruhe, G.:
Methodische Grundlagen zur Durchführung von GQM-basierten Meßprogrammen, Allianz Lebensversicherungs-AG, Stuttgart, Germany, February 1998

Schwarz, R.:
Studien zur Sicherheit der Entgelterfassung in der Digitalvermittlungstechnik, Treffen des Arbeitskreises Netzsicherheit, Darmstadt, Germany, February 1998

Tautz, C.:
Aufbau einer Erfahrungsdatenbank, Allianz Lebensversicherungs-AG, Stuttgart, Germany, May 1998.

Tautz, C.:
Similarity-Based Retrieval of Software Engineering Artifacts: Demo for SFB 501, University of Kaiserslautern, Kaiserslautern, Germany, October 1998

Tautz, C.:
Explicit Documentation of Software Engineering Technologies: Improving Best Practices, International Conference on Software Process Improvement in Research and Education, INSPIRE-98, London, England, September 1998.

Surmann, D.:
The IESE Experience Factory, SoftQuali-Meeting, Kaiserslautern, Germany, November 1998

Verlage, M.:
Rollenspezifische Sichten großer Software-Entwicklungsprozesse, eingeladener Vortrag, Informatik Kolloquium, Universität Dortmund, Dortmund, Germany, January 1998

Verlage, M.:
From Process Design to Process Implementation, ICSP5, Chicago, USA, June 1998

Verlage, M.:
An Approach for Capturing Large Software Development Processes by Integration of Views Modeled Independently, SEKE 98, San Francisco Bay, USA, June 1998

Verlage, M.:
Prozeßverbesserung in der Praxis, Bosch Telecom GmbH, Stuttgart, Germany, June 1998

Verlage, M.:
Prozeßverbesserung in der Praxis, Bosch Telecom GmbH, Düsseldorf, Germany, July 1998

Verlage, M.:
Knowledge Management of Software Engineering Lessons Learned, SEKE 98, San Francisco Bay, USA, June 1998

Widen, T.:
A practical comparison of major domain analysis approaches - towards a customizable domain analysis framework, SEKE 98, San Francisco Bay, USA, June 98

Widen, T.:
Software Design Automation: language design in the context of domain engineering, SEKE 98, San Francisco Bay, USA, June 98

Wieczorek, I.:
COBRA - A Hybrid Model for Cost Estimation, Benchmarking, and Risk Analysis, Allianz Lebensversicherungs-AG, Stuttgart, Germany, February 1998

Wieczorek, I.:
Software Cost Modeling and Estimation, Daimler-Benz Forschung und Technik, Ulm, Germany, May 1998

Wieczorek, I.:
A Case Study in Productivity Benchmarking, Methods and Lessons Learned, ESCOM/ENCRESS, Rome, Italy, May 1998

Wieczorek, I.:
The Repeatability of Code Defect Classifications, Ninth ISSRE'98, Paderborn, Germany, November 1998

Würthner, M.:
Software Design – Häufig gemachte Fehler, und wie Sie sie vermeiden können, STI-Jahrestagung, Kaiserslautern, Germany, November 1998

Articles in Books

Names of Fraunhofer IESE and FC-MD members appear in bold.

Althoff, K.-D.; Birk, A.; Gresse von Wangenheim, C.; Tautz, C.:
CBR for Experimental Software Engineering
In: Lenz, M.; Bartsch-Spoerl, B.; Burkhard, H.-D.; Wess, S.:
Case-Based Reasoning Technology. From Foundations to Applications
Berlin : Springer-Verlag, 1998, (Lecture Notes in Artificial Intelligence; 1400)
ISBN 3-540-64572-1, pp. 235-254 : Ill.

Bergmann, R.; Althoff, K.-D.:
Methodology for Building CBR Applications
In: Lenz, M.; Bartsch-Spoerl, B.; Burkhard, H.-D.; Wess, S.:
Case-Based Reasoning Technology. From Foundations to Applications
Berlin : Springer-Verlag, 1998, (Lecture Notes in Artificial Intelligence; 1400)
ISBN 3-540-64572-1, pp. 299-326 : Ill.

El Emam, K.; Goldenson, D.R.:
Empirical Evaluation of SPICE
In: El Emam, K.; Drouin, J.-N.; Melo, W.L.:
SPICE. The Theory and Practice of Software Process Improvement and Capability Determination
Los Alamitos: IEEE Computer Society, 1998
ISBN 0-8186-7798-8, pp. 287-305 : Ill., Lit.

El Emam, K.; Marshall, P.:
Interrater Agreement in Assessment Ratings
In: El Emam, K.; Drouin, J.-N.; Melo, W.L.:
SPICE. The Theory and Practice of Software Process Improvement and Capability Determination
Los Alamitos : IEEE Computer Society, 1998
ISBN 0-8186-7798-8, pp. 357-362 : Ill., Lit.

Verlage, M.:
Modellierungssprachen für Vorgehensmodelle
In: Kneuper, R.; Müller-Luschnat, G.; Oberweis, A.:
Vorgehensmodelle für die betriebliche Anwendungsentwicklung
Stuttgart : Teubner, 1998
(Teubner-Reihe Wirtschaftsinformatik)
ISBN 3-8154-2605-7, pp. 76-94 : Ill.

Verlage, M.:
Vorgehensmodelle und ihre Formalisierung
In: Kneuper, R.; Müller-Luschnat, G.; Oberweis, A.:
Vorgehensmodelle für die betriebliche Anwendungsentwicklung
Stuttgart : Teubner, 1998
(Teubner-Reihe Wirtschaftsinformatik)
ISBN 3-8154-2605-7, pp. 60-75 : Ill., Conference

Articles in Journals

Briand, L.C.; Kim, Y.-M.; Melo, W.L.; Seaman, C.; Basili, V.R.:
Q-MOPP. Qualitative Evaluation of Maintenance Organizations, Processes and Products
In: Journal of software maintenance. Research and practice 10 (1998), Nr.4, pp. 249-278
ISSN 1040-550X

Briand, L.C.; Daly, J.; Wüst, J.:
A Unified Framework for Cohesion Measurement in Object-Oriented Systems
In: Empirical Software Engineering 3 (1998), no.1, pp. 65-117 : Ill., Lit.
ISSN 1382-3256

Briand, L.C.; Lanubile, F.; Pfleeger, S.L.; Rothermel, G.; Schneidewind, N.:
Empirical Studies of Software Maintenance. A Report from WESS'97
In: Empirical Software Engineering 3 (1998), no.3, pp. 299-307
ISSN 1382-3256

Bunse, C.; Verlage, M.; Giese, P.:
Improved Software Quality Through Improved Development Process Descriptions
In: Automatica 34 (1998), no.1, pp. 23-32 : Ill., Lit.
ISSN 0005-1098

Fusaro, P.; El Emam, K.; Smith, B.:
The Internal Consistencies of the 1987 SEI Maturity Questionnaire and the SPICE Capability Dimension
In: Empirical Software Engineering 3 (1998), no.2, pp. 179-201 : Ill., Lit.
ISSN 1382-3256

Gresse, C.; Briand, L.C.:
Requirements for the Knowledge-Based Support of Software Engineering Measurement Plans
In: Knowledge-based systems 11 (1998), no.2, pp. 125-143 : Ill., Lit.

Latum, F.v.; Solingen, R.v.; Oivo, M.; Hoisl, B.; Rombach, H.D.; Ruhe, G.:
Adopting GQM-Based Measurement in an Industrial Environment
In: IEEE Software 15 (1998), no.1, pp. 78-86 : Ill., Lit.
ISSN 0740-7459

Leippert, F.; Ruhe, G.:
An Interesting Experience at Allianz Life (Germany)
In: ESSI g-r-a-m. Newsletter of the Software Best Practice Community (1998), no.6, pp. 5 : Ill.

Rombach, H.D.; Ruhe, G.:
Das Fraunhofer Institut für Experimentelles Software Engineering. Ein Porträt
In: Informatik. Forschung und Entwicklung 13 (1998), no.4, pp. 235-240 : Lit.
ISSN 0178-3564Report

Conference Proceedings

Name of presenter appears first; names of Fraunhofer IESE and FC-MD members appear in bold.

Althoff, K.-D.; (Auriol, E.; Bergmann, R.; Bolotov, A.; Gurov, S.I.; Larichev, O.I.; Manago, M.; Wess, S.; Zhuravlev, Y.I.):
Case-based reasoning for medical decision support tasks. The Inreca approach
In: Artificial Intelligence in Medicine 12 (1998), no.1, pp. 25-41
ISSN 0933-3657

Althoff, K.-D.; (Nick, M.; Tautz, C.):
Concepts for Reuse in the Experience Factory and Their Implementation for CBR-System Development: (Fachgruppentreffen Maschinelles Lernen (FGML): 11, 1998, Berlin)
In: Wysotzki, F.; Geibel, P.; Schädler, K.; Gesellschaft für Informatik -GI-, Fachgruppe 1.1.3 Maschinelles Lernen; TU Berlin, Fachbereich Informatik: Beiträge zum Treffen der GI-Fachgruppe 1.1.3 Maschinelles Lernen. FGML-98
Berlin: Leiter der Fachbibl. Informatik, 1998
(TU Berlin. Forschungsberichte des Fachbereichs Informatik; 98,11)
pp. 48-55: Ill., Lit.

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IESE-Report 012.98/E, VIII, 40 pp., Ill., Lit.

Laitenberger, O.; DeBaud, J.-M.:
An Encompassing Life-Cycle Centric Survey of Software Inspection
IESE-Report 065.98/E, VIII, 56 pp., Ill., Lit.

Laitenberger, O.; Atkinson, C.:
Generalizing Perspective-based Inspection to handle Object-Oriented Development Artifacts
IESE-Report 057.98/E, VIII, 26 pp., Ill., Lit.

Laitenberger, O.:
Studying the Effects of Code Inspection and Structural Testing on Software Quality
IESE-Report 024.98/E, 10 pp., Ill., Lit.

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Practical Evaluation of an Organizational Memory using the Goal-Question-Metric Technique
IESE-Report 063.98/E, VIII, 24 pp., Ill., Lit.

Pfahl, D.; Lebsanft, K.; Vollei, F.:
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IESE-Report 032.98/E, VII, 32 pp., Ill., Lit.

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IESE-Report 015.98/E, VIII, 146 pp., Ill., Lit.

Tautz C.; Gresse von Wangenheim, C.:
A Representation Formalism for Supporting Reuse of Software Engineering Knowledge
IESE-Report 051.98/E, VIII, 18 pp., Ill., Lit. Uni

ISERN Reports

Names of Fraunhofer IESE and FC-MC members appear in bold.

Basili, V.R.; Briand, L.C.; Morasca, S.:
Defining and Validating Measures for Object-Based High-Level Design
Kaiserslautern 1998
ISERN Technical Report; 98-04
42 pp., Ill., Lit.

Birk, A.; Derks, P.; Hamann, D.; Hirvensalo, J.; Oivo, M.; Rodenbach, E.; Solingen, R.v.; Taramaa, J.:
Applications of Measurement in Product-Focused Process Improvement. A Comparative Industrial Case Study
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VII, 25 pp., Ill., Lit.

Birk, A.; Solingen, R.v.; Järvinen, J.:
Business Impact, Benefit, and Cost of Applying GQM in Industry. An In-Depht, Long-Term Investigation at Schlumberger RPS
Kaiserslautern 1998
ISERN Technical Report; 98-26
VI, 26 pp., Ill., Lit.

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An Assessment and Comparison of Common Software Cost Estimation Modeling Techniques
Kaiserslautern 1998
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14 pp., Ill., Lit.

Briand, L.C.; El Emam, K.; Wieczorek, I.:
A Case Study in Productivity Benchmarking. Methods and Lessons Learned
Kaiserslautern 1998
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12 pp., Ill., Lit.

Briand, L.C.; Carriere, J.; Kazman, R.; Wüst, J.:
COMPARE. A Comprehensive Framework for Architecture Evaluation
Kaiserslautern 1998
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8 pp., Ill., Lit.

Briand, L.C.; El Emam, K.; Freimut, B.:
A Comparison and Integration of Capture-Recapture Models and the Detection Profile Method
Kaiserslautern 1998
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15 pp., Ill., Lit.

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Kaiserslautern 1998
ISERN Technical Report; 98-07
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Briand, L.C.; El Emam, K.; Freimut, B.; Laitenberger, O.:
A Comprehensive Evaluation of Capture-Recapture Models for Estimating Software Defect Content
Kaiserslautern 1998
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VIII, 34 pp., Ill., Lit.

Briand, L.C.; Lounis, H.; Ikonomovski, S.; Wüst, J.:
A Comprehensive Investigation of Quality Factors in Object-Oriented Designs. An Industrial Case Study
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Briand, L.C.; Devanbu, P.;
Premkumar, M.; Walcelio, L.:
Quality Modeling based on Coupling Measures in a Commercial Object-Oriented System
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Dreyer, H.M.; Laitenberger, O.:
Automated Software Engineering Data Collection Activities via the World Wide Web. A Tool Development Strategy applied in the Area of Software Inspection
Kaiserslautern 1998
ISERN Technical Report; 98-12
13 pp., Ill., Lit.

Dreyer, H.M.; Laitenberger, O.:
Evaluating the Usefulness and the Ease of Use of a Web-based Inspection Data Collection Tool
Kaiserslautern 1998
ISERN Technical Report; 98-13
13 pp., Ill., Lit.

El Emam, K.:
Benchmarking Kappa for Software Process Assessment Reliability Studies
Kaiserslautern 1998
ISERN Technical Report; 98-02
14 pp., Ill., Lit.

El Emam, K.; Simon, J.-M.; Rousseau, S.; Jacquet, E.:
Cost Implications of Interrater Agreement for Software Process Assessments
Kaiserslautern 1998
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El Emam, K.; Madhavji, N.H.; Shostak, B.:
Implementing Concepts from the Personal Software Process in an Industrial Setting
Kaiserslautern 1998
ISERN Technical Report; 98-05
15 pp., Ill., Lit.

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The Internal Consistency of the ISO/IEC PDTR 15504 Software Process Capability Scale
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13 pp., Ill., Lit.

El Emam, K.; Wieczorek, I.:
The Repeatability of Code Defect Classifications
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15 pp., Ill., Lit.

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Success or Failure? Modeling the Likelihood of Software Process Improvement
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Kaiserslautern 1998
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Doctoral Theses

Hübsch, V.:
Transaktionsbasierter globaler gemeinsamer Speicher - Ein Modell zur verteilten fehlertoleranten Programmierung
Aachen : Shaker, 1998
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Zugl.: University of Kaiserslautern, Diss., 1997. - ISBN 3-8265-3542-1, XII, 153 pp., Ill., Lit.

Verlage, M.:
Ein Ansatz zur Modellierung großer Software-Entwicklungsprozesse durch Integration unabhängig erfaßter rollenspezifischer Sichten
Aachen : Shaker, 1998
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Zugl.: University of Kaiserslautern, Diss., 1997. - ISBN 3-8265-3273-2, XII, 211 pp., Ill., Lit.

Diploma Theses

Brockhage, K.:
Suche nach einem Verfolgbarkeitsansatz zur Verbesserung von Änderbarkeit
Department of Computer Science, University of Kaiserslautern,
Supervisors: Rombach, H.D., Differding, C., Knethen, A. von
Kaiserslautern April 1998, 116 pp., Ill., Lit.

Dreyer, H.M.:
Development and Evaluation of a Web-based Inspection Process Support Tool (WIPS)
Department of Computer Science, University of Kaiserslautern,
Supervisors: Rombach, H.D., Laitenberger, O.
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Ehresmann, M.:
Cleanroom Software Engineering for Real-Time Systems. A Combination of the Box Structure Method and Statecharts
Department of Computer Science, University of Kaiserslautern,
Supervisors: Rombach, H.D., Bunse, C., Kamsties, E.
Kaiserslautern 1998, 155 pp., Ill., Lit.

Graudejus, H.:
Implementing a Concept Analysis Tool for Identifying Abstract Data Types in C code
Department of Computer Science, University of Kaiserslautern,
Supervisors: Rombach, H.D., Girard, J.-F.
Kaiserslautern February 1998, 60 pp., Ill., Lit.

Hoffmann, O.:
Reintegration von Entwurfsdokumenten zur Unterstützung des Roundtrip Engineering in der SPEARMINT-Umgebung
Department of Computer Science, University of Kaiserslautern,
Supervisors: Rombach, H.D., Rösch, P.
Kaiserslautern February 1998, 96 pp., Ill., Lit.

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A System for Knowledge Management of Best Software Engineering Practice
Department of Computer Science, University of Kaiserslautern,
Supervisors: Rombach, H.D., Birk, A., Althoff, K.-D.
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Nick, M.:
Implementation and Evaluation of an Experience Base: Concepts for the Evaluation of an Experience Factory. Evaluation with the GQM Approach. Implementation
Department of Computer Science, University of Kaiserslautern,
Supervisors: Rombach, H.D., Althoff, K.-D., Tautz, C.
Kaiserslautern February 1998, 148 pp., Ill., Lit.

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Generation of Hypertext User Documentation from Usage Models
Department of Computer Science, University of Kaiserslautern,
Supervisors: Rombach, H.D., DeBaud, J.-M., Jungmayr, S.
Kaiserslautern 1998, 133 pp., Ill., Lit.

Wolf, T.:
State of the Art in Software Engineering Environments (SEEs)
Fachhochschule Kaiserslautern,
Supervisors: Rösch, P., Huber, M.
Kaiserslautern 1998, 88 pp., Ill., Lit.

Master Theses

Broome, M.:
Requirements and Implementation Approaches for an Experience Base
University of Lund
Supervisors: Runeson, P., Tautz, C., Surmann, D., Degen-Hientz, H.
(Lund Institute of Technology, Department of Communication Systems; Fraunhofer Einrichtung für Experimentelles Software Engineering -IESE-, Kaiserslautern)
Lund, 1998, 104 pp., Ill., Lit.

External

Martin Würthner:
Preis der Freunde der Universität Stuttgart für besondere wissenschaftliche Leistungen; awarded by the Vereinigung der Freunde der Universität Stuttgart on the occasion of its 75th year of existence jubilee celebration, Stuttgart, Germany, October, 1998

Internal

Andreas Birk
The Fraunhofer IESE 1998 Award for Project Excellence

Ralf Kempkens
The Fraunhofer IESE 1998 Award for Project Excellence

Betram Recktenwald
The Fraunhofer IESE 1998 Award for Infrastructure Excellence

Stephan Thiel
The Fraunhofer IESE 1998 Award for Infrastructure Excellence

Carsten Tautz
The Fraunhofer IESE 1998 Award for Research Excellence

Isabella Wieczorek
The Fraunhofer IESE 1998 Award for Research Excellence

Kerstin Brockhage
The Fraunhofer IESE 1998 Award for Thesis Excellence

Markus Nick
The Fraunhofer IESE 1998 Award for Thesis Excellence

Chronicle (highlights)

January 22

Presentation by Alfs Berztiss, Title: "Design Reuse For Families of Software Systems"

February 25
Opening of the Fraunhofer Center for Experimental Software Engineering, Maryland

March 23
Visit by a delegation of Social Democratic Party (SPD) members of the Rhineland-Palatinate state parliament.

From left to right: Prof. Dieter Rombach, Ruth Leppla, Dr. Martin Walter Ruf, Hildegard Rogel, Walter Freitag, Harald Brandstädter

March 19-25
Presentation of services and highlights on the CeBit '98 in Hannover, Germany.

Dr. Peter Knauber talking to a visitor

April 1-3
SQM '98, Cologne

Keynote speaker Prof. Dieter Rombach giving a talk on "Software Process Improvement - A Strategic Necessity for all Branches"

June 4
Visit by a delegation from the State of Maryland.

From left to right: Anders Gustavsson (Q-Labs), Charles Talley (OAO Corp.), Vic Basili, Sonnhild Namingha, Dieter Rombach, James L. Hughes, Helga Weschke, Antonia Monster

James L. Hughes, Maryland Department of Business and Economic Development, presents a certificate to Prof. Dieter Rombach

June 16
Visit by a delegation of the Christian Democratic Party of Rhineland Palatinate (CDU).

From left to right: Hans-Josef Bracht, Marlies Kohnle-Gros, Bernhard J. Deubig, Dr. Georg Gölter, Prof. Dr. Rombach, Dr. Josef Rosenbauer, Christoph Böhr

June 6
Success at the Fraunhofer Soccer Tournament in Braunschweig:
4th place for the team from Fraunhofer IESE.

Top row from left to right: Volker Hübsch, Dirk Hamann, Peter Rösch, Erik Dick, Sarah Bügler, Frank Huber, Martin Würthner; bottom row: Johannes Krüger, Dirk Muthig, Drazen Cindric, Stephan Thiel, Marcel Dörr

July 9-10
Evaluation of the Fraunhofer IESE.

After two days of presentations and discussions: Reviewers and leading members of the Fraunhofer IESE meet for a commemorative photograph in front of the IESE main building. From left to right: Dr. Lionel Briand, Dr. Frank Bomarius, Prof. Dr. Jürgen Nehmer, Mike Dyer, Prof. Dr. Victor Basili, Prof. Dr. Dieter Rombach, Dr. David Weiss, Klaus-Steffen Isensee, Prof. Dr. Ernst Denert, Dr. Ulrich Buller, Prof. Dr. Peter Freeman, Prof. Dr. Werner Mellis, Dr. Jean-Marc DeBaud, Dr. Günther Ruhe

September 15
Visit by the speaker for research-related politics of the Social Democratic Party group in the German Parliament, Edelgard Bulmahn (since October 1998 Federal Minister of Education and Research), and the SPD Member of Federal Parliament from Kaiserslautern, Dr. Hansjörg Schäfer

From left to right: Edelgard Bulmahn, Dr. Hansjörg Schäfer, Prof. Dr. Dieter Rombach

October 9
Presentations by Professor Henderon-Sellers, Swinburne University of Technology, Melbourne, Australia on "OPEN object-oriented methodology" and "Introducing an OO Metrics Programme to an Organization Transitioning to OO"

November 2-6
Seminar "Software Cost and Quality Measurement in Practice". External presenters: Horst Degen-Hientz, (Q-Labs, Germany), David Card (Software Productivity Consortium, USA), Risto Nevalainen (Software Technology Transfer Finland, Finland)

November 9
Presentation by Chris Lott, Bellcore, USA, on "Automated Test Generation"

November 11
Visit by Fact-Finding Delegation from the Vietnamese Department of Research and Environment MOSTE.

From left to right: Dr. Ingmar Schmidt (DLR), Nguyen Trung Quynh, Do Van Giap, Hoang Kim Sang, Dr. N. Dinh Ngoc, Prof. Dr. Dieter Rombach, Dr. Frank Bomarius

November 11
Presentation of a Study on the Demand for Software Qualifications, conducted by the Fraunhofer IESE on behalf of the Kaiserslautern Economic Development Agency (WFK).

From left to right: Barbara Jörg (WFK), Mayor Gerhard Piontek, Prof. Dieter Rombach

November 18-19
STI Annual Meeting. External Presenters: Prof. Dr. Per Runeson, Dr. Dirk Meyerhoff, Dirk Stelzer, Werner Schirp, Lothar Cochems

Oliver Laitenberger (Fraunhofer IESE) giving a lecture on "Inspections - an Efficient Method for Reduction of Faults in Code and Documents"

Prof. Dr. Per Runeson (University of Lund, Consultant at Quality Laboratories Sweden AB), giving a lecture on "Systematic Testing - how does it work, what is the appropriate method for your company?"

December 11
Full house! Members of Fraunhofer IESE collected a Christmas donation for the Malteser Hilfswerk Kaiserslautern

December 14
Presentation by Terry Rout, Griffith University, Australia, on "A Strategy for National Software Process Improvement in Australia"

Media Coverage

Media Coverage of the Fraunhofer IESE Reports and articles about the Fraunhofer IESE have been published in the following media:

- Berliner Morgenpost, 02-27-1998
- Computerzeitung, 03-12-1998
- ddp/ADN, 02-25-1998
- Deutschland Germany, 06-03-1998
- dpa lrs,
  02-25-1998
  02-25-1998
  08-26-1998
  09-04-1998
  09-15-1998
- Frankfurter Allgemeine Zeitung,
  02-23-1998
  03-07-1998
- Generalanzeiger, 08-27-1998
- IHK Journal, No. 5/1997
- Industrie Anzeiger, 06-02-1997
- Die Kitzinger, 02-26-1998
- Kölnische Rundschau, 02-28-1998
- Mainzer Rhein-Zeitung, 03-12-1998
- Mannheimer Morgen, 02-26-1998
- MM-Maschinenmarkt, 05-25-1998
- Nordsee-Zeitung, 02-26-1998
- Nordwest-Zeitung, 03-07-1998
- Outlook, 03-03-1998
- Pirmasenser Zeitung,
  02-27-1998
  12-04-1998
  12-10-1998
- Die Rheinpfalz,
  01-27-1998
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  07-29-1998
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  11-09-1998
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  11-19-1998
  11-27-1998
  12-22-1998
- Stuttgarter Zeitung, 02-27-1998
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- Der Tagesspiegel, 02-26-1998
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  Gothaer Allgemeine, 02-26-1998
- Trierischer Volksfreund Trierer
  Stadt-Zeitung,
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  04-18-1998
- Uni-Spectrum Kaiserslautern,
  No. 2/1998
- VDI-Nachrichten, 04-17-1998
- Westricher Rundschau, 12-30-1998
- Wirtschaftsinfo Kaiserslautern,
  Juli 1998
- Wirtschaftsmagazin Pfalz,
  No. 3/1998

The Fraunhofer-Gesellschaft

The Research Organization

The Fraunhofer-Gesellschaft is the leading organization of applied research in Germany. It operates 47 research institutes in Germany with about 9,000 employees, about half of them scientists and engineers. The Fraunhofer-Gesellschaft is expanding into a worldwide Organization, especially in the USA and Asia. Home of the Fraunhofer-Gesellschaft is Munich.

One of the goals of the Fraunhofer company policy is rapid transfer of innovations.

Total expenditure for 1996 reached a level of approximately 1.3 billion DM; more than two-thirds of this amount is earned through contracts from industry and the public sector (>50% of the industrial earnings come from small- and medium-sized enterprises). International activities are increasingly important. Apart from the collaboration with numerous companies and research establishments within Europe, the Fraunhofer-Gesellschaft operates resource centers and research units in the United States. The Fraunhofer-Management-Gesellschaft mbH (FhM) was founded as a subsidiary company in 1990.

The name Fraunhofer-Gesellschaft was chosen in reference to the researcher, inventor, and entrepreneur Joseph von Fraunhofer (1787 - 1826), who won high acclaim for his scientific and commercial achievements.

The Research Fields of the Fraunhofer-Gesellschaft

Eight fields form the core of Fraunhofer research:

- Materials and Components
- Production Technology
- Information and Communication
- Microelectronics and Microsystems
- Sensor Systems, Testing Technologies
- Process Engineering
- Energy, Environment, Health
- Technical and Economic Studies

Apart from research services, certified test beds and other facilities can also be provided.

Advantages of Contract Research with the Fraunhofer-Gesellschaft

- More than 2,600 experts are available for the development of complete systems.
- All developments are based on profitability considerations.
- The Fraunhofer-Gesellschaft collaborates with various renowned companies whose research contracts have resulted in successful products.
- Modern laboratory equipment and scientific aids such as project management and internationally linked communications systems enhance the quality of the research work.
- Detailed project reports, instructions for use, staff training, and complete introduction strategies for new technologies round off the contract research services.
- Reliability, continuity and service of a large organization are available to all companies.

Collaboration with the Fraunhofer-Gesellschaft

Contract research with the Fraunhofer-Gesellschaft has advantages for all companies. Orders come from all branches of industry and companies of all sizes. The institutes' facilities are particularly recommended for small businesses who can take advantage of Fraunhofer research when their own capacities are not sufficient to make the technical innovations necessary to stay competitive. We would be glad to provide further information on subsidy programs for small businesses.

Executive Board
(as of December 31, 1998)

Prof. Dr.-Ing. Dr. hc. mult. Hans-Jürgen Warnecke (President)
Dr. jur. Dirk-Meints Polter (Personnel and Legal)
Dr. rer. pol. Hans-Ulrich Wiese (Finance)

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Fraunhofer Locations

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E-Mail: info@iese.fhg.de

Our web server offers up-to-date information about the institute. We invite you to visit our web site at:
http://www.iese.fhg.de

How to reach us:

by car
coming from the west (Saarbrücken) or the east (Mannheim) on highway (Autobahn) A6. Take the exit "Kaiserslautern-West" and follow the signs that read "Lauterecken". About 500 m after exiting the highway, turn left to "Siegelbach". Follow the road leading through a forest. Right after entering "Siegelbach", you turn right at the first junction into the street "Sauerwiesen". After about 100 m you find IESE on your right-hand side.

by train
from Kaiserslautern railway station either by taxi (ca. 8 km) or by bus (line RSW 6510, departing from bus stop A/2 at railway station, destination: Siegelbach) to Siegelbach; the stop "Siegelbach Sand" is about 100 m from the institute

by airplane
Airport Frankfurt/Main, either by train (about 2 hours) or by car (about 1.5 hours)

Satellite Office at PRE Park
Competence Center for Software Technology and Continuing Education
Luxemburger Str. 1+3
D-67657 Kaiserslautern
Tel: +49 (0) 631 41690 13
Fax: +49 (0) 631 41690 41
email: hoermann@iese.fhg.de
Contact: Dr. Klaus Hörmann

How to reach us:

by car
Highway (Autobahn) A6, exit Kaiserslautern-Ost
Follow signs to Kaiserslautern "Stadtmitte" on highway B40 (=Mainzer Straße). After crossing under the Autobahn, turn left in the direction of PRE-Park
Total driving time from A6 exit: approx. 2 minutes

by train
Take bus no. 2, 5, or 7 from Kaiserslautern railway station to Schillerplatz stop, change into bus no. 4, exit at PRE-Park stop. Attention: Not every bus stops at PRE-Park!
Total time: approx. 30 minutes

Satellite Office at the University of Kaiserslautern
Erwin-Schrödinger-Strasse, Geb. 57
D-67663 Kaiserslautern
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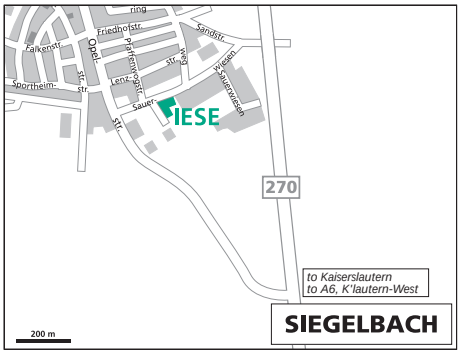
Fax: +49 (0) 631 205 3330
email: jerkku@informatik.uni-kl.de
Contact: Kristina Jerkku

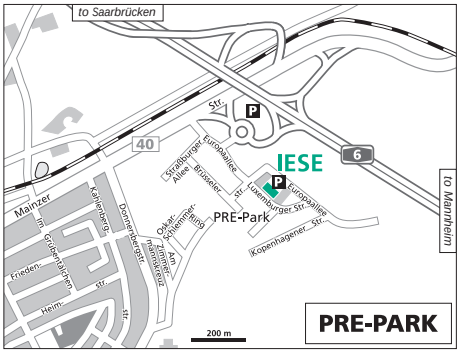
How to reach us:

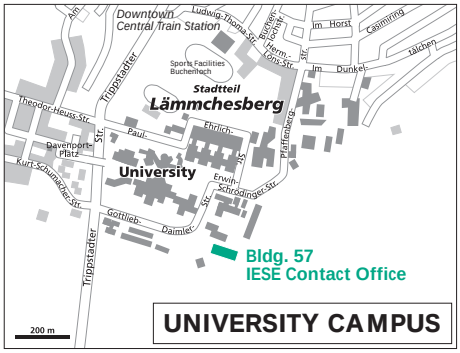
by car
Highway (Autobahn) A6, exit Kaiserslautern-West:
Follow signs to Pirmasens on highway B270; after approx. 1 km (1/2 mile) turn right onto Pariser Straße, following signs "Universität" and "Stadtmitte"; after approx. 1.5 km (1 mile) you will see a white sign "Universität" on your right. Do not take this right turn, but rather continue for another 50 m, then turn right at traffic light and follow the second sign to "Universität". The Contact Office is located in Building 57 on the fourth floor.
Total driving time from A6 exit: approx. 10 minutes

by car
Highway (Autobahn) A6, exit Kaiserslautern-Ost:
Follow signs for "Stadtmitte" on Mainzer Straße; then follow signs "Universität" (Bldg. 57, 4th floor).
Total driving time from A6 exit: approx. 15 minutes

by train
Take bus no. 5 from Kaiserslautern railway station, destination "Uni-Wohngebiet"; exit at Uni-Ost stop; walk back approx. 300 m in the opposite direction, follow signs to Bldg. 57. The Contact Office is located on the fourth floor.







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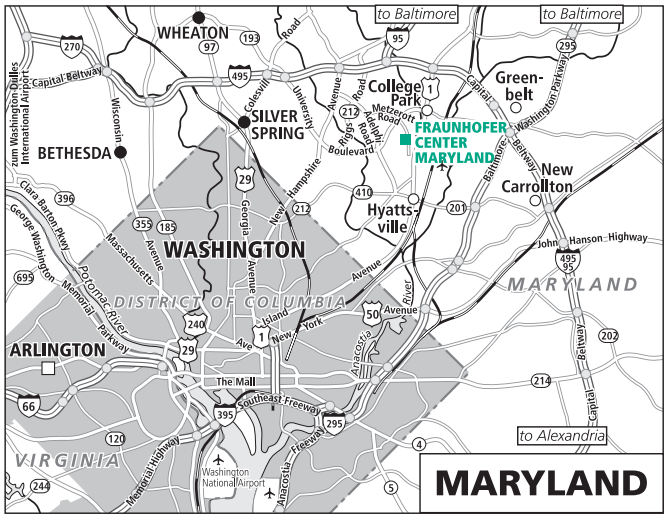

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Directions from Points North
Follow I-95 South to the point where it merges with I-495. At this point, follow the signs for Richmond (I-95/495 South). Take Baltimore Avenue (Route 1) exit 25 towards College Park.
Make a right onto 193 West.
For directions from this point on, see bottom of page!

Directions from Points South
Follow I-95 North to the point where it merges with I-495. At this point, follow the signs for Baltimore (I-95/495 North). Take Exit #25 towards College Park
Make a right onto 193 West.
For directions from this point on, see bottom of page!

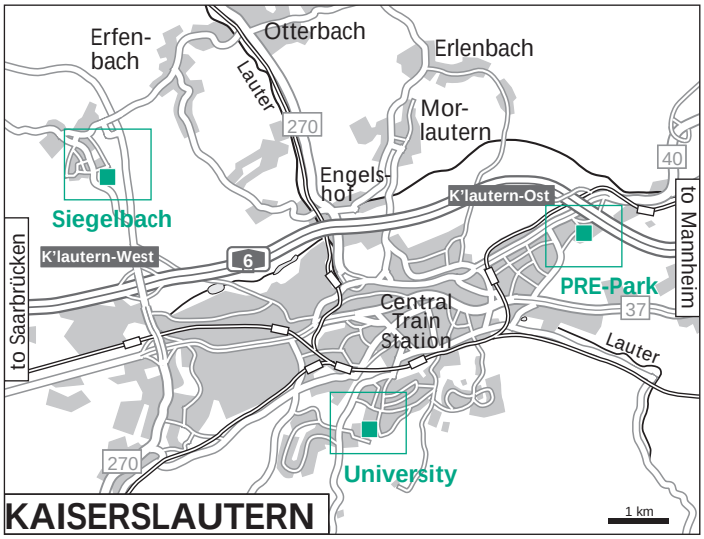
by train
From Metro station (College Park- Univ. of Maryland) 15 minute walk or taxi or by bus 83

by plane
B.W.I. Airport (about >45 minutes by car)
Exit the Airport to Route 295 South, take exit for Greenbelt Road, Maryland Route 193. At the stop sign, make a left onto South Way. Take Greenbelt Road Route 193 East. Continue onto University Blvd.
For directions from this point on, see bottom of page!

National Airport
(about 90 minutes by car)
Exit the airport towards I-395 North headed for Washington D.C.. Continue on I-395 North to New York Avenue. Turn right onto New York Avenue (US Rt-50-East) to MD Rt. 295/Baltimore-Washington Parkway for approximately 6 miles. Stay on BWI Parkway to the exit for Maryland Route 193. This is Greenbelt Road, take Route 193 East. Continue onto University Blvd.
For directions from this point on, see bottom of page!

further directions:
Make a left at the first light onto Azalea Lane. (Metzerott Rd. is to the right) (Azalea Lane turns into Paint Branch Drive)
Bear to your left around the circle past the baseball field, the dumpster, and the parking lots on the left and right hand sides.
You will then see a red brick building.
Make a right into that parking lot K4.
The name of the building is Agriculture / Life Sciences Surge Building.
We are located on the third floor.

Global View of Kaiserslautern



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Information Service

If you want to receive information material by mail, send or fax us a copy of this page.

Fraunhofer-Einrichtung für
Experimentelles Software Engineering
Sauerwiesen 6

D-67661 Kaiserslautern

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- ❒ Publication List
- ❒ STI Software Technology Initiative

Return Address

Last Name, First Name

Company

Position

Department

Address

Zip Code / City

Telephone

Fax

Date and Signature

Your data will be stored in an address database for internal processing only.

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