IESE

Fraunhofer Institut
Experimentelles
Software Engineering

Inside:
Software Development in Germany
Recent Findings

Annual Report 2000

Imprint

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Annual Report of the
Fraunhofer Institute
for Experimental Software
Engineering IESE
2000

Building of the Fraunhofer Institute for Experimental Software Engineering in Kaiserslautern

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Engineering

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Foreword

The year 2000 was marked by several important internal and external developments. The internal developments included the transition of Fraunhofer IESE to permanent institute status, a strategy discussion that lead to a re-organization of Fraunhofer IESE as well as further improvement of our customer orientation. The external developments included our growing status as a national software engineering competence center, the consequences of the merger between GMD and FhG, and the successful development of our sister organization in the U.S. Overall, 2000 has been the most successful year in the young history of our institute.

During 2000, the external project income was increased to about 80% in order to adapt to the normal Fraunhofer funding scheme of permanent institutes effective 2001. I am proud of the exceptional efforts made by all employees in order to achieve this increase of about 10% external project funding in just one year. This was achieved without sacrificing our excellence in research, which is documented by many high class publications, or in project performance documented by the high degree of repeat contracts with industry and long-term strategic collaborations. Many of the success stories are documented in this report. Another important milestone was reached when during our fifth year of operation, the first four PhDs were awarded to Oliver Laitenberger, Andreas Birk, Carsten Tautz, and Christian Bunse by the University of Kaiserslautern. They proved that successful project work is a perfect enabler of excellent research.

Triggered by our Kuratorium Fraunhofer IESE prepared itself for continued growth through a re-organization effective 01 January 2001. The old static line organization was augmented with a dynamic matrix organization of business and competence areas. First, this is expected to enable equal emphasis on personnel management via the line organization, on business areas and projects via the business area managers, and on competence build-up and research via the competence area managers. Each Fraunhofer IESE scientist is grounded in one department of the line organization, member of one (or more) competence areas, and member of projects in one (or more) business areas. This dynamic structure will not only enable faster reaction to business trends but will even allow changes in business and/or research to be anticipated. This organization also has the potential of scaling up with our expected future growth. We also have gotten the commitment of our academic and industrial Kuratorium members to serve as advisors for the competence and business area managers throughout the year. The new structure has been put in place at the beginning of 2001, has been accepted well by all employees, and is expected to make Fraunhofer IESE even more competitive, more effective for our customers, and a better workplace for all employees. I would like to thank all Fraunhofer IESE employees who have contributed to the design and implementation of this new structure.

Customer orientation has always been the number one priority of Fraunhofer IESE. In 2000 we have added a more professional marketing organization that helps create visibility for our products and services via written and electronic marketing materials, fairs and specific marketing in selected industry sectors. A professional Internet representation adds to the external visibility. I would like to recognize the dedication of our entire marketing team.

Federal government (the Ministry for Education and research - BMBF) has chosen Fraunhofer IESE as the German software engineering competence center to conduct a national study entitled 'Analysis and Evaluation of Software Development in Germany'. Partnering with institutes for market research (GfK in Nuremberg) and Systems and Innovation Research (Fraunhofer ISI in Karlsruhe), we produced a very comprehensive assessment of the status of software engineering in practice - both technology- and personnel-wise - as well as predictions on future trends and needs. Government is now using this study as a base line for future policy decisions on education and research. Besides the external reputation, this study also produced a much-improved understanding of the needs of actual and potential customers and puts Fraunhofer IESE in a better position for proactive business and competence development. I would like to thank my two collaborators on this highly visible project, Susanne Hartkopf and Kirstin Kohler, for their excellent work*.

Externally, the year 2000 was marked by the controversial integration of Fraunhofer Gesellschaft e.V. and Gesellschaft für Mathematik und Datenverarbeitung (GMD). The background for this merger was the realization that only large and highly competent research organizations will survive in the competitive global research market. Both FhG and GMD are too small wrt. information technology research competence to compete against other European competitors or competitors from the U.S. and Asia in the long term. It can be predicted that a merger of the new FhG and other European research organizations is on the mid-term horizon in order to counterbalance U.S. and Asian competition. Unfortunately, some mistakes have been made throughout the merger process, which has led to unnecessary resentments on both sides. We have always taken the position that a united FhG/GMD organization has more benefits than disadvantages. We have been working closely together with GMD institutes in the past, and we expect this cooperation to grow even closer under the new common umbrella. If we incorporate the additional GMD competencies into the new organization, and maintain the industrial reputation and interdisciplinary mix of FhG, I am very optimistic towards the future. I encourage all my colleagues to incorporate GMD competencies into future project proposals for the benefit of our customers.

The international flair of our Fraunhofer Virtual Institute for Experimental Software Engineering (FVIESE), consisting of Fraunhofer IESE in Kaiserslautern and our sister organization, the Fraunhofer Center for Experimental Software Engineering, in Maryland (FC-MD) under the leadership of Professor Victor Basili has been further strengthened during the year 2000. FC-MD has grown into one of the largest Fraunhofer centers in the U.S., consisting of about 15 full-time equivalents by the end of 2000. The excellent scientific work of FC-MD has been recognized by ACM through two highly prestigious awards given to Prof. Basili (the ACM SIGSOFT Outstanding Research Award) and to Prof. Zelkowitz (the ACM SIGSOFT Distinguished Service Award). I congratulate my two colleagues and friends. FC-MD has achieved this growth over three years without red figures. The high reputation of FC-MD in the U.S. is best demonstrated by the fact that they have received grants from NASA, NSF and other public funding agencies, from major corporations like Motorola and Lucent as well as from small local firms in the State of Maryland. FVIESE offers great opportunities for joint research and joint international industry projects. In addition, exchanges provide students and full-time employees with opportunities for personal advancement and learning.

Overall, 2000 was a very successful year. Fraunhofer IESE has matured personnel- and organization-wise. It has established itself as one of the leading competence centers in (experimental) software engineering worldwide. One of the largest concentrations of top software engineering scientists enables an exciting work environment, world-class research results, and successful industry projects. Continued commitment of all employees guarantees a continued successful future. I also want to recognize my deputy directors and the entire leadership personnel as well as the Kuratorium members for their invaluable teamwork and dedication to Fraunhofer IESE. Finally, I thank our industrial partners for their long-term trust in our competence and promise them to continue to make their needs our top priority.

Kaiserslautern, January 2001

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

* The study is available for download at "www.iese.fhg.de/software-study".

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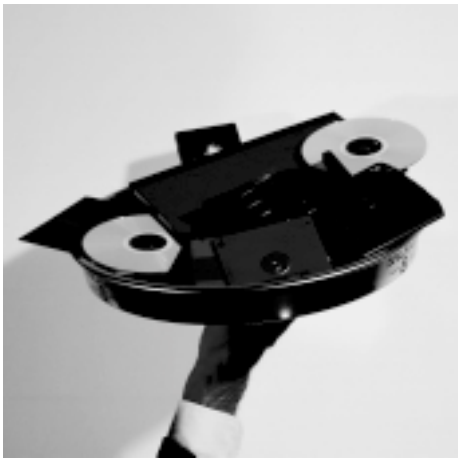

Vision and Mission

Over the past decades, software has been introduced into almost all high-tech products and services. None of them can function without software anymore, and the number of features of these products and services implemented in software is still increasing. Consequently, for the majority of industries, for telecommunications, car manufacturing, trade, banking, insurance, and other service domains, competitiveness and market success depend directly upon their software competence. This is underlined by the fact that the 1999 German market for software and IT services was worth 55.5 billion DM, and an additional 50 billion DM was spent on software development.

A young team at a former industrial site: The employees of Fraunhofer IESE in a historical factory building of the Kammgarn Spinning Mill in Kaiserslautern.

Our vision is that software competence (i.e., engineering, purchasing, and using software) will become the number one enabling competence for all high-tech product and service companies. Such competence has to be built up, managed, and continuoulsy optimized according to well-defined business goals. More and more companies will seek external help in order to align their software competencies with their strategic business goals. Fraunhofer IESE wants to be one of the preferred industrial partners for contract research and transfer of innovative technologies in the area of software competence. We offer collaboration to companies in all major business sectors, of all sizes, and in all regions world-wide. We want to be recognized as the world-wide leading applied research center in the area of experimental software engineering.

The primary Fraunhofer IESE mission is to provide unique and value-adding solutions to our industrial customers by establishing software improvement programs, transferring innovative software technologies, performing cooperative research, conducting studies and assessments, and educating and training software professionals. In addition, we promote experimental software engineering as a proven successful approach for introducing and sustaining engineering-style rigor into industrial software development practice, and advance the state-of-research in software engineering by evaluating promising new technologies experimentally, developing new technologies based on industrial needs, packaging proven new technologies for specific customer needs, and collecting cost/benefit data demonstrating the benefits of new technologies in practice.

Fraunhofer IESE wants to maintain and continuously improve its standing with industrial partners. Therefore, we continuously monitor our customers' needs, investigate new emerging areas of software engineering, develop promising technologies to meet industrial requirements, and, finally, transfer them into industrial practice. This enables our industrial customers to build up the needed and desired software engineering competence in a timely fashion.

Events and Initiatives

Throughout the year 2000, Fraunhofer IESE presented its competencies and services at a wide range of events, targeting an expert and business audience as well as the general public. Some of the supported events, such as SQM 2000 in Bonn and CONQUEST 2000 in Nuremberg, had a clear focus on software engineering. Others, such as the Linux Tag 2000 in Stuttgart with its focus on Linux-based applications, were geared towards a broader spectrum of IT professionals. Reinforcing its commitment to the scientific advance of a business- and product-oriented approach to software engineering, Fraunhofer IESE significantly contributed to the organization of PROFES 2000. The scientific competence of Fraunhofer IESE was also impressively demonstrated at ICSE2000 in Limerick, where several papers (co-) authored by Fraunhofer IESE scientists were delivered, and where the Fraunhofer IESE solution to process engineering, SPEARMINT/EPG, was presented. Last but not least, Fraunhofer IESE also contributed to two events that addressed a mostly regional audience: at the opening celebration of its long-standing customer, maxess systemhaus gmbh, Fraunhofer IESE presented its product line technology; at the State Garden Fair of Rhineland-Palatinate, the focus of the Fraunhofer IESE exhibits was on IT education and on the different facets of software engineering related jobs.

CONQUEST 2000

2000 was the fourth time that the ASQF e.V. had invited software professionals to the International Conference on Quality Engineering in Software Technology at the Fachhochschule Nuremberg. Almost 300 participants listened to lectures in the areas of models for software development processes, analytical methods, metrics and measurement models, defect prevention, and management aspects of software engineering development.

Fraunhofer IESE contributed to the conference as an exhibitor, presenting its process engineering solution Spearmint™/EPG. The benefits of combining several quality and process engineering technologies (assessments, process modeling, measurement) for improving software development processes were presented in a talk.

LSO 2000

The 2nd International Workshop on Learning Software Organization (LSO 2000) took place the day before PROFES 2000, in Oulu, Finland. In total, nine presentations provided an up-to-date and very well received overview on organizational learning issues for about 30 attendees. The workshop was comprised of a keynote speech on an industrial LSO application as well as interesting talks on organizational learning, experience factory, evaluation, reuse, and process improvement. The LSO workshop series will be continued in September 2001 in Kaiserslautern.

PROFES 2000

The 2nd International Conference on Product Focused Software Process Improvement (PROFES 2000) took place in Oulu, Finland on June 20-22, 2000. Prof. Markku Oivo from VTT (on a sabbatical at Fraunhofer IESE) was the general chair of the conference. Dr. Frank Bomarius from Fraunhofer IESE and Terry Rout from Griffith University, Australia served as the program co-chairs. The main theme of PROFES 2000 was professional software process improvement motivated by product quality needs. As in 1999, the topics of this year's conference attracted about 150 participants (62% from industry), which confirmed that process and product improvement are very topical issues in industry. The conference was very well received and obtained high ratings from the participants. The PROFES conference series will be continued in September 2001 in Kaiserslautern.

Linux-Tag

The Linux-Tag (Linux Day) is the largest and most important event in all of Europe dedicated to users and developers of free software. In 2000, the fair was moved from Kaiserslautern to Stuttgart because of the overwhelming increase in exhibitors and visitors.

The focus of Fraunhofer IESE was on the powerful process modeling tool Spearmint™/EPG. Although, strictly spoken, Fraunhofer IESE is not into software development, numerous representatives of small and medium as well as of large and well-known companies visited the Fraunhofer IESE booth to get into contact with the Fraunhofer software experts.

State Garden Fair 2000

For six months, the city of Kaiserslautern was hosting the first State Garden Fair of Rhineland-Palatinate. State Garden Fairs take place in different regions all over Germany. Originally, state garden fairs were intended as an exhibition of horticulture. Over the years, they have also become a platform used by cities and counties to present their technological, industrial, and cultural potential.

Having been offered the opportunity to exhibit, the University of Kaiserslautern, the University of Applied Science of Kaiserslautern, and several scientific and technological institutions jointly presented themselves to a wider public in one of the big exhibition halls.

In cooperation with the Software Engineering Group of the University of Kaiserslautern and with SWA Software Akademie, Fraunhofer IESE had developed a booth and information on the range of IT education in Germany and on the professional perspectives in software-related jobs. One highlight of the booth was an interactive HTML-based "job selection system", which gave users an indication of which software-related jobs would be most suitable for them, based on a survey of users' strengths and preferences.

KL inform

The close relationship that Fraunhofer IESE nurtures with the city of Kaiserslautern and the state of Rhineland-Palatinate was also evidenced by its strong commitment to a local initiative, whose aim it is to advance the region's online presence. A consortium of seventeen Kaiserslautern business companies, research organizations, and public institutions won one of the main awards of the state of Rhineland-Palatinate multimedia contest 1999. At the beginning of 2000, the consortium then initiated development of an Internet portal, which is intended to improve web-based communication in the region via a new and innovative navigation concept. By assuming development and management tasks and being involved in intensive conceptional collaboration, Fraunhofer IESE made a major contribution to this project, so that a prototype of the planned portal could be completed in December of 2000.

Offerings

Our services enable customers to switch to new technology in a risk-controlled fashion and to continuously improve their ability to develop software in a predictable manner. In addition, we provide guidance on purchasing and applying software, ensuring that usage needs are met.

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 and techniques
- Support towards development of certifiable software
- Preparation for auditing or certification
- Continuing training and education for software engineering professionals
- Re-education of unemployed scientists and engineers from other domains for a new career in software development
- Introduction of new technology – this includes tailor-made training programs so as to enable your workforce to use new technologies to the fullest extent.

To users of software, we offer:

- Help in purchasing commercial off-the-shelf software
- Independent support for selecting and evaluating subcontractors
- Independent support for monitoring software development contracts

Services for SMEs

The Competence Center for Software Technology and Training (KSTW) offers services tailored to small and midsize companies:

- Consulting with respect to base practices in Software Engineering such as Requirements Engineering, Systematic Testing, Inspections, etc.
- Tailoring and implementation of the ESF Software Competence Kit ("Baukasten Software Kompetenz"), including the following elements:
  - Moderated Self-Assessment Workshop on simple problem analysis
  - Process Model - documentation of the business processes relevant for software development for the purpose of systemization
  - Problem Analysis - an assessment methodology tailored to SMEs, based on a globally standardized ISO framework (ISO 15504/SPICE)
  - Qualification Model - orientation assistance for staff qualification
  - Handbook Continuing Education Measures - design, implementation, and evaluation
  - Continuing Education Measures - methods, technologies and tools of Software Engineering.

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Collaborations

Fraunhofer IESE collaborates with technology providers, technology-transfer customers, and strategic partners. The overall goal is to identify and further develop software engineering technology, and to transfer it into industrial practice in order to increase our customers' competence.

International Research

The International Software Engineering Research Network (ISERN) with about 20 members from research and industry plays a prominent role in IESE's international research cooperation. ISERN is a forum for applied software engineering researchers to exchange the latest insights and findings in software engineering. ISERN has 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 within many publicly-funded consortia, aimed at either software engineering technology advancement or dissemination of best practices and technology transfer. Often, additional bilateral industrially-funded collaboration results 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 85 industrial collaborations with 60 companies in 1999 were extended to 93 industrial collaborations with 76 companies in 2000, not including further industrial collaborations in the context of publicly funded projects.

The cooperation partners of Fraunhofer IESE range from large global players to 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 or have to perform technology changes and are usually under very tight budget and schedule constraints
- Small companies that need ready-to-use, proven technologies that yield short-term return on investment.

In addition to bilateral collaborations, Fraunhofer IESE and FC-MD have jointly started a multi-national consortium of international companies - the Software Experience Center (SEC). In SEC, member companies team 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 in other application domains.

Organizational Chart 2001

Fraunhofer Virtual Institute for Experimental Software Engineering (FVIESE)

Prof. Dr. Basili
Prof. Dr. Rombach

Fraunhofer Institute for Experimental Software Engineering (IESE) Kaiserslautern

Executive Director Prof. Dr. Rombach Strategy, External Relations	Deputy Director Dr. Bomarius Personnel, Budget	Deputy Director Dr. Ruhe Research, Projects	Advisory Board

Marketing/PR Steffens	Quality Software Development (QSD)	Dr. Paech
Contact Office FC-MD (USA) Namingha	Software Product Lines (SPL)	Dr. Knauber
Coordinator New IESE Facilities Kusche	Quality and Process Engineering (QPE)	Dr. Kaiser (acting)
Contact Office University of Kaiserslautern Jerkku	Systematic Learning and Improvement (SLI)	Dr. Bomarius
Central Services (CS) Würtz	Continuing Education and Training (CET)	Dr. Ruhe

Fraunhofer Center for Experimental Software Engineering, Maryland (FC-MD), College Park, Maryland, USA

Executive Director Prof. Dr. Basili	Deputy Director Prof. Dr. Zelkowitz	Steering Committee

Administration Wall	Reading/Inspection Technologies Project	Dr. Shull
	Maryland Software Industry Consortium	Dangle
	Other Projects headed by various Project Leads	N.N.
	Experience Base Industrial Project	Pajerski
	Experience Management System Project	Dr. Lindvall
	System Testing/ Modeling and Simulation Project	Dr. Rus

Advisory Board

Research

Prof. Dr. Victor R. Basili
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

Dr. Paul C. Clements
Software Engineering Institute (SEI)
Senior Member of the Technical Staff
Pittsburgh, PA
USA

Prof. Dr. Werner Mellis
University of Cologne
Chair of the Supervisory Board of SQS Cologne

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. Mary Shaw
Carnegie Mellon University
Pittsburgh, PA
USA

Prof. Dr. Günter Warnecke
President, University of Kaiserslautern

Industry

Prof. Dr. Ernst Denert
Chairman of the Advisory Board
Chairman of the Executive Board of sd&m software design & management AG
Also: Vice-President of GI - German Computer Society

Dietmar Freigang
Director, Information Systems
Allianz-Lebensversicherung AG

Monika Gonauser
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Siemens AG
ZFE ST ACS

Wolfgang Jung
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Dr. Thomas Wagner
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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

Dr. Bernd Reuse
Director, Division on Promotion of Information Processing
Federal Ministry of Education, Research, Science and Technology (BMBF)

Budget 2000

Business		
Income	**in K DM**	**%**
Industrially-funded projects	5,615	41.1
Publicly-funded projects	4,484	32.8
Other Income	451	3.3
Public Grant (State of Rhineland-Palatinate)	2,645	19.3
Fraunhofer Funds (PROFIL, SME)	475	3.5
Sum	**13,670**	**100.0**

Expenses	**in K DM**	**%**
Personnel	9,237	67.6
Miscellaneous	4,433	32.4
Sum	**13,670**	**100.0**

Investments		
Income	**in K DM**	**%**
Publicly-funded projects	155	14.1
Public Grant (State of Rhineland-Palatinate)	945	85.9
Sum	**1,100**	**100.0**

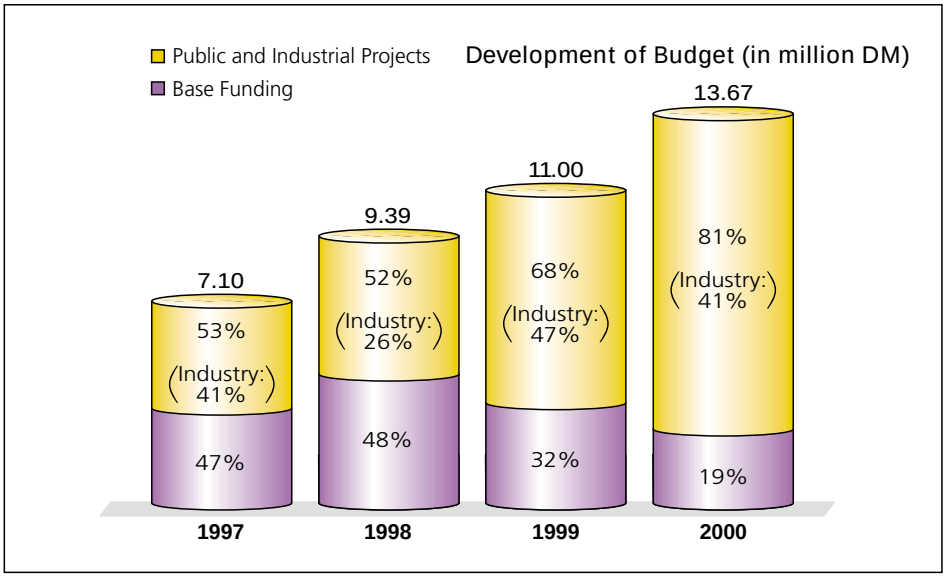
Expenses	**in K DM**	**%**
	1,100	**100.0**

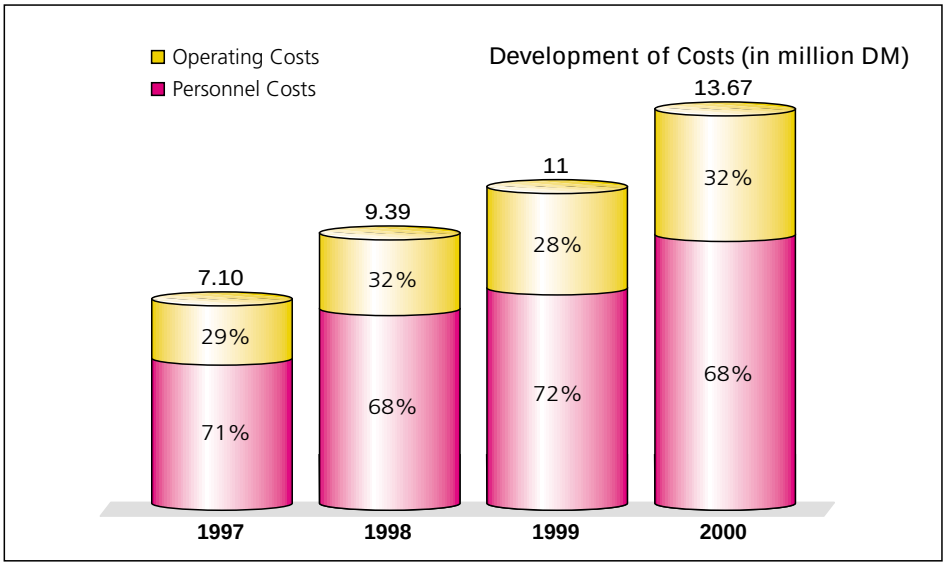
Personnel

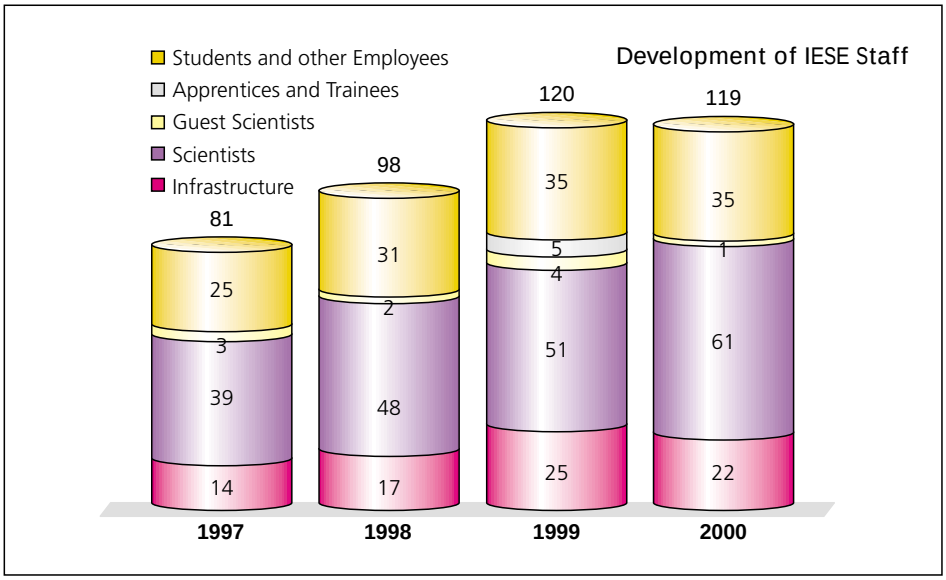
The growth in terms of staff was continued throughout 2000. By the end of 2000, Fraunhofer IESE employed 83 full time employees, 1 guest scientist, 27 students, 5 apprentices, and 3 trainees. Since at any point in time, approximately 20% of the staff comes from abroad, the institute maintains a unique international flavor.
The plan is to grow to about 100 full-time employees by the end of the year 2001.

Personnel	as of 12/31/00
	Number
Scientists	61
Infrastructure	22
Guest Scientists	1
Students and other employees	35
	119

Development







The Fraunhofer Virtual Institute

The Fraunhofer Virtual Institute for Experimental Software Engineering (FVIESE) is comprised of two partner institutions, the Fraunhofer Institute for Experimental Software Engineering (Fraunhofer IESE) in Kaiserslautern, Germany, and the Fraunhofer Center for Experimental Software Engineering, Maryland (FC-MD) in College Park, MD, USA. They are both legally independent units under Fraunhofer Gesellschaft e.V. and Fraunhofer USA, Inc., respectively. Together they form the so-called Fraunhofer Virtual Institute for Experimental Software Engineering (FVIESE), coordinated by Prof. Basili and Prof. Rombach. Detailed descriptions of Fraunhofer IESE and FC-MD are provided in separate sections of this report.

Fraunhofer IESE

Fraunhofer IESE is organized into five problem-oriented research and transfer departments plus an administrative department, providing central services (see the organizational chart on page 14). The departments reflect our research competencies and contribute to projects in five business areas. The following two sections give an overview of the departments and the business areas. More detailed descriptions of the competencies associated with each department and of the projects conducted within the individual business areas are provided in the chapters "Competencies" and "Selected Projects", respectively.

Research and Transfer Departments

Quality Software Development

Requirements Engineering

Software Design

Inspections and Testing

Quality Software Development provides methods for building software in a systematic way, so that quality requirements can be guaranteed. Special emphasis is on requirements engineering, object orientation in general and UML in particular, componentware, and testing and inspections.

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Software Product Lines

Systematic Scoping and Modeling

Software Architectures

Software Reengineering

Software Product Lines extends the systematic development of quality software development to the area of families of software systems. In particular, it 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.

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Quality and Process Engineering

Goal-oriented Assessment and Measurement

Process Engineering and Technology

Cost and Quality Engineering

Quality and Process Engineering provides the methods to instrument development processes in such a way that relevant process attributes (cost, quality, risk) as well as product qualities can be measured and modeled. This enables managers and developers to understand, monitor, control, improve, and finally predict their software development processes and products.

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Systematic Learning and Improvement

Experience Factory Technology

Management of Improvement and Learning

Information Technology Security

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

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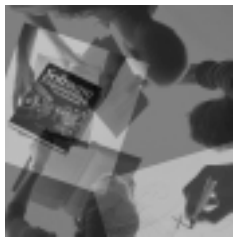
Continuing Education and Training

Evaluation and Certification

Reuse-based Education and Training

Technology enabled inidividual and collaborative Learning



Continuing Education and Training offers tailor-made education and training 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 a new career in the software business.

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Business Areas

Fraunhofer IESE's mission is to promote experimental software engineering – the best approach for introducing engineering-style rigor into business practice. This approach provides customers with measurable facts about their development practices and enables informed decision making. Measurable facts, analysis, and continuous feedback of findings are the engine for goal-oriented continuous improvement and risk-controlled innovation.

We have structured our offers into five business areas that address the typical viewpoints of our customers:

Software Development

Quality Software Development

Rapid Software Development

Legacy System Reengineering

Software Development for Distributed Organizations

Componentware

Software Product Lines

We help you to select, tailor, and continuously improve the software development practices best suited to your market's and your organization's needs.

Our experts in re-engineering and product line development show you the most economical way of carrying your legacy systems into the future. We help you to evolve existing systems into product lines and to integrate componentware into your systems.

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Software Project Management

Data-driven Cost/Quality/Risk Management

Subcontractor Assessment and Management

Software Procurement

We help you to implement lean practices for planning, tracking, and predicting cost, quality and risk by integrating goal-oriented measurement, assessment, and benchmarking.

We help you to select, integrate and manage subcontractors or to select, evaluate and integrate purchased (off-the-shelf) software.

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Improvement Management

Process Assessment and Improvement

Product Assessment and Improvement

IT Security

We perform efficient, reliable, and reproducible assessments of your practices and products and help you implement an action plan that meets your actual business goals.

We help you to detect vulnerabilities that may become targets of deliberate as well as accidental threats, define security goals for your organization, and determine action plans for achieving and sustaining them.

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Software Competence Management

Software Learning Organizations

Skill Profiling

Job-oriented Education and Training

Education and Training on Demand

We help you to continuously identify and capture valuable information from processes, products, and people. This enables you to assess, manage, and maintain knowledge, and to supply it to your entire organization.

We help you to determine current and future job profiles of your software developers, tailor and perform education programs to build the core competencies of your workforce. We provide modules for training on demand integrated with your work processes.

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Software-based Business Development

Innovation Management

Expert Reports

Software Economics

E-Business

Technology Consulting

Change Management

We help you to continuously innovate your software-related business practices so as to enable you to compete proactively. We help you to make informed decisions regarding risk, cost and benefit of new technologies as well as of process and organizational changes.

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... offering a unique approach

Overview

Competencies sorted by Departments

Quality Software Development

Quality is a critical property of any software system. The perceived quality of a system depends 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.

One 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 a significant redevelopment effort. Only through continuous and systematic application of appropriate engineering and design techniques at all stages in the development cycle can quality goals be attained cost-effectively.

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, including the Unified Modeling Language, scenarios, use cases, design rationale, patterns, components, and object-oriented 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. Precise functional and non-functional requirements agreed on by all stakeholders must be captured and tracked during software development. This can only be achieved in an incremental process with early quality assurance and feedback treating requirements as the outstanding source of knowledge on system goals and usage.

The group is developing RE-KIT, a portfolio of methods for capturing, validating, and managing customer and software requirements with emphasis on participatory design, modeling, knowledge management, and their integration into incremental software development. RE-KIT is tailored to specific application domains like information or embedded systems, and evaluated in experiments. Examples include RE-KIT-FRAIME, a method for assessment and improvement of requirements engineering processes, RE-KIT-SAM, a method for surfacing ambiguities in requirements documents, and RE-KIT-MUC, a method for developing and managing use cases.

Software Design

The process of software design translates the requirements into an executable form that effectively meets the needs and quality goals of the customer. The software design group focuses on 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, and component technology (esp. CORBA, COM and JavaBeans).

Requirements Engineering

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Department Head

Erik Kamsties

Software Design

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Dr. Christian Bunse

Training, Education and Consulting Center

Markus Müller

Dr. Klaus Hörmann

One major emphasis of the group is on the synergistic integration of these techniques to support the seamless mapping of requirements into implementation features. To this end, the group is leading the development of the KobrA method, which aims to support architecture-centric, measurement-driven, component-based 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. Furthermore, these principles are used to extend the idea of extreme programming to extreme development.

Inspections and Testing

As a human intensive activity, software development is inherently error prone. Therefore, to attain adequate quality, 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 integration of inspections and testing.

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Françoise Thekal Secretary

The Software Product Lines (SPL) department provides products and services to guide organizations away from one-at-a-time system development to systematic development with large-scale reuse using product lines. One-at-a-time development leads to unnecessary duplication of effort and risky ad hoc reuse when an organization produces numerous related systems.

A product line is a collection of software systems in a business area that are sharing common functionality. Product line engineering focuses on leveraging these commonalities by building a reuse infrastructure that is used to efficiently and systematically develop members of the product line.

An additional technology area of significant importance to product line engineering is reengineering. In most cases, when an organization converts to product lines they have existing systems with valuable knowledge and reusable assets embedded within them.

Through product line engineering, organizations can reduce their development effort, shorten the time to market for new products, facilitate maintenance and evolution of products, and support the planning and management of product development and maintenance. Additionally, the quality of products can be improved through the reuse of proven high quality assets. These benefits help organizations keep a competitive edge in their markets.

The SPL department is comprised of three groups:

The Systematic Scoping and Modeling (SSM) and the Software Architecture (ARC) groups focus on the definition and construction of Software Product Lines.

The Software Reengineering group (REE) focuses on support technology for product line engineering in the area of rediscovering the knowledge embedded in existing systems.

Systematic Scoping and Modeling

The Systematic Scoping and Modeling group (SSM) focuses on the development of methods for determining the appropriate scope for a product line and for creating, instantiating, and evolving product line models.

The scope of a product line determines which products and which characteristics of the products are to be included in the product line and therefore are part of the reuse infrastructure built for the product line.

The SSM group focuses on economic scoping processes to overcome weaknesses of existing scoping techniques, which focus mostly on the technical boundaries of a domain. Economic scoping relates the business objectives of an enterprise to the products and their characteristics.

A product line model captures the requirements for all products and characteristics in the product line scope. The product line model captures both common and variable requirements. Common requirements are shared by all members of the product line, while variable requirements denote the differences among product line members.

The SSM group provides customers with solutions that cover the complete life-cycle of the product line model, which includes creation, instantiation, and evolution.

Our experience has shown that existing domain analysis methods are not sufficiently adaptable to the situations in which they are needed. Therefore, the SSM group aims to provide systematic support for customizing the domain modeling process and models.

Systematic Scoping and Modeling


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Department Head


Isabel John


Dirk Muthig


Abdul Noman


Klaus Schmid


Tanya Widen

Software Architectures

The Software Architectures group (ARC) focuses on the development of methods for creating, evaluating, and instantiating reference software architectures.

A reference software architecture represents a generic architecture for all products in a product line and is engineered around the products' commonalities and variabilities. In contrast to a single-system architecture, a reference architecture includes not only common but also variable parts. Reference architectures are the key to successful software product lines: they define the essential parts of the reuse infrastructure and thus ensure that reused common components and instance-specific components fit together for all members of the product line.

Because of their genericity, the creation and validation of reference architectures is inherently more complex than that of single-system architectures. The complexity is further intensified by the need to be able to derive instance-specific architectures from a generic one in order to actually build individual applications. The ARC group provides customers with state-of-the-art engineering methods to cope with this complexity and thus build the groundwork for successful product lines.

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 on existing systems.

When these technologies are applied to multiple systems from the same domain, they enable 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 that is 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 which information is actually needed. This leads to cost-effective results for our customers.

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Software Architectures


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Software Reengineering


Jean-François Girard


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Ulla Geib
Secretary

Quality and Process Engineering

The Quality and Process Engineering department (QPE) provides comprehensive support for customers interested in the improvement of software development, maintenance and sub-contractor processes, and related products.

Our main objective is to increase productivity, reduce time-to-market, and improve the quality of both products and processes.

QPE provides a wide range of services, including:

- Elicitation and assessment of software processes within the ISO 15504 (SPICE) and BOOTSTRAP frameworks
- Assessment and evaluation of software products in order to provide recommendations for improvement
- Setting-up and supporting goal-oriented measurement programs for systematic and customized improvement
- Support for goal-oriented process improvement and process guidance through the establishment of web-based electronic process guides (EPG)
- Quantitative modeling for software cost and quality estimation and evaluation
- Supporting organizations in the establishment of purchase-based software development, including supplier selection, sub-contractor management, component evaluation, etc.

The QPE department is composed of the following three groups.

Goal-oriented Assessment and Measurement (GAM)

The Goal-oriented Assessment and Measurement (GAM) group supplies instruments to perform a 'health-check' for software development. The outcome of a characterization is an indication of where an organization should improve its products and its processes, how to improve them, and the extent to which success is feasible (risk, cost/benefit, strategy, etc.).
The two main technologies applied by the GAM group are assessments and measurement.

- Assessments are used to rapidly get an overview of the current state of a product or process. Through the collection of a set of 'evidence' consisting of, e.g., interview results or document studies, a current status overview is created. This may consider the process or the product. Well-known methods used for this are CMM, SPICE, BOOTSTRAP, ISO9126, ISO9001, TickIT, etc.
- Measurement is used to get a deep and thorough understanding on what current practices look like and what the reasons (causal relationships) are for issues in practice. Through the definition of a set of required metrics, the collection of data, and the analysis of these data with the people in the software organization, a deep understanding is created of what has happened and which causal relationships exist. The main method for measurement used is the Goal/Question/Metric approach.

Process Engineering and Technology (PEAT)

Process engineering plays a major role in today's software industry. To achieve maximum quality and productivity in every project, companies need well-designed processes that are effectively communicated to everyone in the company. Process models are extensively used to help obtain ISO certifications, to guide process improvement programs, and to introduce "best practices" into organizations.

Cost and Quality Engineering

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Department Head

acting

Dr. Rini van Solingen
Department Head

left end of 2000

Bernd Freimut

Dr. David Moon

Michael Ochs

Jürgen Wüst

Isabella Wieczorek

Goal-oriented Assessment and Measurement

Danilo Assmann

Dirk Hamann

The Process Engineering and Technology group (PEAT) provides a wide range of integrated services and technologies to support process engineering and re-engineering. We also provide access to our own, specially developed process engineering technologies, including the Electronic Process Guide (EPG) and the Spearmint™/EPG process modeling tool. Our services include:

- Improving existing processes: We elicit, document, and analyze your process and identify areas for improvement. We then help companies to realize these improvements.
- Tailoring processes for the company's specific needs: We show companies how to tailor existing or standard processes specifically for a company and/or projects.
- Introducing new processes: We have expertise and technologies that help companies to introduce new processes into their working environment.
- Communicating processes: We ensure that the company's most up-to-date processes are quickly and easily communicated throughout the company.

Cost and Quality Engineering (CQE)

The Cost and Quality Engineering group (CQE) focuses on ways to build and apply models and methods aimed at the characterization, evaluation, control, and prediction of a variety of software attributes. This implies the combination of goal-oriented measurement with rigorous and integrated quantitative modeling, and the use of many other experimental techniques.

The goal of the CQE group is to enable software project managers to make the right decisions in a specific situation, resulting in increased productivity, decreased time-to-market, and lower development effort and cost.

Our services address a wide range of issues including:

- Supporting decision-making during project bidding and planning: We identify important cost and risk factors in our customers' development environment. Based on such analyses, we help build cost and risk models. We also select, apply, and develop software cost estimation models and methods suitable for different contexts and purposes.
- Providing guidance in deciding whether to purchase a Commercial-Off-The-Shelf (COTS) component: We support our customers in exploring, evaluating, selecting and integrating most suitable COTS components through the definition of an effective, efficient, and reliable acquisition process.
- Providing guidance on setting up and running inspection and testing activities: We build models to predict the error-proneness of software components to focus verification and validation activities. Moreover, our methods can estimate how many defects remain in a document after inspection, or evaluate the cost effectiveness of inspections. Thus, project and quality managers can address important issues, such as to decide whether to re-inspect a software artifact.
- Producing industry benchmarks: We explore industrial data bases and use and develop methods that are well suited to produce interpretable industry benchmarks for our customers.

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Systematic Learning and Improvement

The department Systematic Learning and Improvement (SLI) develops and validates methods and techniques for implementing 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, select and take adequate actions towards reaching these goals, measure success, and systematically collect experience to accelerate learning.

Our overall approach is implemented by means of well-defined roles and processes for the software project groups and their improvement support group. The former ones are responsible for performing successful software projects. The latter is concerned with the collection of relevant experience from the software groups, its preparation (i.e., structuring, documentation, and maintenance), and feedback of experience to leverage the software groups' success.

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.

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 it only were easily accessible at the right place at the right time. 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 databases. 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 tightly integrate the Experience Base 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. Maintaining a leading edge requires exploration of the most valuable resource in a company – knowledge. The introduction of concepts for Learning Organizations encounters many non-technical problems related to Business Process Improvement and Change Management. Moreover, acquisition, storage, and distribution of experience still present a lot of open issues on the methodological level.

Experience Factory Technology

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Dagmar Surmann

Dr. Carsten Tautz

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. We are experts in embedding processes for identification, acquisition, and usage of experience in an organization. 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.

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 tele-working and tele-conferencing, 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.

We help to make a Learning Organization safer by protecting its essential assets – the information infrastructure.

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Continuing Education and Training

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 to 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.

Software results from a complex and human-based development process. As a consequence, the quality and success of this process essentially depend on the knowledge and skills of all the different actors involved. The individual competencies are a prerequisite for organizational software process improvement. That is why the CET Department addresses individual and collaborative learning and training.

Evaluation and Certification

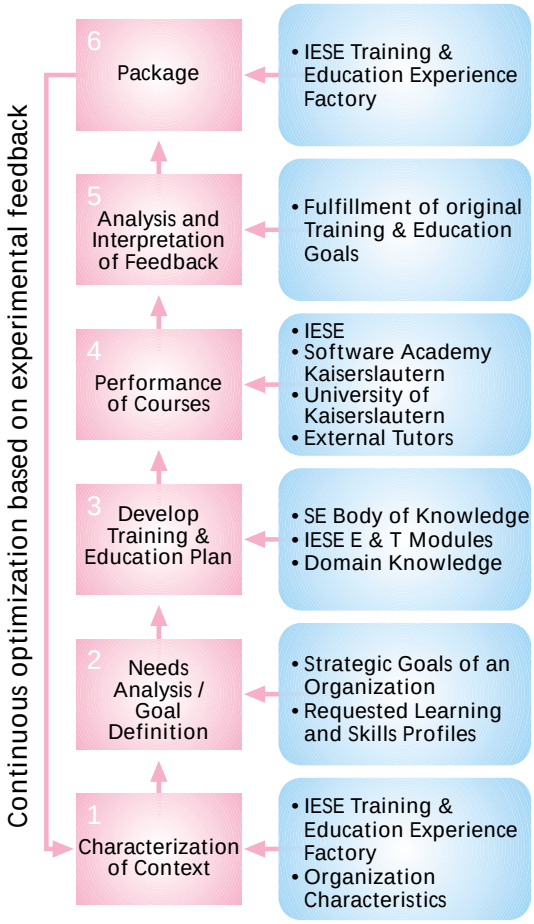
Empirical evaluation and feedback mechanisms are a prerequisite for all education and training programs. The focus is on quality assurance and certification. Certification is done on an individual basis, confirming the success of attending a specified course or training. Additionally, assistance for gaining (organizational) certification for implementing courses and training will be offered.

Empirical evaluation is used for measuring the progress of the learners, the achievement of predefined competence and knowledge profiles and for incrementally increasing quality and efficiency of the training and learning procedures.

Technology enabled Individual and Collaborative Learning

The area of technology-enabled individual and collaborative learning addresses the integration of computer-based learning and training technologies (processes, methods, techniques, and tools) with development and business processes in software organizations. Special focus is placed on supporting personalized and collaborative learning and training by using web-based and simulation-based technologies.

The process-centered approach to learning, which will be based on job-oriented skill and knowledge profiles, provides answers to the question WHO (role) should learn WHAT (content), WHEN (process) and HOW (methods, techniques, tools) in software organizations. Managerial issues as well as differences between large software organizations and SMEs will be considered.



Reuse-based Education and Training

The CET education and training approach supports reuse-based planning and execution of customizable, high-quality education and training modules by adapting the Quality Improvement

Evaluation and Certification

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Reuse-based Education and Training

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Paradigm (QIP) approach for software development.

Reuseable artifacts can be modules (content), know-how, know-what, and know-why. Content in a certain domain has to be structured and organized in such a way that reuse is easily possible (product line approach for education and training).

CET Offerings

CET is offering assistance and support for:

- Design and development of professional education and training programs
- Design and development of technology enabled learning and training programs
- Evaluation, quality assurance and certification of professional education and training.

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

Fraunhofer 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 that are
  - technology-oriented
  - one to five days in duration
  - at Fraunhofer IESE or at the company
  - during working hours
  - complementing the transfer of Fraunhofer 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 Fraunhofer IESE, at PRE Park, or at company
  - organization: full-time or part-time, 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 to upper executive management of companies.
- Education, training, and consulting for SMEs.

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Technology enabled individual and collaborative Learning


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Secretary

... sharing knowledge and experience

Overview

Projects sorted by Business Areas

Software Development Processes

Software Project Management

Software Improvement Management

Software Competence Management

Software-based Business Development

Increasing Inspection Competencies at DaimlerChrysler

To remain competitive in their marketplace, organizations must deliver high quality products on time and within budget. However, to bring their products to market more quickly, managers may avoid quality enhancing processes such as software reviews and inspections. They often do not consider the benefits and rather believe that these approaches only add time and costs to the development cycle. Moreover, managers may lack the knowledge to maintain technological momentum. To address these issues, the RIT team at DaimlerChrysler in Ulm is responsible for review and inspection related activities as a unique source of reference and information.

Objective

The collaboration between Fraunhofer IESE and the RIT team at DaimlerChrysler aimed at increasing the existing competencies with respect to the state of the art and the state of the practice of review and inspection technology. Hence, the results of this project can be regarded as a complement and extension of the already existing inspection and review knowledge at DaimlerChrysler.

Approach

The collaboration focused on two major areas. The first included a consolidated study of existing inspection experience in the form of a survey. The survey was to provide the RIT team with an overview on the large body of contributions. It discusses new inspection methodologies and/or incremental improvements that have been proposed to leverage and amplify the benefits of inspections and reviews within software development and even maintenance projects. The importance of such an overview stems from the fact that projects at DaimlerChrysler have different inspection needs that one must be aware of for the successful implementation or improvement of inspections.

The second area of work included active involvement and consulting of Fraunhofer IESE in the context of the RIT Team. Throughout this activity, different issues were subject to discussion. The most important one was the development of a classification schema for checklist questions. Since there is a potentially infinite number of possible checklist questions, such a schema allows existing questions to be structured according to several quality criteria. A simple data base has been set up that offers the capability of effectively generating an initial checklist according to predefined criteria. This kind of support is important, since project and quality managers often ask for checklists when introducing inspections.

Results

The combination of the two activities were perceived as an optimal approach to achieve the stated goals. The results enhance the existing knowledge in the RIT team and also serve as a basis for further collaboration.

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Engineering Software Architectures, Processes and Platforms for System Families (ESAPS)

Software system families are strategic business assets. The structuring of systems into system families allows the sharing of development effort within the system family and as such, counters the impact of ever-growing system complexity.

Objective and Approach

ESAPS is a European research project (Eureka ∑ 2023 Program, ITEA project 99005), which aims to provide an enhanced system family approach by combining the most promising technologies of the partner companies in the following areas: Analysis, Definition, and Evolution of system families. The project started in June 1999, and will run for two years.

IESE's goal in ESAPS is to evolve parts of the existing PuLSE™ (Product Line Software Engineering) technology. The main focus is on PuLSE-Eco and PuLSE-DSSA, the technical components for dealing with product line scoping and product line architecting, respectively.

The technology evolved here is being validated with industrial partners, incorporated into the existing PuLSE method, and disseminated accordingly.

Results

To date, our major results within ESAPS are:

- Assessment guidelines for detecting architectural mismatches during systems composition
- Mapping between the PuLSE process and the SPICE process description to detect strengths and weaknesses of PuLSE and to determine evolution directions
- Evolved PuLSE-Eco by: devising an approach for analyzing the potential risks and benefits of developing a product family; developing cost-/benefit-models for product line development; and improving the existing approach for determining assets that should be developed in a reusable way
- A notation for representing reference architectures using the UML, which provides well-founded support for instantiation and evaluation of those architectures
- Started working towards a traceability method. Focus areas of this work are the specific intricacies of product line infrastructures, the necessary types of traceability links, and the handling of conflicting concerns.

Our research results were validated in industrial settings. They are being disseminated via publications, presentations, and at the following dissemination events:

- An event for German industry, where ESAPS partners presented their work (November 2000)
- A German system family workshop that has brought together people from German research and industry (November 2000)
- A Dagstuhl seminar to present and discuss results from ESAPS to and with a group of leading researchers from ESAPS related disciplines (April 2001).

Partners

- ESAPS involves 21 partners, including universities, research institutes, and companies of various sizes. Some of the non-German partners involved are:
- Philips, Nokia NRC, Thomson-CSF, the European Software Institute (ESI), and INRIA.
- The German consortium consists of: Siemens, Bosch, Market Maker, University of Essen, Fraunhofer IESE

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Component-Based Application Development - KobrA

Among the various approaches to software reuse currently available, one of the most promising is component-based development. However, the adoption of the component paradigm in real-world software products is being hampered by the narrow view of components currently used in the dominant "component technologies" (e.g., JavaBeans, COM and CORBA) and development notations/methods (e.g. UML/RUP). These all essentially take the view that components are binary executables (or something close to them) and are thus of importance only in the later stages of a software development project. In short, they take the view that components are the result of a development project rather than an integral part of it.

This view of components is not practicable for industrial scale software development, where developers routinely have to struggle with legacy software systems, outdated development technologies (e.g., tools, languages, etc.), and the rapidly fluctuating demands of the market. Companies concerned with the day-to-day business of enterprise software development are therefore rarely in a position to throw away all their existing software assets and re-implement them from scratch in the latest technology of the day (e.g., component technologies). On the contrary, as in the transition to any new development paradigm, the move to component-based development will be a slow, incremental and often painful process for most companies.

The KobrA project is addressing this problem by developing a method and supporting workbench to provide a flexible and incremental introduction to component-based development. It achieves this by providing an abstract, UML-based representation of components at a level of abstraction akin to analysis/design, and by strictly separating this view from their implementation in an executable form. In other words, KobrA regards composition and implementation as two totally separate dimensions of concern. This approach facilitates an incremental and controlled migration to the component paradigm, first at the analysis/design level and later at the implementation level.

As well as allowing a gradual introduction of component concepts, the KobrA method also supports an incremental transition to product lines. Since many of the components within a domain tend to be deployed in a similar way in different product variants, it makes sense to consolidate these common components and deployment patterns within a preconfigured, but tailorable framework. KobrA therefore allows redundant features and variation points to be included in the abstract description of components, and introduces decision models to resolve these redundancies in specific deployed instances.

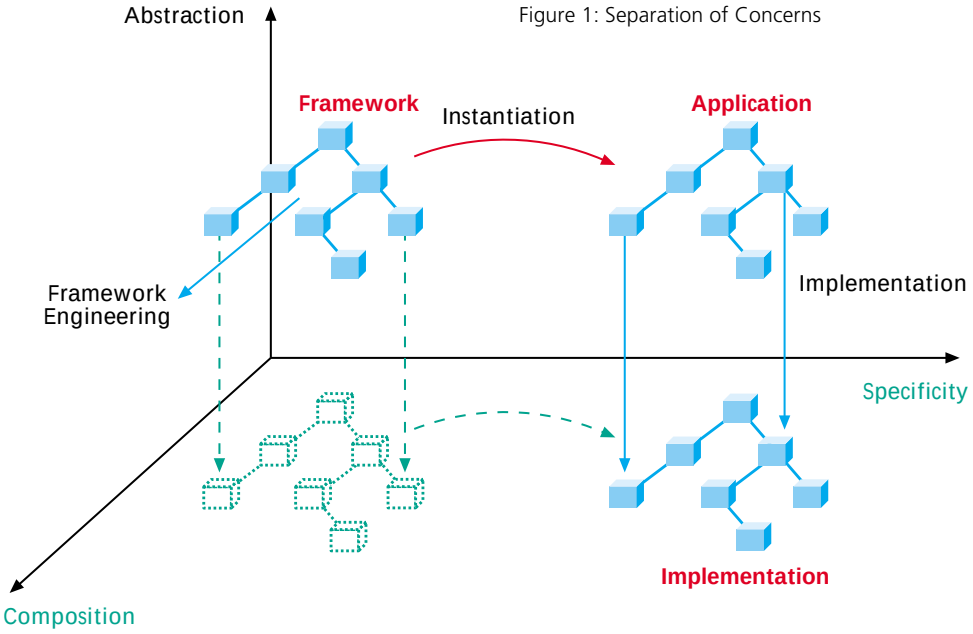

Figure 1: Separation of Concerns

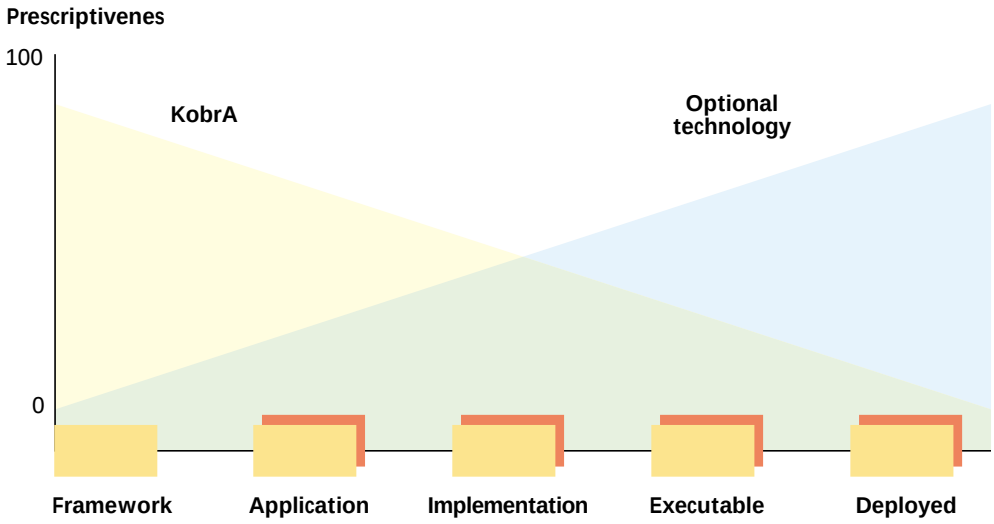

Figure 2: Degree of Prescriptiveness

The three main development dimensions involved in KobrA development are illustrated in [Figure 1]. The abstraction dimension relates to the level of detail at which a hierarchy of components is described (i.e., UML or code level), the specificity dimension relates to the presence or absence of variable features from the perspective of a product line, and the composition dimension relates to the composition of larger components in terms of smaller components. By making solutions to these concerns as orthogonal as possible, different strategies can be "mixed and matched" in a manner that best suits a particular development organization.

Another central dilemma for a development method is achieving the appropriate balance between prescriptivity (that is, the enforcement of concrete rules) and flexibility (that is, the provision of freedom for the developer to work as he or she sees fit). The KobrA Method's approach to this dilemma is illustrated in Figure 2, which shows the degree of prescriptiveness for each of the main artifacts created in the general KobrA development chain.

As can be seen from this figure, the method is most prescriptive (i.e., defines the most concrete rules) in the earlier framework engineering phase, but the level of prescriptiveness decreases roughly linearly through the subsequent development stages, which become increasingly liberal. This approach provides the optimal support for practical migration to the component and product line paradigms, since it gives companies prescriptive support where it is most needed (in the earlier, front-end phases) but allows them to employ their own in-house development technologies for the final implementation and deployment phases. The KobrA method also incorporates innovative approaches to configuration and change management, inspection and quality modeling.

IESE's partners are supporting the project by creating a KobrA case study in the area of Enterprise Resource Planning, and by developing a supporting workbench that can be used with off-the-shelf case tools. In addition, a book on the KobrA method is currently under preparation for publication in the first half of 2001.

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Reverse Engineering at Bosch K3

Reverse engineering consists of recovering information from source code and other information sources, and then creating an abstraction, which can be more easily understood, analyzed, and manipulated. One of the key challenges in this context is to select, represent, and visualize all the relevant data, but only the relevant data, in order to avoid information overload, which happens only too frequently.

Context and Goals

Bosch's car engine management system is a world leader in its field. Most car manufacturers use it. This sophisticated system employs a large amount of software that must fulfill the space and timing requirements of embedded systems.

Developers need to understand various aspects of this system in order to be able to evolve it and tailor it to the needs of a specific customer.

The goal of the Reverse Engineering project was twofold:

- First, it was to identify the information about the system that could be recovered by reverse engineering approaches and that could support developers in performing their tasks.

- Second, it was to demonstrate our technology's potential by extracting the selected information from the flash programming subsystem and representing it so that it could be used in practice.

Approach

The approach taken in the project consists of the following steps:

- Adapt our tools to the specific programming language variation used in the car engine management system
- Identify, together with application experts, the type of information that could concretely support developers in their work
- Extend our tool to extract the relevant information and to represent this information in an environment where it could be visualized and queried by the developers.

Results

The information extracted from the system can be queried and visualized by a developer. In practice, this allows to concentrate on interactions among components of interest, then focus on different types of interaction, one at a time or in combination, according to the developer's needs. The developer can also isolate the calls or data uses that cross memory sections within a selected part of the system, and focus on those cross-section connections that could be critical in a given context. Both of these are examples of how a developer can obtain relevant, just-in-time information for a current task.

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RE-KIT-SPINE Requirements Specification and Management

The RE-KIT-SPINE approach to requirements specification and management enables a coherent requirements engineering process for in-house development, procurement, and acquisition.

Any requirements engineering process involves different stakeholders with manifold views of and responsibilities for requirements: Customers are interested in the expected benefits of the software system. Users focus on adequate services. User interface designers and developers take requirements as input to their design work. Project managers rely on requirements for resource planning, allocation and control. Quality assurance takes requirements as the basis for tests and inspections, configuration management controls changes and releases through requirements.

A balance between these views and responsibilities can only be reached through incrementally developed explicit specification and management of the requirements and their quality criteria.

RE-KIT-SPINE, the Fraunhofer IESE approach to such a balanced method, can be characterized as follows:

- RE-KIT-SPINE treats requirements as living knowledge of the application context and the software that is accumulated and exploited during software development
- RE-KIT-SPINE supports all stakeholders of the requirements engineering process
- RE-KIT-SPINE is tailorable to different application domains, e.g., business systems or embedded systems

RE-KIT-SPINE contains several technical components that give detailed guidelines on all aspects of specification and management:

- Development of precise natural language specifications
- Selection and use of adequate modeling techniques
- Structuring of requirements specification documents
- Quality assurance for the requirements specification
- Capture and use of rationale information, i.e., justifications, goals, options, during requirements engineering
- Capture and analysis of dependencies between requirements

These components can be applied individually or together. This enables organizations to incrementally introduce requirements specification and management practices according to their needs.

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Software Variant Building

The Software Variant Building Project started in September 1997 and successfully finished in August 2000. Participants included six small and medium sized enterprises (SMEs) in Rhineland-Palatinate, and Fraunhofer IESE.

Objective

The objective of the project was to enable these enterprises to benefit from the advantages of developing software in product lines:

- Reduced development and maintenance costs
- Shorter time-to-market
- Improved software quality
- Faster education and training of new employees

Approach

Starting from Lucent's commonality analysis, for each of the involved SMEs the approach was extended and customized according to their specific requirements.

Results

The key result of the project is an SME customization of IESE's PuLSE™ (Product Line Software Engineering) method, which consolidates the experience gained from diverse environments and domains.

First, the consolidated approach takes care of the specific situation of SMEs by not only introducing product line engineering, but also aiming at the introduction of general software engineering capabilities.

Second, the approach supports a step-by-step introduction of new techniques and concepts. Each of those steps is planned in such a way that it results in a significant improvement for the SME.

Third, the approach integrates well with the work in progress and tends to minimize additional effort for product line development. This is important because SMEs must continue working on the existing products and typically cannot afford to focus entirely on setting up a product line. Hence, the approach also supports the integration of (parts of) existing products into the planned product line.

Fourth, the approach is especially centered around the evolution of product lines. Therefore, it takes into consideration that SMEs do typically not plan for a set of variants that must be built, but rather, that they continuously change their product portfolio by adding new variants or by changing the existing ones.

Successful application of the approach depends mainly on two prerequisites. On the one hand, the management of an SME must fully commit to the approach. It must coordinate every development effort spent on products in the product line with the on-going introduction of product line engineering.

On the other hand, the employees of an SME must recognize the ways in which product line engineering supports their work and report the benefits to management. In the absence of measurement programs - a situation typical for most SMEs - this feedback is the single most important factor to ensure management's continued commitment to product line engineering.

The software variant building project was successful in showing that SMEs can benefit from product line engineering. The cooperation with two of the involved SMEs is being continued in the context of subsequent projects.

Partners

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- SoftTECH Software Technologie GmbH
- tec:inno GmbH
- Tecmath GmbH & Co. KG
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Software Project Risk Management at Tenovis

With the increasing dependency of telecommunication products on software and the increasing size and complexity of that software, the risks involved with software development increase.

Fraunhofer IESE supports organizations with integrated risk management for their software practices in such a way that potential risks are continuously made explicit and monitored, and that corrective action is taken.

As a player in the telecom market, Tenovis is faced with the ever increasing demand to accelerate the innovation cycle of its products, providing new services based on the latest technologies in shorter time. Consequently, Tenovis has to change their software development approach and improve their project management to cope with problems like missed deadlines, exceeded budgets or less than satisfactory products in a changing environment. To anticipate and prevent these problems, Tenovis introduced systematic project risk management for one innovative project with the support of Fraunhofer IESE.

Objectives

The main objectives of the project are to:

- Establish risk management procedures integrated with everyday project management. Risks are continuously identified, analyzed and monitored, corrective actions are devised, implemented, and checked on a regular basis.
- Set up a method to learn from risks and mitigation strategies of previous projects. This is achieved by enhancing the Tenovis experience base with risk management experiences and establishing processes to enter and retrieve risk related information. Thus, in the set-up of a new project the project managers can learn about the potential risks of their project as well as proposals for potential corrective actions and their impact on the risk.
- A project monitoring procedure is proposed that can be used to identify deviations from the project's schedule. Thus, the project manager is informed early about problematic situations and can analyze the situation and launch corrective actions as necessary.

Approach

The project started with the selection of a risk management method suitable for the software development environment at Tenovis. This method was transferred and coached by Fraunhofer IESE.

In regular sessions with project managers and developers, potential risks to the project are identified and risks mitigation strategies are implemented for the most important ones.

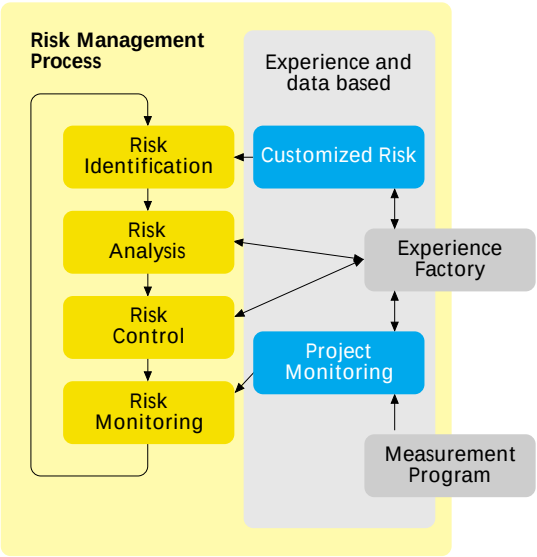
In order to be able to learn from risks in the past, a schema for storing risk related experiences was developed. It includes risks, their project context, corrective actions, and their impact on risks. It is in line with other information objects of the Tenovis experience base. Based on this schema, a prototype for an experience base interface was developed, which allows project managers to enter information and query for potential risks and mitigation strategies in their projects.

Risk monitoring is supported by quantitative data as well: a project monitoring procedure was developed. Effort, productivity, progress, and rework data are being collected as risk indicators in the framework of a measurement program. In a first step, deviations between planned and real data are used as indicators of certain problems that have to be analyzed by the project manager. In a second step, deviation patterns may be interpreted using an experience base to find out the cause of the deviation.

Results

At Tenovis a customized risk management process has been introduced, which may be used for other projects as well.

The risk management procedures are described in detail to make them repeatable for Tenovis. The risk experience base and project monitoring are implemented as prototypes.



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Purchase-based Software Development (BUY-IT)

Component-based software engineering is forecast to have a considerable positive impact on productivity, development cost, and time-to-market. Component, in this context, refers to a piece of software that is to be integrated with a deliverable software system in order to provide specific services. Generally, two possible approaches to purchasing software components exist:

- Purchasing commercially available off-the-shelf software (Commercial-Off-The-Shelf or briefly COTS) for later tailoring and system integration

- Charging software sub-contractors with developing those software components that an organization has a need for.

Regarding the first option, there can be a considerable number of COTS alternatives offering a solution to a specific demand for functionality. Thus, the development organization is faced with the problem of making the right selection of COTS software to be used. Questions arise: Which COTS is the one fitting best to the given requirements? Which COTS is the one with the lowest impact regarding quality decay of the overall system? Which COTS vendor is - from a strategic perspective - the most stable and cooperative one? Which COTS does inject the least architectural mismatches? These questions and risks have to be addressed when dealing with COTS software.

Fraunhofer IESE can provide customers with a method to perform systematic, reliable, cost-efficient, multi-stakeholder-incorporating, requirements-based COTS assessments and selections.

CAP (COTS Acquisition Process) provides this support and consists of two components.

First, CAP fully supports organizations in planning COTS assessments. This is systematic structuring and prioritizing of the requirements according to multiple stakeholder interests, setting up a specific measurement plan, and planning the assessment to save cost but not lose information important for the decision.

Second, CAP gives operational support in enacting the COTS assessments. This is the collection of data on the COTS software alternatives and analysis of these COTS data. Based on this input, a final decision is made regarding the COTS software that will be bought. This information is later broadcast to the supply and the system integration process.

CAP offers a wide range of flexibility regarding roles, interfaces to existing processes, iterations within the process, COTS assessment depth, and maintaining the COTS decision when requirement changes occur or new COTS alternatives are identified.

Experience from a set of industrial projects showed that CAP is superior to ad-hoc or checklist-based COTS selection methods with respect to, e.g., decision reliability and objectivity, repeatability of the decision process, and documentation of the results. Moreover, the measurement activities performed before a COTS decision is made can be reduced by up to 30% compared to the previously stated approaches.

In addition, CAP provides a project management component specifically tailored to the needs of COTS assessment projects. The goal of using this component is to avoid an "over-engineered" COTS assessment and selection ending up in lower productivity, higher cost, and higher time-to-market as compared to traditional development.

Regarding the second option - charging a sub-contractor with developing a specific system component - an organization may be faced with a considerable number of potential software sub-contractors.

MASS (Method for Assessing Software Subcontractors) provides goal-oriented support for selecting sub-contractors that match concrete organizational needs. The method is based on existing approaches, know-how, and experience, e.g., SA-CMM, SW-CMM, ISO 15504. Developing such a second-generation approach has the advantage of remaining compliant to approaches in use. Each existing approach to sub-contractor selection and management focuses on specific aspects and customers, or is tied to a specific process model. Therefore, MASS was developed in a generic fashion covering the functionality and scope of the existing approaches, but providing more flexibility and tailorability to a broad range of organization/project sizes and structures.

MASS integrates three conceptual elements. The first one is a basic step-by-step approach that guides the acquisition of a sub-contractor. The second one is a set of processes that help improve the acquisition process and provide templates for many tasks and data for planning activities. The third element is a set of adaptation processes that continuously gather information about the organization structure and goals, aiming at an adaptation of the other processes to the actual situation, goals, and needs.

Future Fraunhofer IESE efforts will be directed at completing the BUY-IT framework, i.e., at methods for requirements engineering in the scope of purchase-based software development, architecture-centric COTS integration, and informed make-or-buy decisions. The framework will be modular, leaving organizations free to choose when and how to migrate from traditional to purchase-based development.

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Online Process Support for Software Projects

Objective

Software development increasingly involves large development teams. Often, software development takes place in different geographical locations. For managing such software projects, coordination through a defined process is a key factor. Software process improvement is not possible without a defined process.

Fraunhofer IESE offers support for describing these processes and for providing Web-based process documentation. This documentation can be easily accessed by developers via their web browser. Such electronic process guides (EPG) can also help coordinate projects in organizations where software is being developed at different sites, maybe world-wide.

Approach

Typically, organizations use process handbooks to communicate their processes and to coordinate developers in the process. A process handbook is a reference document of company-specific processes that provides guidance to process participants carrying out their tasks.

Printed process handbooks have shown to be inadequate to support software development processes. They are difficult to update and their linear structure is not well suited to describe complex process structures.

The increased availability and use of Internet technology offers new communication channels to make information available to many people across large distances.

Front-end to the EPG is Spearmint™, an advanced process modeling tool. Spearmint provides sophisticated mechanisms to deal with complex process models that are typical for software development. The graphical user interface and the consistency functions provided by the tool allow for efficient capture and maintenance of process knowledge. An export facility generates HTML- and XML-based EPGs on demand, and allows companies to have an up-to-date process documentation available online.

Especially for small and medium-sized enterprises (SMEs), cost is often a key issue. Our experience has shown that for small companies, cost is often the factor that deters them from process improvement. The usage of the Spearmint™/EPG approach allows for cost-efficient development of company-specific process handbooks - focusing on exactly those aspects that are key to the success of an organization.

To further support project management for SMEs, Fraunhofer IESE has developed a process library. This library contains processes especially designed for the needs of SMEs. Using Spearmint™/EPG, these processes can be customized to fit the specific needs of these organizations at low cost.

Spearmint™/EPG has been used to develop process descriptions at several SMEs. From these descriptions, electronic process handbooks were generated, providing up-to-date processes available to everybody in the companies and therefore supporting project management. The development of Spearmint™/EPG has been partly supported by Stiftung Innovation Rheinland-Pfalz.

Spearmint™/EPG has become a way to introduce a defined process into organizations at a very low cost.

Partner

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Secure Electronic Banking

Online banking offers many advantages. For the customer it provides convenient access to his bank account and up-to-date stock market reports. From the bank's perspective, it reduces the costs per transaction. However, one potential drawback of online access lies in security risks inherent in Internet communication. Both bank and customer have strong needs for confidentiality, integrity, and availability of online transactions.

One way to ensure continuous accessibility while shielding the bank's Intranet from direct Internet access is to transfer financial service provision to an independent third party. MarketMaker Software AG is such a provider of financial services that offers online stock market information and professional stock exchange services as well as application software for financial transactions.

Objective

The purpose of a study requested by MarketMaker was to design an architecture for secure online access to client stocks and shares accounts. In this particular case, a number of constraints had to be satisfied, among them:

- An independent mediation device was to be deployed at MarketMaker Software AG for reliable 24-hours-a-day service provision.
- Accounting and stock market data had to be received from a trusted server inside the bank, accessible only for the mediation server.
- The client interface was required to run on any standard web browser without specific configuration needs - even on public kiosk terminals.
- Both bank and customer should have to put as little as possible trust in the mediation device and the communication link.

An additional requirement was to base the solution on off-the-shelf components.

Approach

We first analyzed the functional requirements and security constraints to derive a detailed model of all relevant trust relationships between system components and business partners. Next, we mapped the trust relationships on available security mechanisms and selected standard technology for their implementation. Finally, we assigned the various security mechanisms to the appropriate components to obtain the overall security architecture.

Results

In the final design, sensitive accounting information was encrypted end-to-end with a key known only to bank and customer. The mediation device, while retaining its capability of providing the customer with preformatted business charts, kept critical data in encrypted format, thus reducing its vulnerability to loss of confidentiality or subversion. Therefore, there was no need for specific non-disclosure agreements between bank, service provider, and customer. Furthermore, the mediation device required minimal physical securing. This led to substantial cost reductions and increased the bank's confidence in the security of the final solution.

To satisfy portability requirements, the client interface including the necessary authentication and decryption engine was implemented as a signed Java applet. Consequently, we were able to precisely define the mutual level of trust between customer and bank, solely depending on the terminal's security and trustworthiness. Restricting security considerations to the access point was crucial to simplify the analysis of the service configuration.

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Cost/Benefit Analysis of Investments into Software Process Improvement

Any improvement of a software process should be considered an investment for which the costs and benefits are well balanced. Such economical aspects of software process improvement (SPI) are often overlooked in an SPI program. Fraunhofer IESE supports organizations in prioritizing improvement opportunities and making selections based on expected costs and benefits.

Method

In order to judge both costs and benefits of an SPI effort, our method consists of the following steps:

- Cost Analysis; by identifying the process steps affected by the SPI program and their respective costs (e.g., effort, investments), a foundation is laid for cost calculation. From this information a cost model is derived that is used to calculate the effective costs.

- Beneficial Factors; since SPI benefits are not necessarily based on cost reduction, the quantification of beneficial factors is used to capture profits that are not included in the cost model (e.g., quality improvements, learning effects, image improvement).

- Measures are defined to monitor costs and benefits of the SPI initiative. According to these measures, data are collected in the framework of the measurement program.

- Baselining; in order to know a reference point against which the improved processes are computed, a baseline has to be defined. It can be derived by using expert knowledge (i.e., through interviews) and/or by using existing measurement data.

- Analysis of measurement results by benchmarking the success of the SPI, i.e., comparison of the results with the baseline.

- Roll-out; in case the cost/benefit analysis shows a positive return on investment, the improved process should be firmly established in the organization.

Even for process changes, including a change of technology or method, that have been introduced some time ago, a post-mortem analysis of the return on investment can be performed, assuming that historic data is available.

Example: Analyzing the Cost-Effectiveness of Inspections

Software inspection is one method for detecting defects early. However, it is associated with up-front investment as effort is spent in early development phases in addition to constructive development activities. This effort is expected to pay off by a reduced rework effort in later development phases. Yet, this intuitive expectation needs to be demonstrated explicitly and quantitatively.

In collaboration with Siemens ZT SE3 and Siemens ICN CA MS E we investigated the inspection processes at Siemens ICN CA MS E to assess their economical impact in terms of cost effectiveness.

Approach

The economical impact of inspections was captured using an expert opinion based baselining. This approach involved two major activities.
First, a suitable quantitative model of inspection cost-effectiveness was developed capturing inspection costs and their quantitative benefits.

Second, measurement data was used to develop the baseline for the cost-effectiveness. However, since not all data necessary for the model were collected, expert opinion was used to estimate the missing information. By combining measurement data and expert opinion, the cost-effectiveness was determined for various inspection processes.

Results

The results of this project included:

- An identification of inspection processes that were less cost-effective than others. This helped focus the quality management team's improvement efforts on areas where the gain is likely to be more substantial.

- A baseline for the cost-effectiveness of inspections. The cost-effectiveness of future projects can be evaluated against this spaceline and thus changes to the inspection process can be quantitatively assessed in terms of the improved cost-effectiveness.

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Product and Process Assessment

Due to the abstract and complex character of software products, it is often difficult to get an overview of product and process quality. For this purpose, Fraunhofer IESE performs product and process assessments. During such an assessment, a team of experienced assessors visits an organization, analyzes documentation and software, and interviews people. The result is a set of proposed improvement suggestions based on a strength and weakness analysis compared to best-practices in industry.

Objectives

The goals for performing an assessment can differ, but one always determines either the process or the product quality. Possible areas of application regarding the product are:

- Preparation of (independent) evaluations of software products

- Specific improvement of product quality

- Selection of "strategic" software products

Possible areas of application regarding the process are:

- Preparation of company evaluations
- Specific improvement of process quality
- Selection of sub-contractors
- Benchmarking

Approach

For performing process assessments, Fraunhofer IESE has developed a method called FAME (Fraunhofer Assessment MEthod). FAME is an assessment method that allows you to perform either a SPICE or BOOTSTRAP™ (in the future also CMM) assessment efficiently and reliably in accordance with the upcoming standard for software process assessment (ISO/IEC 15504). It helps to determine the strengths and weaknesses of current software processes and supports you in making well-informed decisions on process improvement.

What makes FAME so unique to existing methods is the added value elements that contribute to it. FAME focuses on the right processes for the right business, provides efficient and reliable assessments, and helps determine best practices to adopt. These elements have been developed through practical experiences from the worldwide SPICE trials, customer projects, and professional expertise. FAME is made for all business types and for all types of improvement needs. FAME is a complete solution to improving the software development processes.

Until now, product checks and product certifications have required a lot of time and money. Therefore, we are currently developing a methodology that, analogous to process assessments, will enable the efficient performance of product assessments as well. In order to fulfill requirements such as reliability and comparability, the methodology is based on recognized standards (ISO/IEC 9126, ISO/IEC 14598, and ISO/IEC 12119). In addition, we also draw upon our rich experience in expertly assessing software products. In 2001, we will be ready to offer product assessments to our customers.

Projects Performed

In 2000, various assessment projects were performed. Several projects were performed in which process assessment was an integral part of a Software Process Improvement (SPI) project. Assessments were also performed in the area of sub-contractor control in the following domains: automotive, mechanical engineering, banking and insurance, and in the military sector.

An impression of the type of projects can be gained from the following quote by Hans-R. Baudewig, Managing Officer of Thomson-CSF Elektronik Kiel:

"Based on our specific needs, the Fraunhofer experts conducted an intensive assessment of our key business processes. The assessment provided us with a big picture of our current development organisation. This helped us to understand where we are positioned and how we could leverage our business to a new level of performance. It also made us realize the unique strengths of our organisation and how to tap into the full potential of our culture."

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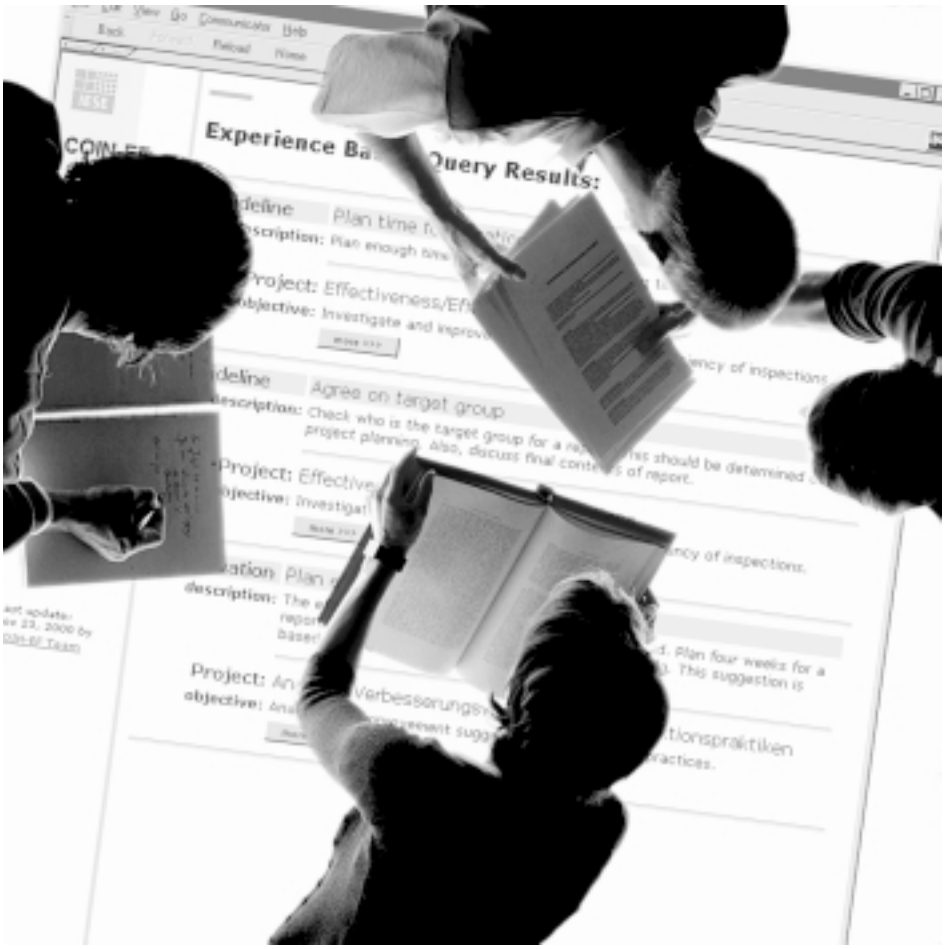
Software Competence Management



Software Experience Portals

The Experience Factory approach has been introduced in many industrial environments during the last two decades and has proven to be a successful concept for the organization of knowledge management in software organizations. In their quest for accelerated and intensified experience exchange, software companies are looking for ways to support such exchange with appropriate technology. Intranets are becoming the technology of choice, as more and more functionality is moved to or integrated with corporate Intranets.

While an Intranet per se is not a knowledge management system, it can, however, strongly support knowledge intensive processes by helping to capture information, simplifying and standardizing information dissemination and retrieval, and integrating diverse information sources. Software experience portals are Intranet web sites particularly designed to support experience exchange.

Objectives

A Software Experience Portal is comprised of a set of tailored processes (to capture, maintain and deploy experiences) and a matching technical support system that allows to

- Effectively capture experience from a large number of software developers, managers and other roles throughout the organization
- Focus acquisition of experience to a well-defined spectrum of topic areas that match current and future business needs
- Disseminate valuable information to a broad community.

A goal-oriented design of the system is vital for success: an experience portal is not just a data sink with powerful storage and retrieval (search) capabilities. It is rather a well-designed living system that is continuously revised and adjusted to the needs of the users and thus oriented to the (changing) business goals of the organization.

Approach

We have developed a method that allows experience portals to be implemented efficiently. The method is comprised of a series of steps that have to be performed in order to elicit the usage scenarios for the portal. This includes determining the goals of the organization regarding the experience portal and consequently, which topic areas are to be covered, how the relevant information is to be elicited, and how such information is going to be used.

In a series of workshops with users and stakeholders, the goals, usage processes, topics, available information sources, and future extensions are determined, documented, and reviewed. The result is a high level design of the intended technical system (data structures, retrieval, storage, web page design, etc.) together with the work

processes that make use of the portal.

Next, this high level design is implemented. That is, the technical system is developed using a set of customizable modules and populated (usually as a series of prototypes), processes are established, users are trained, and effectiveness and efficiency of the system are evaluated and adjusted.

Project Examples

We have created several experience portals for customers as well as for our own organization. The systems cover a range of applications:

- Experience bases for a narrow topic area, such as inspections, goal-oriented measurement and improvement, GQM programs

- Portals for broad topic areas to support software engineering consultants in their diverse work processes and in many topic areas of interest.

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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 Fraunhofer IESE and its sister institute in the U.S., the Fraunhofer Center for Experimental Software Engineering, Maryland, as a framework for creating SEC consortia.

Mission

SEC consortia are designed to bring together like-minded international companies for the purpose of an open exchange of experience 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.

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 started to put together the first international SEC. The official start of this consortium was June 1999.

As of November 2000, the following companies have joined the SEC: ABB (Switzerland), Boeing (USA), Daimler-Chrysler (Germany), Nokia (Finland), Motorola (USA).

More SECs, national as well as international ones, are planned to be assembled in the future.

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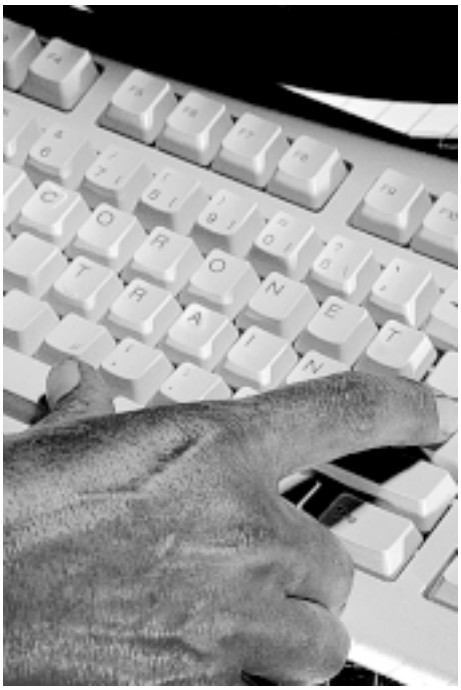

Corporate Software Engineering Knowledge Networks for Improved Training of the Work Force (CORONET)

Web-based learning and training is taking the industry by storm. University education and classroom-based professional training courses play a crucial role for introducing innovative software engineering know-how and for preparing personnel for the increasing and fast changing demands of information technology. But they cannot solve the problem alone due to the limited number of people they can reach.

The research project CORONET will provide a comprehensive methodology and a technical platform for effective and efficient learning and training over the web. Systematic management of knowledge is a key factor in this endeavor. Therefore, the concept of corporate knowledge networks will be used as a framework for creating and exploiting knowledge assets, sharing knowledge for use and re-use, and learning from others and with others.

Objective

The CORONET project pursues the following goals:

- Development and implementation of a new learning and training approach, CORONET-Train, which is essentially based on learning in corporate knowledge network environments and collaborative work with human experts as part of training sessions and on-the-job problem solving
- Design and implementation of a new hypermedia learning environment to support CORONET-Train
- Improvement of hypermedia courseware production through reuse of existing knowledge packages on software engineering methods and techniques
- Validation of CORONET-Train in industrial environments
- Empirical demonstration of the benefits of CORONET-Train.

Approach

Since skill development needs of software developers change rapidly and significantly, it is important that the learning/training environment be flexible enough for new topics to be easily added and discussed.

CORONET-Train has been designed to support a comprehensive set of interaction forms, synchronous as well as asynchronous ones, which help connect individual software developers in a way that:

- They become aware of colleagues within the company who work on similar problems, technologies, and projects.
- They can access training material and other documents on specific topics and technologies.
- They can communicate with their peers regarding training material and other documents.
- They can add new insights and experiences with certain methods and technologies to the information space.
- They can access examples of how their peers used the new method or technology within their projects.
- They develop a "best practice" description of the use of a new method or technology for their specific organizational environment.

Results

The final results of the CORONET project will be available in summer 2002, including:

- The description of the collaborative learning and training methodology CORONET-Train in the form of a handbook
- A fully functional hypermedia learning environment supporting CORONET-Train
- Experience from customized industrial applications of CORONET-Train for several application scenarios
- Hypermedia courseware demonstrators to support collaborative software engineering education and training
- Empirical results of the benefits and cost drivers of CORONET-Train.

CORONET Consortium:

- Centro de Computação Gráfica (P)
- Comunicación Interactiva (E)
- DaimlerChrysler AG (D)
- Editions Highware sarl (F)
- Fraunhofer IESE
- Fraunhofer IGD
- Institut für Informationsverarbeitung und computergestützte Neue Medien (IICM) (A)
- University of New South Wales (AUS)

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CORONET is partly funded by the European Commission under the Information Societies Technology Programme (project no. IST-1999-11634).

Tenovis Software Engineering Education

Tenovis GmbH & Co. KG is Germany's leading supplier of telecommunication solutions for companies with 20 to 500 employees, and for conglomerates such as Aral, Bertelsmann, BMW, Hypo-Vereinsbank, and Volkswagen.

Currently, Tenovis is changing its focus towards software-based IT services. To prepare its personnel for this change, a comprehensive education program has been set in place. The basic component of this education program is a course in software engineering, implemented by Fraunhofer IESE.

The Tenovis Software Engineering Education project at Fraunhofer IESE developed a concept for providing 45 experienced hardware and system engineers with the basics of software engineering knowledge in 30 days.

Objective

Objectives of the Tenovis Software Engineering Education project:

- Provide hardware and system engineers with the basics of software engineering knowledge to prepare them for new projects
- Mix topics of theoretical and practical relevance. General principles of software engineering are illustrated by techniques from the OO domain.
- Provide participants with basic knowledge concerning different roles (developer, architect, and technical manager).

Approach

The approach chosen to fulfill the objectives consists of three modules, each for the duration of 10 days:

- The first module gives a brief overview of relevant software engineering topics from the viewpoint of all three roles.
- The second module exists in three variants with more detailed contents tailored to the needs of the three roles.
- The third module integrates participants from all three roles in a 5-person software development team. Each team executes a small software development project.

The first module defines basic terminology for all three roles by considering the following topics: engineering approach to software development, system analysis, system design, implementation, inspections and testing, project management, quality management. After this module, the participants attend one variant of the second module, depending on their interests.

The second module focuses on one of the roles: the variant for architects considers the topics UML analysis and design, OO testing, architectures, and an introduction to Java. The variant for developers mainly considers the topics UML analysis and design, Java, inspections and testing. The variant for technical managers includes the topics project management, configuration and change management, risk management, and quality management.

In the third module, teams comprised of participants from all three variants of the second module are formed. Each team adds functionality to an existing fully documented software system described in UML and Java. All software development phases from the integration of user requirements to system test are executed.

Results

The TENOVIS Software Engineering Education project is considered a success, and requests for implementing similar projects have allready reached Fraunhofer IESE.

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APO - Workflow-embedded Vocational Training in IT

"The crucial key for a long-lasting education and employment policy within the IT area is the development of a job-related continuing education concept that is fit for the future," said MD Edelgard Bulmahn at the press conference "IT in der Bildung (08/2000) - Anschluss statt Ausschluss".

In the APO project, continuing education and training measures are being developed for those professional degrees that were defined in this BMBF-funded project. The intention is that graduates of IT apprenticeship jobs, university graduates from departments other than computer science, and university students who broke off their studies get an opportunity to specialize in different IT job fields (IT profile) and, through university adequate certificates, secure career opportunities.

Independent of concrete company interests, the APO project develops practice-oriented, professionally competent recommendations, which rely on innovative methodology and didactics, for making continuing education and training in the IT sector a reality.

Objectives

Objectives of the APO project are, e.g.:

- Specify the special requirements of industry and transfer them into a modern education and training system
- Develop learning media that are synchronized with the learning environment, the participants, and with industrial requirements
- Develop quality standards for IT education and adapt these to a certification structure for the IT area
- Build up competence to develop industrial education and training programs according to industrial requirements.

Approach

The realization of the objectives listed above is based on the approach that professional knowledge be transferred on the basis of real work tasks (reference project). For this, a suitable didactical concept must be developed, supported by appropriate electronic learning media.

Implementation of the work-related learning environment (implementation project) into the company environment affects not only personnel development, but also organizational development.

Since certifiable criteria for future continuing education and training measures are to be formulated from the continuing education and training concept being developed, the high quality demand on the results will be ensured by means of an evaluation that will accompany the project.

The project is segmented into a baseline and an improvement cycle. The baseline cycle will describe five out of thirteen IT profiles, the improvement cycle will describe the other eight.

In every cycle one implementation project will be realized. The improvement cycle will exploit experiences from the previous cycle.

Results

At the end of the project, we will have described thirteen reference projects (e.g., Software Developer, IT Manager, Quality Management Coordinator), and realized two (e.g., Network Administrator). Furthermore, we will have developed methods and tools to support the education requirements of industry.

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Industrial Partners

- Berufsbildungswerk GmbH (bfw)
- Bildungswerk der Wirtschaft in Berlin und Brandenburg e.V. (bbw)
- CDI Deutsche Private Akademie für Wirtschaft GmbH
- DEKRA Akademie GmbH
- Deutsche Telekom AG
- Integrata Training AG

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IT Qualification Campaign Rhineland-Palatinate

For many software and consulting companies, the lack of qualified personnel has become a serious restraint on their growth. On the other hand, the region has a high unemployment rate, which even affects persons with university degrees.

The IT qualification campaign is aiming to stimulate the regional economic structure. Suitable and innovative measures contribute to reducing unemployment as well as satisfying the large demand for IT professionals. The project, with a special focus on Rhineland-Palatinate, consists of three work packages:

1. Re-Education Courses

In co-operation with the local Job Center and the Software Akademie AG, we are carrying out full-time re-education courses for university graduates. The courses are based on job outlines and designed to meet practice requirements.

Participants in the course "Software Documentation Specialist" acquire knowledge and skills in:

- Software engineering
- Creation of professional text documents and planning/managing complete software documentation
- Use of suitable software tools.

Participants in the course "OO Developer" are trained for:

- Analyzing customer needs
- Designing, programming, and verifying software solutions accordingly
- Considering quality assurance within the process.

About 40 participants, university graduates from a wide variety of non-CS disciplines, passed the courses in 2000. The great majority of graduates found employment after graduation. In the field of documentation, in particular, we met with enthusiastic response from industry.

2. Web-based Training (WBT)

WBT offers a rising number of possibilities for flexible, self-organized and user-centered learning. WBT allows

- Workflow-adapted "training on the job"
- Goal- and problem-oriented learning in collaborative groups
- Extensive exchange of ideas, information, and resources among learners, tutors, and experts.

The Fraunhofer IESE approach to WBT combines technology-based learning and instructor-based training, enriched with communicative components. Learners will work in small groups on real-life problems and will be supported by technically and didactically qualified tutors.

In a first prototype version a WBT course "Object-Oriented Analysis and Design" is designed for employees of small and medium enterprises. The final version (fall 2001) will address a larger variety of contents as well as further target groups.

3. IT Qualification Network

The IT qualification network will connect the education and training demand of IT companies with Fraunhofer IESE's competence and with the potentials of regional education centers and unemployed university graduates. Fraunhofer IESE is building a co-ordination forum that will investigate the demand for personnel and education and design relevant curricula for re-education courses that meet the requirements. The forum will implement these curricula together with education centers and introduce unemployed persons to them.

The project is partly funded by the European Social Fund (ESF) and by the Ministerium für Arbeit, Soziales und Gesundheit Rheinland-Pfalz (Az. 63-116-2/99)

Partners

- Arbeitsamt Kaiserslautern
- SWA Software Akademie AG

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Software-based Business Development

IT Job Network Rhineland-Palatinate

The demand for IT experts, especially for those with a university degree, is steadily increasing in Germany. The state of Rhineland-Palatinate is no exception in this regard. This was shown by a survey conducted by the Rhineland-Palatinate Ministry of Economy, Traffic, Agriculture, and Viniculture. According to this survey, roughly 1,000 highly qualified IT experts are needed.

In contrast to jobs with lower qualification requirements, the short-term demand for highly qualified IT experts can neither be fulfilled by further education institutions nor by graduates from university. Motivated by this shortage, the German federal government initiated a "Greencard Program" with the objective of acquiring highly qualified IT experts from outside the European Union.

To help the local economy of Rhineland-Palatinate benefit from the Greencard Program, the Ministry of Economy, Traffic, Agriculture, and Viniculture asked Fraunhofer IESE to set up and host an Internet portal for Green Card applicants. The portal, which Fraunhofer IESE developed, allows companies to register open job positions and applicants to post their resumés. In June 2000, companies and applicants started to post job offerings and resumés. Various public relation activities were conducted, ensuring fast population of the database.

Job seekers and companies both use the same information categories for specifying their requirements and qualifications, respectively. This allows for an automatic matching of electronic job descriptions and qualification profiles. The software used for the matching is not only able to suggest applicants for open positions on the basis of exact matches, but also on the basis of good, but not perfect matches.

Various parameters allow the specification of "kill criteria" (e.g., insufficient German language skills) and the definition of acceptable matches (e.g., by specifying the importance of each category of expertise). The intelligent software is even able to balance out strengths and weaknesses of an applicant. For example, if an applicant has only basic knowledge in the programming language Java (although expert skills are required) and expert knowledge in Oracle databases (which is also required by a given job description), this applicant will be preferred over an applicant who has expert knowledge in Java, but no experience regarding Oracle databases. Once suitable candidates have been spotted, the software automatically e-mails the resumés of the applicants to those companies that posted a matching job description.

From the viewpoint of Fraunhofer IESE, this project is a first step towards building skill databases systematically. Since skill databases allow people to be found quickly for and within organizations, they are becoming increasingly important, especially in large companies.

Partner

Ministerium für Wirtschaft, Verkehr, Landwirtschaft und Weinbau des Landes Rheinland-Pfalz

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Making an E-Commerce Organization Fit for Market through Process Improvement

Objective

E-commerce is an emerging new business field with a high potential for establishing new markets. As more and more companies move towards e-business, e-commerce is one of the future trends.

The new E-conomy is highly dependent on well functioning, secure, easy to use and good quality e-commerce applications. Time-to-market for e-commerce applications is very short and so are the development processes.

Characteristic for many of these e-business companies is often an ad-hoc development process, high staff turnover, and rapid growth of the organization. Yet, any e-commerce project is a software project that requires specific management techniques, styles, and skills, just like any other IT project.

However, conventional development processes are not suitable, because they are too inflexible. For e-commerce development, process frameworks are needed that organize and coordinate the critical tasks of the project.

Approach

A process to suit the needs of e-commerce applications requires the integration of best practices (e.g., ISO), familiarity with product line concepts, and knowledge that is characteristic for the e-commerce domain. This combination allows to tailor a process specifically to the company's needs.

The outcome is a process specifically designed to fit the needs of an e-commerce company. To strengthen the new process even more, introduction of the process should be supported by intensive coaching. In addition, a suitable documentation structure, along with templates and examples, facilitates acceptance and use of the process.

Establishing a process allows to keep knowledge within a fast-changing company. In addition, a process definition allows data collection for cost estimation and, therefore, better project management and planning.

The situation within the e-commerce development at maxess was typical for a dynamic e-business company: An originally small organization with constantly high workload had tripled in size within less than two years. To maintain product quality and remain competitive on a tight market, a well-defined process was necessary.

Based on product requirements and company characteristics, a new process was defined and introduced.

Maxess now has a new process that specifies the main tasks and the documentation of the deliverables. Such a process allows the organization to remain competitive on the market.

The introduction of the process was supported by intensive coaching of the new process and the tools used.

Results

The maxess experience has shown that in e-commerce development, a well-defined process is a key factor to business success.

Fraunhofer IESE supports companies that transfer their business to e-commerce by setting up proper processes and applications. By integrating best practices and domain-specific knowledge, Fraunhofer IESE is able to define processes that are tailored to the specific requirements of e-commerce development.

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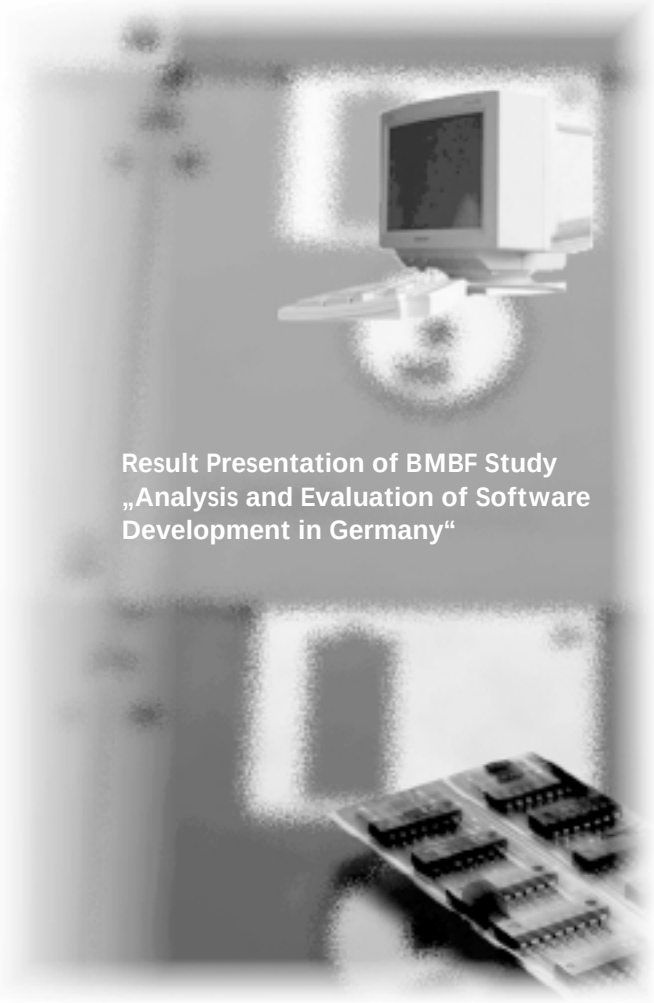

Result Presentation of BMBF Study „Analysis and Evaluation of Software Development in Germany“

The study ‘Analysis and Evaluation of Software Development in Germany’ represents the most current comprehensive survey regarding the commercial and technological role of software and software development in Germany across many sectors of industry. It was commissioned by the German Federal Ministry of Education and Research (BMBF), and performed by GfK Marktforschung GmbH (a Germany-based international market research organization) in Nuremberg, and the Fraunhofer Institutes for System Technology and Innovation Research (ISI) in Karlsruhe and Experimental Software Engineering (IESE) in Kaiserslautern. Its intention is to serve as a baseline for future decisions on education and research (funding) strategies in Germany.

The study shows a dramatic increase in the importance of software from a business perspective across all sectors, dramatic deficiencies in current software development practices in industry as well as a lack of qualified personnel. However, one can observe trends towards more engineering rigor in software development, increased emphasis on reuse, and more strategic decisions on in-house development versus outsourcing/purchasing of software. The expected result of this latter trend of ‘smart’ outsourcing is that in the future, companies within the secondary sector will focus more on hiring application developers rather than programmers.

The study results suggest that there is a dramatic need in Germany for establishing a significant research program in Software Engineering (similar to the one triggered by the Presidential Information Technology Advisory Committee Report (PITAC, http://www.ccic.gov) in the United States), and also for providing software engineering education with a major boost. The concurrent view expressed in the in-depth interviews is that Germany will only have a long-term future in software development (i.e., generate jobs in software development) if companies achieve a software process maturity that ranks among the best in the world, and if the educational system produces enough highly qualified software engineers.

In summary, the role of Software Engineering Technology for Germany’s economic future is expected to be of similar importance as, e.g., the role of Production Technology in the past! Fraunhofer IESE will continue to take the lead in developing cutting-edge software engineering technology, supporting companies in adopting such technologies, and lobbying for a comprehensive National Software Engineering Initiative.

The Fraunhofer IESE team consisted of Prof. Dr. Dieter Rombach, Susanne Hartkopf, and Kirstin Kohler. It was supported by Prof. Dr. Manfred Broy from the Technical University of Munich.

A German version can be downloaded from the Internet (http://www.dlr.de/IT/IV) or ordered from Fraunhofer IESE.

Project Partners

- GfK Marktforschung GmbH
- Fraunhofer Institute for Experimental Software Engineering IESE
- Fraunhofer Institute for System Technology and Innovation Research ISI

Analysis and Evaluation of Software Development in Germany

A Study for the German Ministry of Education and Research BMBF

Executive Summary

December 2000

Fraunhofer IESE Translation of the Original German Version
(see Appendix, page 87),
not authorized by BMBF

Mandate and Procedure

The study "Analysis and Evaluation of Software Development in Germany" for the German Federal Ministry of Education and Research (BMBF) was performed by GfK Marktforschung GmbH in cooperation with the Fraunhofer Institutes for Experimental Software Engineering (IESE) and for System Technology and Innovation Research (ISI). The goal of the study was to quantitatively and qualitatively characterize the national software market, which continues to increasingly develop into one of the key markets in Germany and world-wide, and to describe its future development and its requirements. This is the basis for determining the investments necessary for the success of software development in Germany, to include both investments into research and technology development as well as those into professional qualification and education.

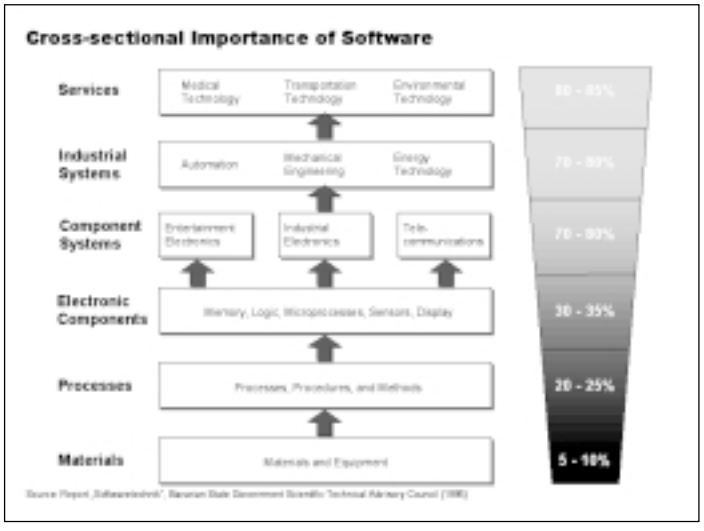

Figure 1

The triggers for this study were, on the one hand, the rapidly changing situation on the software market, where software is increasingly being developed as an essential, often competitive instrument by companies of all application domains (secondary software sectors) - in addition to software companies (primary software sector), and, on the other hand, the lack of market data specifically on the situation of secondary software sectors. The primary sector includes not only data processing service providers, but also manufacturers of data processing devices and equipment. Secondary sectors included in the study are companies from the areas of mechanical engineering, electrical engineering, automotive engineering, telecommunications, and financial services. This selection ensures coverage of sectors within the manufacturing and service sectors that have a high percentage of software development. Other sectors, like medicine, chemistry, biology and gene technology as well as the entire media and entertainment sector were not examined in order to limit efforts, since the main purpose of the study in the secondary sector was to create a situation analysis, on the basis of which recommendations for action can be given for research funding. It was also necessary to take into account that the secondary sector is basically unlimited. This is the case in the media and entertainment sector in particular, which has a massive problem of defining and differentiating the sector from related sectors.

This study makes methodical use of a combination of representative telephone interviews for capturing quantitatively significant facts and expert interviews for qualitative intensification of predictions for the future, in particular.

As part of the telephone interviewing process, interviews were held with a total of 920 representatives of primary sector companies (n=249 companies) and secondary sector companies (n=671) selected on a cross-section basis. The target persons for the 30-minute (on average) interview in each company was usually the director of software development or, in the case of smaller companies, frequently the owner or manager. Since official company statistics were not available, which were, however, necessary for arriving at basic figures and thus at a basis for estimates for the results per sector, extensive prior research was done using the German Federal Office of Statistics (Statistisches Bundesamt), the German Federal Labor Office (Bundesanstalt für Arbeit), as well as information services and address companies.

In addition, 55 expert interviews were conducted with staff at primary and secondary sector companies, expanded by the sectors trade, transportation, and chemistry/pharmaceuticals. From the various sectors, both small, young and/or profile determining and market leading companies were selected. The persons interviewed in the companies were part of middle and upper management in software development. The objective of these expert interviews was to gain deeper insight into the practice of software development from the point of view of those directly affected, as an addition to the facts obtained from the representative company interview.

Based upon the data from these interviews and scenarios, conclusions are drawn for necessary measures to be taken in research and education policy. The major results of the foci "Market Structure of the Software Sector", "Personnel Situation in Software Development", and "Technological State of Innovation in Software Development" will be summarized below.

Number of Employees in Companies with Software Development

	In companies with				Total
	1 – 9 employees	10 – 49 employees	50 – 199 employees	500+ employees	
Primary Sector	44,000	39,000	42,000	173,000	298,000
Secondary Sectors total	25,080	56,700	131,900	2,274,360	2,457,960
Mechanical Engineering	2,800	24,700	61,800	1,254,500	1,343,200
Electrical Engineering	7,300	16,100	24,500	176,000	223,900
Automotive Manufacturing	150	200	3,300	138,600	142,250
Telecommunications	250	1,500	3,400	186,000	191,150
Financial Services	15,380	14,200	38,700	619,200	668,400
Total	69,080	95,700	173,900	2,444,360	2,702,960

Figure 2

Market Structure of the Software Sector

In Germany, software is currently being developed and/or modified in approximately 19,000 companies of the sectors investigated - 10,500 primary sector companies (data processing, manufacturers of data processing devices and equipment) and 8,650 secondary sector companies (mechanical engineering, electrical engineering, automotive engineering, telecommunications, and financial services). These companies employ a total of approx. 2.8 million people (approx. 300,000 employees in the primary sector and 2.5 million in the secondary sectors) (Figure 2). While the structure of the primary sector is largely characterized by small companies with 1-9 employees, software development and modification in the secondary sectors takes place mainly in medium-size and larger companies.

Sales involving software have massively increased during the last few years, there is no end of the growth on the horizon. According to a press statement by Bitkom (http://www.bitkom.org/presse/pr230200.htm), sales on the German market for software and IT services amounted to 55.5 billion DM in the year 1999 alone. In the secondary sectors, the sales volume involving software is much harder to appraise. By now, in many secondary sectors the entire volume of sales is dependent on software. In the automotive industry, for example, control functions can no longer be realized without software, automobiles can not be produced or sold without software, and business processes - from production planning to human resource planning - can no longer be maintained without software.

As a result of the representative company study, the value added in the primary and secondary sectors through software development and modification was calculated to amount to a total of approximately 50 billion DM. This value is already relatively high if viewed by itself. It does, for instance, surpass the value added in the sector of agriculture, forestry, and fisheries (approx. 42 billion DM) by roughly 20%.

However, the calculation of value creation that is customary in macroeconomics, which was also applied in this study, does not do complete justice to the strategic importance of software - especially in the secondary sectors.

The way software development departments are treated as pure cost factors in the overwhelming majority of companies shows that the strategic importance of software as a sales generator has not been recognized yet in many companies. The first secondary sector companies, however, are already starting to justify software development projects not via their cost share in product development, but rather via the amount of sales that can be realized with the help of this software. This indicates that companies increasingly understand software as investment and "business enabler", and no longer as a pure cost factor.

Software is created as an independent product (primary sector) or embedded into products or services (secondary sectors).

The Primary Sector is characterized by young companies (67% of the companies in the primary sector were founded after 1990) (Figure 3). New companies are founded as spin-offs by people working at universities, research institutions, and companies, but also by established companies developing products out of their internal project business and marketing them in external spin-offs. Thus, companies from traditional sectors (e.g., commerce) create new bases in the primary sector by professionalizing their internal products (e.g., merchandising systems). Overall it can be assumed that the boom on the primary sector can also be traced to the lower demand for investments of service-oriented companies and to more flexibility regarding location.

The Secondary Sectors reflect the traditional strength of the German economy. Engineering-style individual solutions (e.g., control functions for automotive safety like ABS, energy use that is friendly to the environment, like injection systems, or comfortable maintenance like online diagnosis systems) contribute to the fact that these sectors can expand their global leadership. In all of these sectors, an increasingly stronger shift from hardware to software can be observed in the area of development. Overall, however, the growth potential even in the secondary sectors lies in the area of

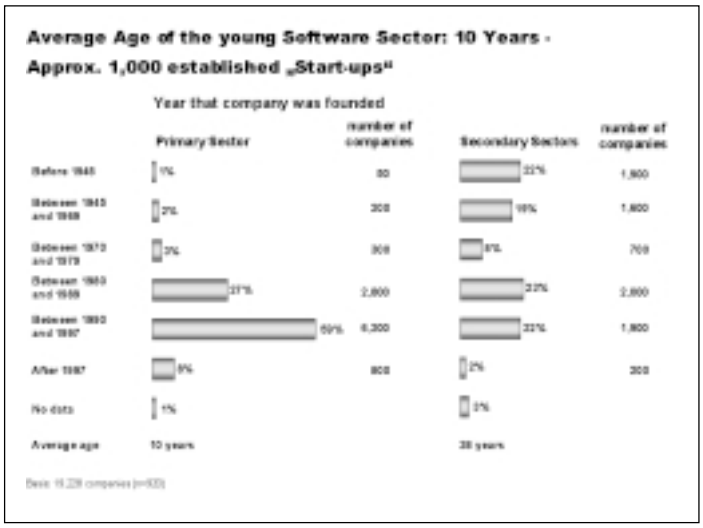

Figure 3

services. This is not only true for business process support in the traditional service sectors like commerce (e.g., electronic business), banks (e.g., electronic banking), and telecommunications, but is also increasingly manifested through software-based added-value services that accompany a product.

One particular characteristic of existential significance for secondary sector companies is the high age of many software systems. Their creation often dates back to the 70s. These are so-called Legacy Systems. On the one hand, these legacy systems have matured over many years. They contain the company's accumulated application knowledge and are extremely stable. On the other hand, many of these systems were developed with methods that are now obsolete and turn out to be very difficult to maintain and modify. Changed businesses processes, however, require innovative software solutions. This results in a dilemma for many companies: How to meet the new challenges without seriously jeopardizing the present stability?

In software development, geographical flexibility of software development, lack of staff, and considerations regarding the strategic importance of software contribute to a major change in the decision on which software will be developed in-house and which development will be outsourced/ subcontracted. The companies with high software competence concentrate more on in-house development of the kind of software that relates to their core competence.

One important motive for the extensive outsourcing of software development is the lack of qualified staff. Orders are given to one's own branch offices or to outside companies in countries within and without the European Union or Asia. These subcontractor relationships often prove to be complicated with respect to the coordination of the development processes between customer and contractor, as well as with respect to the frequent lack of application know-how on the part of the subcontractor.

In the secondary sectors, in particular, the necessary amount of in-house development of software is currently being discussed. Which software guarantees competitiveness and must therefore be developed in-house? Which software does not provide competitiveness and can/should be outsourced or purchased? One can currently observe two different trends in this respect. Whereas automotive manufacturers are considering re-assuming some of the software development that has been outsourced so far, banks and insurance companies are planning to increasingly outsource. A few statements of intentions (from the expert interviews) are available, according to which some of the banks and insurance companies want to increase their external development proportion from currently

approx. 30% to 70 or 80%. The issue of which software is of strategic importance to the company always plays a prominent role in this decision.

Even when software development is outsourced or purchased, the companies must continue to possess the know-how on how to develop applications. This means that fewer programmers are needed. Instead, there is a more urgent need for requirements engineers, system architects, and acceptance testers. In this respect, the secondary sector companies are replacing programmers with software engineers. Overall, a differentiation of various roles in software development can be observed, but this is only slowly gaining ground.

The intended increase of software development outsourcing can only be met insufficiently by purchasing off-the-shelf products. This leads to major changes. Either new primary sector companies get the chance of acting as subcontractors, due to the standardization of use architectures, or secondary sector companies like financial services companies found spin-offs.

The unique position characteristics of innovative products and services like telecommunications or insurance products are no longer conceivable without software.

Competition is increasingly determined on the basis of "software-enhanced" functions of the products or services. As a result, for high wage countries like Germany, jobs with high value creation, like those found in the areas of software-enhanced products and services, are gaining significance.

Personnel Situation in Software Development

The present personnel situation is characterized by a major deficit in qualified personnel. The study found a demand of 28,000 software developers for immediate employment and a demand for 55,000 software developers for hiring in the next 12 months, which reflects the minimum demand. The additional fluctuation created by retirements and an additional demand for application developers, which can hardly be quantified yet today, will put even more pressure on the demand for personnel. Many companies call the lack of personnel their most urgent problem in software development at this time. Satisfaction of this demand through a freely available workforce on the market is currently so insufficient that many companies do not even list the exact number of their vacant positions any more. Promising projects are postponed due to the lack of human resources. All this indicates that the figures gathered represent a rather conservative estimate of the actual demand.

As far as the qualification of those employed is concerned, the majority has an academic education. While computer scientists represent the majority on the primary sector, the majority of employees on the secondary sectors have a sector-specific qualification. Large secondary sector companies are attempting to increase the proportion of computer scientists. However, they currently fail in doing this, because of the low supply as well as because of the often-criticized lack of application orientation of university studies for computer scientists.

One major problem in assigning suitable professionals - in particular the effective use of computer scientists - lies in the ambiguous role definition for various software development activities, in qualification requirements that are not sufficiently defined, as well as in a lack of continuing education measures for up-dating the necessary know-how. Until now, there has not been enough differentiation in software development between engineering activities like requirements analysis or system design and simpler technical activities like programming or component testing. Unlike in other technological areas, there is no broad acceptance of the fact that for engineering activities in software development, a university degree (e.g., computer science) is required, whereas technicians can also find their way into practice via professional academies or apprenticeship professions. Consequently, highly qualified computer scientists are not used adequately, they do not feel challenged enough and leave for the primary sector.

Professionalizing software development requires a clear picture of the roles and matching qualifications. Professional titles, in particular, like ‚software engineer' should be protected. Due to the rapid cycles of innovation in the software sectors, a life-long qualification concept is also necessary. Having nothing more than a solid basic education is just not enough anymore. Continuing education and training must become the rule. This requires a change of attitude in both employers and employees.

The medium-term demand for human resources until 2005 is increasing rapidly. Based on the results from the interviews one can assume that by 2005, the number of people employed in the primary and secondary sectors will rise from 177,000 (today) in software development to an estimated 385,000 (Figure 4). This is an increase of almost 120%. The main growth market will be the primary sector with 179,000 additional jobs. In the secondary sectors, an additional growth of 30,000 jobs is expected. If the secondary sectors not considered in the study are taken into account, the number will again increase significantly. Furthermore, a significant shift from jobs in hardware development to those in software development is to be expected. Since university graduates traditionally constitute the majority of software developers in the primary sector, and since in the secondary sectors, due to increased outsourcing of pure programming activities, an increased trend towards university graduates is also to be expected, it is obvious that this high demand for highly-qualified people can not be covered by the standard courses of study at the universities and other educational institutions. Even if the rationalization potential on the technical level of programming is fully used by

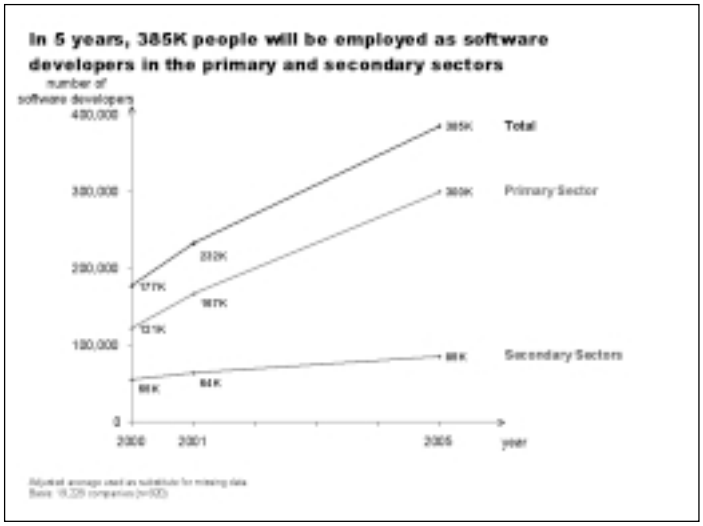

Figure 4

using tools, an additional increase in the demand for human resources is still to be expected.

The expert interviews, in particular, have made it clear that in the secondary sectors the qualification expected of applicants varies greatly depending on the size of the company.

Large companies are mostly looking for engineers with university degrees for software development. The foci of these employees' activities are in the area of requirements analysis and architecture. They develop the architecture of the software and decide which components to purchase externally and to integrate. For this, understanding the application as well as computer science concepts on a high level of abstraction are necessary prerequisites. These are taught in particular via application oriented courses of computer science (e.g., practical computer science with a focus on mechanical engineering or business administration). Small and medium-size companies, however, present an entirely different picture. They have a very high demand for graduates of technical colleges. The focus of their employees' activities lies in programming and application adaptation. The practice-oriented education of technical college graduates makes it possible to quickly make such employees familiar with their new jobs. Some companies have had less positive experiences with university graduates, since they often lack routine in dealing with applications and are not challenged enough and unsatisfied with pure programming activities.

Independent of the size of the company, there is an increasing demand for upper level managers with a computer science education. This is, for example, evidenced by the fact that more and more often, software-heavy companies are creating the position of a Chief Information Officers (CIO). The increasing importance of software, especially also in the secondary sectors, also entails an increasing demand for employees with leadership qualifications. For large software projects, in particular, project managers are increasingly in demand. Since software increasingly determines competitiveness, computer science issues are of central importance for a company's success, up to the level of the Board of Directors.

Regarding the topic of education, the companies interviewed are increasingly urging interdisciplinary courses of study, in which secondary sector application know-how is combined with computer science know-how. For computer science education, high importance was assigned to teaching the methods and technologies of

quality assurance for software as well as teaching component-based software development. Current education often concentrates too much on the ability to develop new software, instead of dealing with standard components and aggregating these to new systems. Furthermore, social and communication skills like team and leadership skills should be taught much more.

Short innovation cycles of methods and tools in the area of software development as well as the shift in activity foci described above also require new concepts for continuing education. In order to be able to keep pace with the rapidly changing environment in software development and fulfill the increasing demand for software developers by retraining employees, many companies want institutions that support "life-long learning". Major companies meet this challenge by founding their own "Corporate Universities". Small and medium-size enterprises are currently looking for new possibilities of quickly and cost-effectively making their employees familiar with new methods and technologies in the area of software development. In this context, repeated demands were voiced for expanded offers by the universities, which should not only educate engineers, but also continue to educate them.

Technological State of Innovation in Software Development

The various requirements on software are caused by the different areas it is used in. In practice, however, quality requirements are often dominated by cost and time constraints. The result is that quality defects only become visible too late in the development process. However, the realization that quality must be taken into account right from the start of the development process is slowly taking hold, just like the realization that investments into quality will also, when viewed comprehensively, have a positive impact on costs and development times. Indications of a change in thinking towards this direction can already be seen in the increased early use of inspections and reviews, through which problems can be identified and solved on time.

In general, a trend towards risk-minimizing development processes (e.g., incremental processes) can be detected. By reducing the development increments to a manageable size, individual companies can already attain significant improvements with regard to plannability, and thus show a higher rate of success.

As far as the method is concerned, there is a strong focus on early defect detection through inspections and reviews, on the use of component technology for cost reduction, and on improved interaction between software development proper and the requirements from the application in the context of the requirements analysis.

As far as technology is concerned, the discussion about the future of software development is dominated by the topic Internet. The Internet determines the trend, both as a platform for services and as a development platform for software. This represents a major change of paradigm for many companies. The urgently necessary changeover from their central software systems necessary for their survival to the new platforms is often too much for them. The consequence is further increase in the amount of "Legacy Software".

Cooperation with universities and research institutions is still below the desirable level and below the level comparable to countries like the U.S. Of all the primary and secondary sector companies interviewed, only 22% indicated that they even do any kind of research (Figure 5). In the expert interviews, however, this was placed in a relative context in many cases, since many companies consider research to be "academic basic research". In fact, the so-called "predevelopment" that many companies do is nothing else but applied industrial research. Overall, smaller companies in particular are having a hard time developing a comprehensive, long-term view with regard to software development and in doing so, correctly assess the role and the importance of research. Seen on the whole, the result of the high pressure on development and the lack of professionals is that innovative technologies are not tackled sufficiently. Chances and poten-

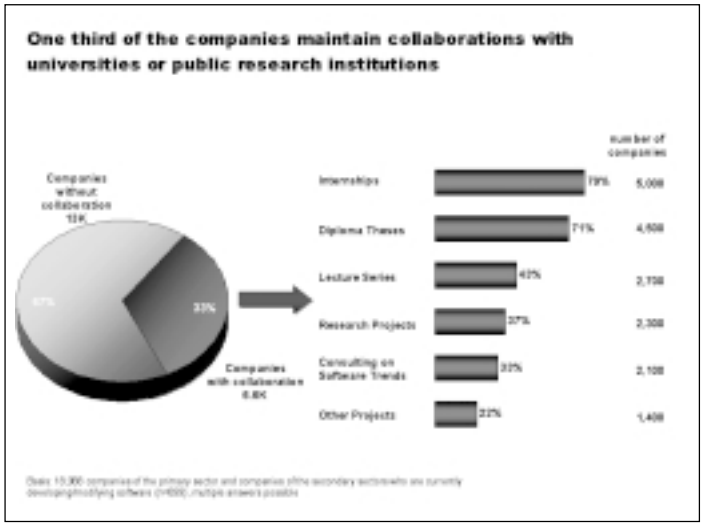

Figure 5

tials of innovative technologies are not used or are used too late.

Increased cooperation on these topics with universities and research institutions is desired, but is considered to be hard to realize at this time, since many universities and research institutions are not application oriented. Examples for useful cooperation models mentioned were the research-on-demand practiced in the U.S. and the Fraunhofer model in Germany.

Recommendations for Action

These results suggest the following urgent Recommendations for Action:

According to the unanimous opinion expressed by all interviewed experts, the prerequisites for favorable development of the secondary sectors in Germany as well as for primary sector growth consist of increased efforts in technology development (especially in software technology) as well as in the continuing qualification of professionals. However, a massive increase of government funding in the area of software technology is urgently required. Carefully matched, differentiated forms of funding must be selected in order to do justice to the special requirements of this area.

Direct economic support for primary and secondary sector companies is not necessary. In order to make innovative technologies accessible in companies, financial support is needed less than better overall conditions, for instance, qualified young talents and competent partners in research institutions. Support for research in the area of software technology is required, which will build a broad research infrastructure in universities and research institutions based on the topics that are of strategic importance to German industry, and which is available to the wide field of companies as a point of contact for collaborations outside public funding.

Substantial public support for research is absolutely mandatory for several reasons, and is of central importance to the rapid development of the software sector: first, the necessity of making better development methods (software technology) available has been recognized in all sectors of industry and must therefore be considered a national task for securing the future in one of Germany's most important growth industries. Second, there are specifically German challenges like the solution of a software variant building problem in those secondary sectors that have traditionally done a lot of manufacturing, like the automotive industry. Third, there is a great opportunity for stimulating a boom of spin-offs in the primary software sector by supporting sector-specific software competence (e.g., for defining sector-specific software architectures). These new companies will serve as competent suppliers of large system integrators in the secondary sectors. Support must generally concentrate on the following foci:

- Improvement of the degree of software maturity in the companies through evolution of standards (state of the art, best practices) and support for companies in implementation. This also includes systematically gathering data for assessing different technologies in software development

and tailoring technologies to the different application domains.

- Basic research to have a scientific foundation of software technology in critical and future-oriented areas (safety, security, methodology, tools, models, etc.).

- Developing of and experimenting with innovative concepts in software technology.

These three areas complement each other and create synergies. In addition to quick, decisive, wide-spread, substantial support for research, they will also need a massive increase of educational capacities in schools, professional training, technical colleges, and universities.

■

The experts provided very specific ideas on the type of research support. On the one hand, the question about "market oriented research" or "basic research" was answered with an unambiguous "both". People increasingly think that in an area with such rapid development (with technology half-time values of 3 to 5 years), only topic-specific parallel support for basic research and applied research promises success. Therefore, the following items were considered to be the most important issues of a goal-oriented support program:

- Small projects (not large consortia, but rather a few active companies and research institutions with efficient dissemination of results),

- Permeable structure (integration of basic issues and applied issues, integration of research and application partners),

- Inter-disciplinary approach (many challenges require interdisciplinary know-how), and

- Faster project assignment (publishing of research programs and project assignment must be accelerated in accordance with the time requirements of the field).

Thematic control requires instruments for faster and more goal-oriented reaction to new innovative topics. This requires establishment of a small, effective control panel with experts from business, science, and politics, which reviews research strategies and modifies them continually.

■

When identifying important research topics, the specific strengths of Germany as an economic center - a strong manufacturing industry, a culture of individual production rather than mass production - must be taken into account. Therefore, research should concentrate on the following application domains in particular:

- Software in products ("embedded software", e.g., automotive, cellular phones)

- Software for the support of services (e.g., insurance companies, public administration, health sector, planning and logistics)

- Software for value added services that accompany a product (e.g., traffic guidance systems for vehicles)

Research on software technology should face the following areas:

- Improvement of the software competence of companies on a wide basis through incremental improvement of processes, procedures, tools, and methods

- Development of the scientific basis for making software technology a genuine engineering discipline and as the basis for innovative technologies

- Providing and experimenting with innovative software technology

All three areas mentioned are of central importance and depend on each other.

Thematic foci could be set as follows:

- Processes, methods, and tools for the development and integration of reusable software components ("componentware") on the basis of long-lived software architectures
- Processes, methods, and tools for the efficient development of high quality software
- Processes, methods, and tools for the efficient development of software variants
- Processes, methods, and tools for the support of geographically distributed product and software development
- Configurability and scalability of software systems in heterogeneous application systems
- Documentation, representation, and personalization of information contents from heterogeneous data sources ("Knowledge Management", "Contentware Engineering")
- Development of human-to-machine interfaces tailored to user demands ("Human Centered Engineering")
- Development and integration of heterogeneous network infrastructures with scalable functions ("Network Engineering")
- Requirements Engineering for capturing, documenting, validating, and tracing complex applications
- Innovative future-oriented software technology like ad hoc systems, extreme programming, net-based software infrastructures

Additional cross-sectional topics for all application domains include

- Digital modeling and simulation: computer implementation of complex models as a substitute for experiments
- High performance information processing for processing large amounts of data
- Security: against unauthorized access during data transfers via heterogeneous networks

■

Parallel to software technology research support, new quantitative and qualitative emphases must be put on continuing education and training. The demand for qualified professionals requires differentiation and expansion of the education and training offered in the area of software. This can be supported by

- Increasing capacities in computer science,
- Better integration of IT application know-how in other courses of study,
- Reduction of study times,
- Additional funding for apprenticeship professions in the IT area, as well as
- Increased continuing education measures.

With respect to quality, however, a general renewal of the German IT education and training system is considered necessary. This renewal should focus on internationalizing university education, updating the contents taught, increasing interdisciplinary collaboration as well as incorporating practice orientation. Integrating IT application know-how into other courses of study and continuing education and training in the sense of life-long learning are other urgent requirements.

One decisive factor will be the education of top qualified software experts, who will determine how fit for the future software systems in companies are and who will open up new areas for software use. Such experts can only be trained on the hotbed of a network of ambitious projects and competence centers. Maybe they will be the most valuable outcome of goal-oriented research support.

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It can be noted in general that the research environment in the Federal Republic of Germany turns out to be too unwieldy for the innovative, rapidly developing field of software technology. The existing institutes mainly deal with topics from traditional disciplines, hardly any work is done on modern software topics, or such work is done uncritically. More competence centers and institutes are urgently needed.

The chances for Germany in this know-how-oriented field for the future are excellent. However, the important new emphases in research and education must be set immediately, in order to secure and expand a strong presence of German software producers on the global growth markets of the future.

Profile of Fraunhofer Center Maryland

Vision and Mission

In 1994, the Fraunhofer Gesellschaft established Fraunhofer USA, headquartered in Plymouth, Michigan, as the mechanism for fostering collaborative activities with research institutions and industries in the United States. Since then, six separate centers have been set up in the United States, each center affiliated with both a local American university and one of the Fraunhofer Institutes in Germany.

Now in its third year, the Fraunhofer Center for Experimental Software Engineering, Maryland (FC-MD) is the only Fraunhofer USA center in the US to specialize in software and related engineering fields, with a focus on the use of experimental approaches to introduce innovative techniques into industry. FC-MD is a US, not-for-profit, 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 improvement to those needs.

Business Fields, Targets, Benefits

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.

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 FC-MD lie in the areas of technology transfer and process and product improvement.

As technology transfer agents, FC-MD 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 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 engineering 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 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.
- 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 company-wide experience bases to allow the organization to expand their learning organization concepts to other projects and divisions.

Development of an Experience Management System

Knowledge intensive organizations are highly dependent on their employees. Organizations for software development and applied research are prominent examples as their products are intangible and seldom documented, so most of the knowledge resides in employees' brains. The damage to the organization can be severe when employees leave and take the undocumented knowledge with them.

To prevent such damage and to enable organizational learning, an Experience Management System (EMS) is under development that will capture, structure, and share knowledge within an organization.

EMS is based on FC-MD's Executive Director Victor Basili's concepts of the Experience Factory and our experience with solving knowledge management problems. The Experience Factory recognizes that all organizations need to learn from their past successes and failures, and from one another. A vital point in enabling such organizational learning is to make knowledge available and accessible to all employees.

The first part of 2000 was devoted to requirements analysis based on the evaluation of an already existing prototype of EMS and analysis of current commercial systems. One main requirement is for EMS to support distributed and fast-paced knowledge intensive software organizations. It is therefore based on advanced Internet and client-server database technologies as well as state-of-the-art graphical user interfaces. During the second part of 2000, the EMS was implemented in Java and populated with experience packages important to the FC-MD's business activities. Examples of experience packages are project, proposal, and document packages. The EMS will be field-tested and used by FC-MD employees and further fine-tuned to serve its users well.

Doing this has several benefits:

- To learn about the system from a customer's perspective
- To package the knowledge and processes about FC-MD for use by our customers
- To define the process of implementing an Experience Factory and associated technology in a research organization, which will be useful in other projects.

After field testing and updating the system locally, EMS will be available to industry to help take it to the next levels of functionality and usability.

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Experience Base Support

Today's companies are often distributed across multiple sites and have many databases that utilize different access and management approaches. To increase efficiency and enhance productivity across the engineering groups, Johnson Controls (JCI) wants to develop an approach that would integrate these disparate databases to form an experience base for their automotive engineering groups.

The purpose of this project is to analyze the systems and data used by JCI Engineering, evaluate future system needs, and feedback this information to the organization to enhance the sharing of knowledge across the organizations.

Since the end goal is to define an integrated engineering experience and knowledge model to enable extensive reuse, we need to understand the capabilities of the current systems and their usage at the JCI sites. The first step in doing this is to characterize JCI Engineering and determine what knowledge currently exists by

- Reviewing the existing systems' content and structure (types of knowledge, categories of reusable knowledge)
- Identifying the business processes and the support roles that constitute the context of the current system
- Mapping the systems' environment (hardware and software), interface formats and linkages
- Identifying existing groups of users (newcomers, employees, and contractors)
- Describing current usage patterns and system capabilities
- Evaluating the current system in all of these aspects in order to identify strengths and improvement areas.

Working closely with JCI staff, a questionnaire was developed to solicit baseline information from people in various positions (technical and management) within the different engineering groups to gain a wide range of customer perspectives.

In the second phase of the project, the requirements for an integrated experience management system are being developed, focussing on future needs, different approaches, and enabling technologies in order to

- Develop use cases for the different classes of users
- Define a taxonomy for the types and formats of data involved
- Research available technology and describe different technical opportunities.

Two key reports are being produced. The first is a baseline report describing the current status of the engineering systems and data from a variety of aspects including the processes involved and users supported. The results from the second phase include both a preliminary future needs evaluation and a final recommended strategy and experience model, including the requirements for an integrated engineering database.

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Reading/Inspection Technologies

Software inspections have been shown to be a practical method of ensuring that software artifacts, created during the software lifecycle, possess the required quality characteristics. For instance, inspections have been used to improve design and code quality by increasing defect removal during development. In this way, inspections help reduce defects in a software system by ensuring that the software artifacts which are necessary for its construction correctly reflect the needs of stakeholders.

The Fraunhofer Center - Maryland has continued its work on the research and application of "software reading techniques," which increase the effectiveness of software inspections by providing guidelines that inspectors can use to examine (or "read") a given software artifact and identify defects. There is empirical evidence that software reading is a promising technique for increasing software quality for different situations and document types, not just limited to source code. Software reading can be performed on all documents associated with the software process, and is an especially useful method for detecting defects, since it can be applied as soon as the documents are written. FC-MD is engaged in a number of collaborations for the purpose of refining reading techniques for different stages of the lifecycle.

Perspective-Based Reading (PBR) is a set of reading techniques for inspecting software requirements. PBR has been the subject of replicated experiments in universities around the world and has been introduced in industrial case studies. FC-MD collaborated with Fraunhofer IESE to develop a tutorial for introducing PBR to a wider industrial audience, which was delivered at the ICSE 2000 conference and the 2000 Software Engineering Workshop held by NASA's Software Engineering Laboratory.

A related area that is of increasing interest to industrial organizations is that of inspecting Object-Oriented artifacts. Inspections of OO artifacts present unique challenges because of the possibility for multiple and subtle relationships between objects in the system. FC-MD is collaborating with researchers at the University of Maryland, College Park, to refine and evaluate a set of reading techniques for OO design inspections. The aim of the techniques is to ensure that the problem domain has been correctly understood before the system is constructed, and to catch fundamental design problems before they have the chance to affect implementation. Results concerning these reading techniques have been presented at well-known conferences such as OOPSLA 1999.

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State-of-the-Art Software Inspections

The Fraunhofer Center - Maryland is working with NASA's Goddard Space Flight Center (GSFC) to improve their processes for inspecting software work products to find defects. Software defects have had negative effects on NASA missions, ranging from the expense of corrective actions to the loss of the mission. The inspection or reading of software products such as requirements, design, or code is a proven verification and validation technique for ensuring that the finished system is of higher quality and reliability. However, these inspection techniques must be continuously assessed and improved.

The Fraunhofer Center - Maryland is working with GSFC to pilot an integrated, full life cycle approach to readings and inspections, and to assess whether new reading techniques that have been validated under laboratory conditions can be applied effectively within NASA. A unique outcome for this research will be the integration of a well-proven process for inspections across the software engineering life cycle and advanced reading techniques that detect more faults and are more cost effective.

FC-MD is working, first, to interview developers and extract lessons learned from projects in the NASA environment. FC-MD scientists interview developers who have completed projects using inspections, collecting qualitative data from their experiences to produce a lessons learned report. The next phase of the work will involve studies of reading techniques (specific techniques for performing effective inspections) in the NASA environment. Controlled experiments will be carried out to measure the impact of reading techniques when applied to NASA products by experienced developers. The final result will be to update the GSFC approach to inspections based on the lessons learned from this work.

Partner:

NASA's Goddard Space Flight Center, Greenbelt, Maryland, USA

Contact

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Return on Investment Model for Software Independent Verification and Validation

Although independent verification and validation (IV&V) of software increases the cost of a project, anecdotal evidence suggests that by using it, the final software product is more reliable and safer, with fewer and less critical errors remaining to be found during operational deployment. IV&V discovers errors earlier in the life cycle, resulting in fewer errors needing to be fixed later, either during development or operation, lowering thus the overall development and operational costs for the software system. IV&V also contributes to process analysis and improvement, increases communication and visibility into the project, and enhances the domain engineering aspect of software development.

The set and amount of IV&V activities applied to a project depends on the application domain, product features (criticality, safety and reliability requirements), development environment (number of contractors, developers' experience and domain knowledge, or budget constraints). The analysis and development of models of IV&V cost and benefits and its return on investment (ROI) for past projects is important for cost prediction and resource allocation purposes for future projects. In order to analyze the requirements for ROI models and to identify the data needed to develop and validate these models, the Goal/Question/Metric (GQM) paradigm is used as a mechanism for defining and evaluating a set of operational goals, using measurement.

For NASA, IV&V was mandated as a means to increase crew safety on the space shuttle program. NASA is now interested in determining the costs and benefits, aside from increased safety, from applying this technology. This project started in1999 with a literature survey of ROI models, their application in software engineering, and cost and benefits of software verification and validation methods and techniques.

For developing and validating the initial version of the IV&V ROI model, NASA development data, such as collected by the NASA IVV Facility and NASA Johnson Space Center on the development of software for the space shuttle program is being studied.

Partners

- NASA IVV Facility
  Fairmont, West Virginia, USA
- West Virginia University
  Morgantown, West Virginia, USA
- Portland State University
  Portland, Oregon, USA

Contact

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Dynamic Modeling and Simulation of the System Testing Process

The last stage in the development of the release of a product is system testing. This is a complex and time-consuming activity that ensures that the product is reliable, has high quality, and meets the requirements set out for it at the start of development. Unfortunately, most complex products are delivered with latent defects, so the important questions that need to be addressed are how to best test, how long it will take, how much it will cost and how to determine when a product has achieved its reliability and quality goals. In particular, which tools and procedures are best at achieving these goals for a new development? We propose to use a simulator of the testing process in order to answer these questions. More specificly, we want to build a series of models, starting with a qualitative descriptive model and ending with a quantitative prescriptive computer model (simulator) of the system testing phase for Motorola. By running what-if scenarios of potential changes in the process, as a result of new technology adoption, we want to analyze the impact of change on productivity, cycle time reduction, and product quality.

The goals for this project are 1) to develop a capability within Motorola for planning process changes, analyzing their risks, costs, and benefits and forecasting their impact; and 2) to evaluate this capability within the system testing environment of the GSM division of Motorola.

Partner:

Motorola, Inc.
Schaumburg, Illinois, USA

Contact

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Software Industry Consortium

The Maryland Software Industry Consortium (SwIC) Project, in conjunction with the Maryland Department of Business and Economic Development, provides a software engineering resource to assist Maryland organizations in advancing the practices of system and software engineering and improving the quality of their software related products and services. SwIC integrates research and experience into practical improvement, creates opportunities to develop and disseminate improvement practices, enhances the competitiveness of member companies, especially small to mid-size companies, accelerates new software technology adaptation, leverages member company experience, promotes inter-corporate cooperation of member organizations, and provides training and education.

Partners

- Maryland World Class Consortia, Ltd. Baltimore, Maryland, USA
- Maryland Department of Business and Economic Development Baltimore, Maryland, USA

Contact

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Center for Empirically Based Software Engineering

A necessary step towards the goal of building more reliable software systems, on time and within budget, is to establish an institutionalized empirical discipline for understanding causal relationships among the processes, components, and technologies that affect the building of systems. As in the physical and natural sciences, experimentation in software engineering requires a community in which proposed experimental designs can be critiqued by multiple researchers, in which experimenters access the resources they need to perform experiments, and in which the results of experiments replicated at different locations can be analyzed for what they say about the "big picture."

For these reasons the Fraunhofer Center - Maryland cooperates with four universities across the country to form the Center for Empirically Based Software Engineering (CeBASE). Through CeBASE, FC-MD undertakes original empirical research and is developing a prototype system for sharing and evolving the results of such research with a community of affiliated researchers and practitioners. CeBASE

develops and refines techniques to increase the descriptive and predictive power of empirical models, and studies specific software development technologies to enable industrial organizations to understand the benefits and drawbacks of those technologies in their specific context. FC-MD also helps to provide courses and symposia on empirical methodologies and results, and assist the use of empirical knowledge in software engineering education.

Partners

- University of Maryland
  Maryland, USA
- University of Southern California
  California, USA
- Mississippi State University
  Mississippi, USA
- University of Nebraska
  Lincoln, Nebraska, USA

Contact

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Software Experience Center

The goal of the Software Experience Center (SEC) Consortium, a joint project between the Fraunhofer Center - Maryland and the Fraunhofer IESE, is to improve the software competencies and development practices of member companies. To achieve this goal, member companies share past and ongoing experiences in software process improvement and particular development technologies. The Fraunhofer organizations contribute their expertise to help analyze, package, and disseminate the lessons to be learned from these experiences.

The Fraunhofer organizations collaborate to provide a number of services to member companies:

- Twice-yearly workshops are organized to provide a forum for the discussion of software development experience.

- The Fraunhofer organizations produce a series of experience reports that address specific technologies of interest to the Consortium. The reports are gathered and stored in the Fraunhofer-operated SEC Experience Base for use and feedback by all members.

- The Fraunhofer organizations have developed an extensive network of software experts, both within the organizations and externally, that can be made available to SEC member companies.

The Consortium is currently composed of five international corporations with significant investments in software development: ABB, Boeing, Daimler-Chrysler, Motorola, and Nokia. A last member is being solicited since membership is limited to a maximum of six companies.

The latest Consortium workshop was held in November, 2000, in Helsinki and sessions ranged from in-depth working groups to presentations of experience reports. Session topics were selected by the member companies and included distributed software development, software requirements engineering, and defect analysis, among others.

Partners

- ABB, Corporate Research Ltd.
  Baden-Dättwil, Switzerland
- Boeing Company
  Seattle, Washington, USA
- DaimlerChrysler AG
  Stuttgart, Germany
- Motorola, Inc.
  Schaumburg, Illinois, USA
- Nokia Corporation
  Helsinki, Finland

Contact

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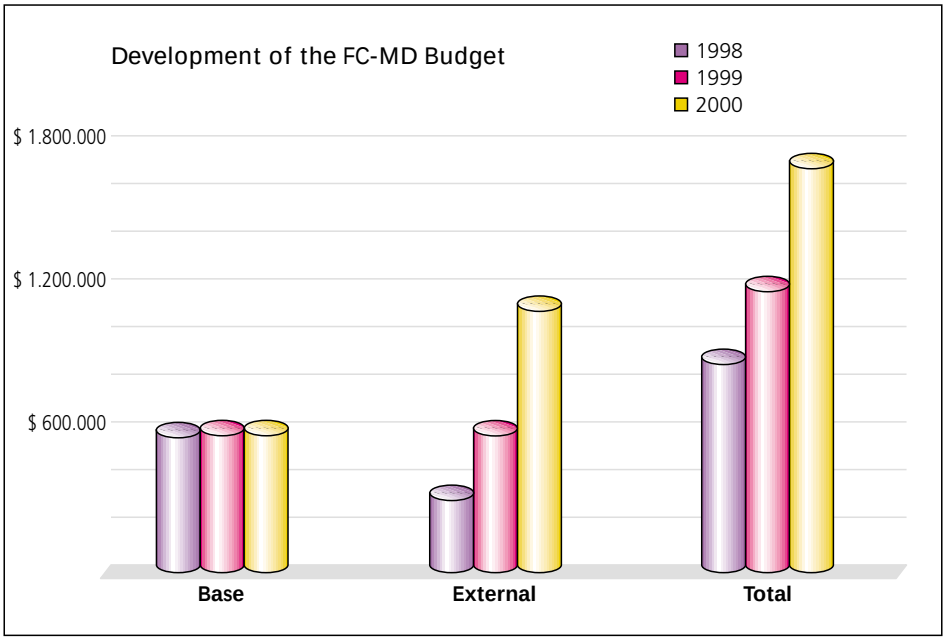
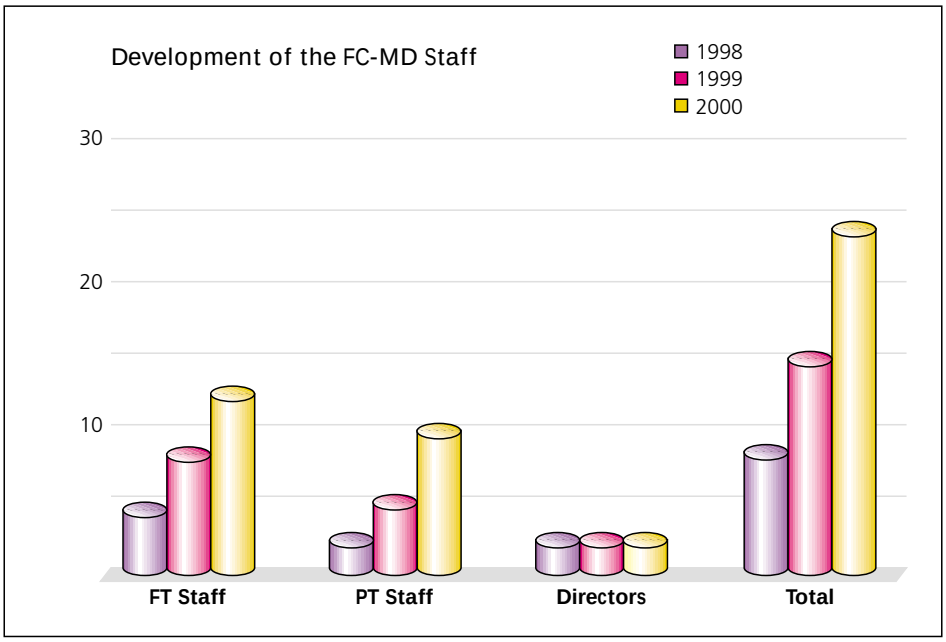
Budget and Personnel

The Center added five new staff members in 2000 and expects to add an additional four more in 2001. We have also hosted a growing number of visiting scientists, professors, and students this year and expect to continue at this level during subsequent years. The student population more than doubled (three to seven) in 2000 and will increase slightly in 2001.

The Center generated over 62% of its revenue from new and continuing agreements with external government and industry sources in 2000. This represents a 113% increase in these sorts of funds. Next year, the estimate is over 70% of our revenue will derive from these sources.





Steering Committee Members

Mr. Keith Blurton
Vice-President
Fraunhofer USA

Mr. Richard C. Mike Lewin
Secretary
Maryland Dept. of Business & Economic Development

Professor Dr. Dieter Rombach
Executive Director
Fraunhofer Institute for Experimental Software Engineering

Mr. Bill Woodard
CEO/President
ACS Government Solutions Group

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

Dr. Michael Plett
Vice President
Computer Sciences Corporation

Mr. Frank E. Herman
Vice President
BAE Systems

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

Dr. Stephen Halperin
Dean, College of Computer,
Math & Physical Science
University of Maryland

References

- ABB
- ACS
- Anteon
- BAE Systems
- Boeing
- Computer Sciences Corporation
- DaimlerChrysler AG
- DataSources, Inc.
- Johnson Controls
- Lockheed Martin
- Motorola (USA)
- OAO
- NASA
- Nokia
- NSF
- Q-Labs, Inc. (USA)
- Telcordia
- State of Maryland: Department of Business and Economic Development

Research Partners

- Experimental Software Engineering Group, University of Maryland, Maryland
- NASA Independent Verification & Validation Facility, West Virginia
- Portland State University, Oregon
- 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)

Events

Converse GQM,
January 20

SWIC Advisory Board Meetings,
February 23

EWSPT Keynote Austria,
February 24

Fraunhofer USA
Pre-Board/Board Meeting,
March 17

Maryland High Tech Council,
Tech Fast Presentation,
April 06

SEC Meeting,
April 10-12

PBR Tutorial at ICSE,
May 06

FC-MD Steering Committee Meeting,
June 29

FC-MD Open House,
June 29

SWIC Quarterly Meeting,
July 27

CeBASE Kick-off Meeting,
September 20-22

SWIC Quarterly Meeting,
October 18

25th NASA Goddard Software Engineering Laboratory Workshop,
November 28-30

FC-MD Steering Committee Meeting,
December 18

Visitors Hosted

Marco Habetz, Michael Frey,
University of Kaiserslautern,
January through March

Reidar Conradi, NTNU,
January through April

Barry Boehm, University of Southern California, February 02-03 and September 21-23

David Weiss, Avaya, February 16

Lou Blazy
Nancy Eickelmann
NASA, February 17

David Raffo
Wayne Harrison
Portland State University
February 17

Allan Willey, Motorola,
February 18

John Marciniak, March 03

Jakob Iversen, Aalborg University,
March 27

FC-MD Open House Speakers,
June 29:
- Stephen Halprin, University of Maryland
- Tom Hendershott, County Council
- Vernon Thompson, Maryland Department of Economic Development
- Dieter Rombach, Fraunhofer IESE

Marc Kellner, SEI, July 19

Keith Blurton, FhUSA,
September 13

Professional Activities

Victor R. Basili

- Associate Editor, Journal of Systems and Software, Elsevier North Holland, Inc.
- Co-Editor-in-Chief, Empirical Software Engineering, An International Journal, Kluwer Academic Publishers
- Editor, Software Eng. Advance Book Series, Kluwer Academic Publishers
- Founding Member, ISERN - International Software Engineering Network
- Member, Advisory Committee, Airlie Software Council, DoD Best Practices Initiative
- Member, IEEE Software Process Achievement Awards Committee
- Member, Q-Labs Advisory Board, College Park, Maryland
- Member, Advisory Board (Kuratorium) of the Fraunhofer Institute for Experimental Software Engineering, Kaiserslautern, Germany

Mikael Lindvall

- Guest Editor for the IEEE Software Special Issue on Process Diversity
- Member, Institute of Electrical and Electronics Engineers (IEEE), Computer Society

Ioana Rus

- Guest Editor for the IEEE Software Special Issue on Process Diversity
- Reviewer for SEPG2000 conference
- Reviewer for Computer Magazine
- Member, Institute of Electrical and Electronics Engineers (IEEE), Computer Society
- Member, Association for Computing Machinery (ACM)

Forrest Shull

- Program Committee, International Conference on Product-Focused Software Process Improvement (PROFES) 2000, Oulu, Finland, June 2000
- Program Committee, Second International Workshop on Learning Software Organizations (LSO) 2000, Oulu, Finland, June 2000
- Program Committee, NASA Goddard Space Flight Center's Software Engineering Workshop, Greenbelt, MD, December 2000
- Reviewer for IEEE Transactions on Software Engineering
- Reviewer for IEEE Software Magazine

Marvin V. Zelkowitz

- Program Committee, European Workshop on Software Process Technology,
- Vienna, Austria, February 2000
- Series Editor, Advances in Computers, Academic Press, 1994 - present
- Editorial Advisory Board, Journal of Computer Languages, 1980 - present
- Editorial Board, Journal of Empirical Software Engineering, 1995 - present

Presentations and Tutorials

Basili, V.:
Process Improvements for Software Quality and Reliability, Comverse Network System, Boston, MA, January 19-20, 2000

Basili, V.:
Using Experiments to Build a Body of Knowledge, Meetings at the Universidade de Sao Paulo, Sao Paulo, Brazil, March 21-24, 2000

Basili, V.:
Software Improvement Feedback Loops: The SEL Perspective, and Using Experiments to Build a Body of Knowledge, University of Alberta, Edmonton, Canada, April 26-28, 2000

Basili, V.:
Using Experiments to Build a Body of Knowledge, Fifth Annual Electrical Engineering, Computing and Systems Research Review Day, University of Maryland University College, May 12, 2000

Basili, V., Shull, F., Rus, I., Laitenberger, O.:
Improving Software Inspections by Using Reading Techniques, International Conference on Software Engineering ICSE2000, Limerick, Ireland, June 2000

Basili, V.:
Software Improvement Feedback Loops: The SEL Experience, Software Process Improvement Network (SPIN) Meeting, Baltimore, MD, July 20, 2000

Basili, V.:
Software Measurement Implementation and Practice, A Professional Development Seminar sponsored by the Data & Analysis Center for Software (DACS), Los Alamos, NM, August 22-24, 2000

Basili, V., Shull, F., Rus, I.:
Techniques for Improving Software Inspections, 25th NASA SEL Workshop, November 2000.

Eickelmann, N., Rus, I., Zelkowitz, M.:
Preliminary Case Study Findings of the Space Shuttle Software Evolution as a Product Line Process, International Software Architecture Workshop (ISAW-4), Limerick, Ireland, June 2000.

Rus, I., Collofello, J.:
Assessing the Impact of Various Defect Reduction Practices on Software Quality, Cost and Schedule, Process Modeling Simulation Conference, ProSim2000, London, July 2000.

Travassos, G., Shull, F., Carver J.:
A Family of Reading Techniques for OO Design Inspections. 7th Workshop on Software Quality (WQS2000), Joao Pessoa, Brazil, October 2000.

Publications

Zhang, Z., Basili, V., Shneiderman, B.:
Perspective-based Usability Inspection: An Empirical Validation of Efficacy, Empirical Software Engineering: An International Journal, Volume 4, No. 1, March 1999

Boehm, B., Basili, V.:
Gaining Intellectual Control of Software Development, Computer, May 2000.

Lindvall, M., Rus, I.:
The 24th NASA SEL Workshop, Software Practitioner, May/June 2000

Lindvall, M., Rus, I.:
Process
Diversity in Software Development, IEEE Software, July/August 2000

Shull, F., Rus, I., Basili, V.:
Perspective-Based Reading:
Techniques for Improving Requirements Inspections, Computer, July/August 2000

Shull, F., Lanubile, F., Basili, V.:
Investigating Reading Techniques for Object-Oriented Framework Learning, Accepted for publication by IEEE Transactions on Software Engineering

Overview

Analyse und Evaluation der Softwareentwicklung in Deutschland

Eine Studie für das Bundesministerium für Bildung und Forschung BMBF

Kurzfassung

Dezember 2000

Reprint of the Executive Summary, Original German Version

Auftrag und Vorgehen

Die Untersuchung "Analyse und Evaluation der Softwareentwicklung in Deutschland" für das Bundesministerium für Bildung und Forschung (BMBF) wurde von der GfK Marktforschung GmbH in Zusammenarbeit mit den Fraunhofer-Instituten für Experimentelles Software Engineering (IESE) und für Systemtechnik und Innovationsforschung (ISI) durchgeführt. Ziel dieser Untersuchung war es, den nationalen Softwaremarkt, der sich immer mehr zu einem der Schlüsselmärkte in Deutschland und weltweit entwickelt, quantitativ und qualitativ zu charakterisieren und in seiner weiteren Entwicklung und seinen Anforderungen zu beschreiben. Auf dieser Basis werden die für den Erfolg der Softwareentwicklung in Deutschland notwendigen Investitionen in Forschung und Technologieentwicklung sowie in Fachkräfte-Qualifikation und Ausbildung abgeleitet.

Anlass für diese Untersuchung war zum einen die sich rasch verändernde Situation auf dem Softwaremarkt, in dem zunehmend Software als wesentliches, oft wettbewerbsentscheidendes Instrument von Unternehmen aller Anwendungsbranchen (sekundäre Softwarebranchen) - in Ergänzung zu Softwareunternehmen (primäre Softwarebranche) - entwickelt wird, zum anderen das Fehlen von Marktdaten speziell zur Situation der sekundären Softwarebranchen. Die Primärbrache umfasst neben DV-Dienstleistern auch Hersteller von Datenverarbeitungsgeräten und -einrichtungen. Zu den Sekundärbranchen zählen in der Studie Unternehmen aus den Bereichen Maschinenbau, Elektrotechnik, Fahrzeugbau, Telekommunikation und Finanzdienstleistungen. Damit werden exemplarisch Branchen innerhalb des produzierenden Gewerbes und des Dienstleistungssektors mit einem besonders hohen Anteil an Softwareentwicklung abgedeckt. Weitere Branchen, wie z.B. die Medizin, Chemie, Biologie und Gentechnik sowie die gesamte Medien- und Unterhaltsbranche wurden zur Begrenzung des Erhebungsaufwands nicht untersucht, da es im Sekundärbereich in der Studie in erster Linie darauf ankam, eine Situationsanalyse zu erstellen, auf deren Basis Handlungsempfehlungen für die Forschungsförderung abgeleitet werden können. Auch war zu berücksichtigen, dass der Sekundärbereich praktisch nicht begrenzbar ist. Dies ist besonders bei den Medien und in der Unterhaltsbranche der Fall, wo das massive Problem der Definition und Abgrenzung der Branche zu angrenzenden Bereichen besteht.

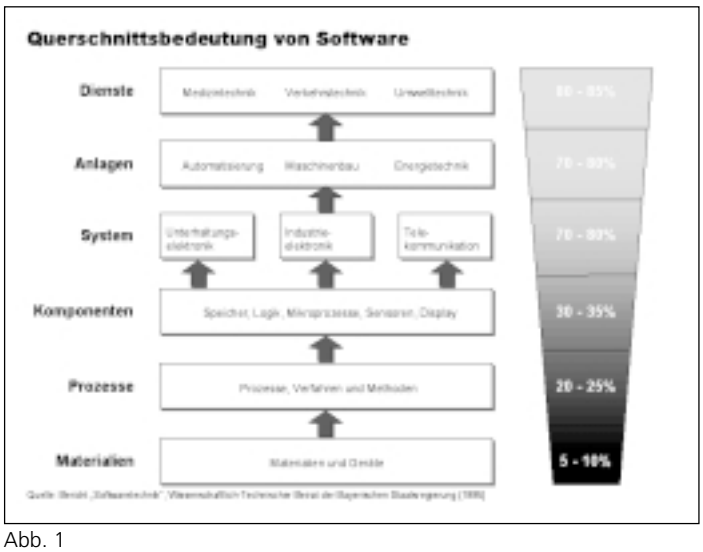


Abb. 1

Die vorliegende Studie nutzt methodisch eine Kombination repräsentativer telefonischer Befragungen zur Erhebung quantitativ aussagekräftiger Fakten und Experteninterviews zur qualitativen Vertiefung insbesondere der Zukunftsprognosen.

Im Rahmen der telefonischen Befragung wurden insgesamt 920 Interviews mit Vertretern von repräsentativ ausgewählten Unternehmen der Primärbranche (n = 249 Unternehmen) und den Sekundärbranchen (n = 671 Unternehmen) durchgeführt. Die Zielpersonen im Unternehmen für die durchschnittlich 30minütigen Interviews waren in der Regel die Leiter der Softwareentwicklung bzw. in kleineren Unterneh-

men häufig auch die Inhaber oder Geschäftsführer. In Ermangelung offizieller Unternehmenszahlen erfolgten zur Ermittlung der Grundgesamtheit und damit der Hochrechnungsbasis für die Ergebnisse je Branche im Vorfeld umfangreiche Recherchen beim Statistischen Bundesamt, der Bundesanstalt für Arbeit, sowie bei Informations-Services und Adress-Verlagen.

Zusätzlich wurden 55 Expertengespräche mit Mitarbeitern von Unternehmen der Primärbranche und den Sekundärbranchen, die um die Branchen Handel, Transport/ Verkehr und Chemie/Pharma erweitert worden sind, durchgeführt. Aus den verschiedenen Branchen wurden sowohl kleine, junge und/oder profilbestimmende und marktführende Unternehmen ausgewählt. Die interviewten Personen aus den Unternehmen gehörten dem mittleren und oberen Management in der Softwareentwicklung an. Ziel dieser Expertengespräche war es, zusätzlich zu den ermittelten Fakten aus der repräsentativen Unternehmensbefragung, einen tieferen Einblick in die Praxis der Softwareentwicklung aus der Sicht der unmittelbaren Beteiligten zu gewinnen.

Basierend auf den Daten dieser Befragungen und Szenarien werden Schlussfolgerungen für notwendige forschungs- und bildungspolitische Maßnahmen gezogen. Die wesentlichen Ergebnisse zu den Schwerpunkten "Marktstruktur der Softwarebranche", "Personalsituation in der Softwareentwicklung" sowie "Technologischer Innovationsstand in der Softwareentwicklung" werden im Folgenden zusammengefasst.

Anzahl Mitarbeiter in Unternehmen mit Softwareentwicklung

	in Unternehmen mit...				Gesamt
	1 – 9 Mitarbeitern	10 – 49 Mitarbeitern	50 – 199 Mitarbeitern	500+ Mitarbeitern	
Primärbranche	44.000	39.000	42.000	173.000	296.000
Sekundärbranchen gesamt	25.000	56.780	131.980	2.274.300	2.487.900
Maschinenbau	2.080	24.780	61.080	1.254.680	1.342.220
Elektrotechnik	7.380	16.100	24.500	175.000	223.980
Fahrzeugbau	168	208	3.380	138.600	142.260
Telekommunikation	250	1.580	3.480	106.000	191.150
Finanzdienstleistungen	15.380	14.280	39.780	519.200	668.480
Gesamt	69.000	95.780	173.980	2.444.300	2.782.900

Abb. 2

Marktstruktur der Softwarebranche

In Deutschland wird derzeit in rund 19.200 Unternehmen der untersuchten Branchen - 10.550 Unternehmen der Primärbrachen (DV-Dienstleistern, Hersteller von Datenverarbeitungsgeräten und -einrichtungen) und 8.650 Unternehmen der Sekundärbranchen (Maschinenbau, Elektrotechnik, Fahrzeugbau, Telekommunikation und Finanzdienstleistungen) - Software entwickelt bzw. angepasst.

In diesen Unternehmen sind insgesamt ca. 2,8 Millionen Erwerbstätige beschäftigt (ca. 300.000 Erwerbstätige in der Primärbranche und 2,5 Millionen in den Sekundärbranchen) (Abb. 2). Während die Struktur der Primärbranche überwiegend durch kleine Unternehmen mit 1-9 Mitarbeitern geprägt ist, findet Softwareentwicklung und -anpassung in den Sekundärbranchen eher in mittleren und größeren Unternehmen statt.

Der Umsatz mit Software hat sich in den letzten Jahren massiv erhöht, ein Ende des Wachstums ist nicht abzusehen. Im deutschen Markt für Software und IT-Services wurden lt. Angabe von Bitkom im Jahr 1999 allein 55,5 Mrd. DM umgesetzt. In den Sekundärbranchen ist das Umsatzvolumen durch Software weit schwieriger einzuschätzen. Mittlerweile ist in vielen Sekundärbranchen der gesamte Umsatz von Software abhängig. Beispielsweise können heute in der Automobilindustrie keine Steuerfunktionen ohne Software realisiert, keine Automobile ohne Software produziert oder vertrieben, und keine betrieblichen Abläufe – von der Produktions- bis zur Personalplanung – ohne Software aufrechterhalten werden.

Als Ergebnis der repräsentativen Unternehmensbefragung wurde eine durch Softwareentwicklung bzw.- anpassung erzielte Wertschöpfung von ca. 50 Mrd. DM in den Primär- und Sekundärbranchen insgesamt errechnet. Dieser Wert ist für sich allein betrachtet bereits relativ hoch. Er übersteigt z.B. die im Sektor Land-, Forstwirtschaft und Fischerei erzielte Wertschöpfung von ca. 42 Mrd DM um rund 20%.

Die in der Volkswirtschaft übliche und auch im vorliegenden Bericht angewendete Berechnung der Wertschöpfung wird allerdings der strategischen Bedeutung von Software – vor allem in den Sekundärbranchen – nicht voll gerecht.

Es zeigt sich an der Behandlung von Softwareentwicklungs-Abteilungen als reine Kostenstellen in der überwiegenden Zahl der Unternehmen, dass die strategische Bedeutung von Software als Umsatzgenerator auch noch nicht überall erkannt wird. Erste Unternehmen aus den Sekundärbranchen beginnen aber bereits damit, Softwareentwicklungs-Projekte nicht über ihren Kostenanteil an der Produktentwicklung, sondern über den mit Hilfe dieser Software realisierbaren Umsatz zu rechtfertigen. Damit zeichnet sich ab, dass Unternehmen Software zunehmend als Investition und "Business-Enabler" und nicht länger als reinen Kostenfaktor begreifen.

Abb. 3

Software entsteht als eigenständiges Produkt (Primärbranche) oder eingebettet in Produkte oder Dienstleistungen (Sekundärbranchen).

Die Primärbranche ist durch junge Unternehmen gekennzeichnet (67% der Unternehmen in der Primärbranche wurden nach 1990 gegründet) (Abb. 3). Neugründungen in Form von Spin-Offs entstehen durch Mitarbeiter aus Universitäten, Forschungseinrichtungen und Unternehmen, aber auch dadurch, dass etablierte Unternehmen aus ihrem internen Projektgeschäft heraus Produkte entwickeln und diese in Ausgründungen vermarkten. Damit kreieren Unternehmen traditioneller Branchen (z.B. Handel) durch Professionalisierung ihrer internen Produkte (z.B. Warenwirtschaftssysteme) neue Standbeine in der Primärbranche. Insgesamt ist davon auszugehen, dass der Boom in der Primärbranche auch auf den geringeren Investitionsbedarf dienstleistungsorientierter Unternehmen sowie auf räumliche Flexibilität zurückzuführen ist.

In den Sekundärbranchen spiegelt sich die traditionelle Stärke der deutschen Wirtschaft wider. Ingenieurmäßige Individuallösungen (z.B. Steuerungsfunktionen zur Sicherheit von Automobilen wie ABS, umweltschonender Energieverbrauch wie Einspritzsysteme, oder komfortable Wartung wie Online-Diagnosesysteme) tragen dazu bei, dass diese Branchen ihre Weltmarktführerschaft ausbauen können. In all diesen Branchen kann im Entwicklungsbereich eine immer stärkere Verschiebung von der Hard- zur Software beobachtet werden. Insgesamt liegt aber auch in den Sekundärbranchen das Wachstumspotenzial im Bereich der Dienstleistungen. Dies gilt nicht nur für die Unterstützung von Geschäftsprozessen in den traditionellen Dienstleistungsbranchen wie Handel (z.B. Electronic Business), Banken (z.B. Electronic Banking) und Telekommunikation, sondern manifestiert sich immer mehr durch produktbegleitende Mehrwertdienstleistungen auf der Basis von Software.

Ein besonderes Merkmal mit existenzieller Bedeutung für die Unternehmen der Sekundärbranche ist das hohe Alter vieler Softwaresysteme. Ihre Entstehung geht häufig bis in die 70er Jahre zurück. Man spricht von sogenannten Legacy-Systemen. Diese Legacy-Systeme sind auf der einen Seite über viele Jahre gereift. Sie enthalten das akkumulierte Anwendungswissen des Unternehmens und sind extrem stabil. Auf der anderen Seite sind viele dieser Systeme nach mittlerweile veralteten Methoden entwickelt worden und erweisen sich als sehr schwer wart- und änderbar. Veränderte Geschäftsprozesse erfordern aber innovative Softwarelösungen. Daraus ergibt sich für viele Unternehmen ein Dilemma: Wie soll man sich auf die neuen Herausforderungen einstellen, ohne die gewohnte Stabilität ernsthaft in Frage zu stellen?

In der Softwareentwicklung tragen Ortsunabhängigkeit der Softwareentwicklung, Mitarbeitermangel und Überlegungen bezüglich der strategischen Bedeutung von Software zu einem gravierenden Wandel bei der Entscheidung bei, welche Software in den Unternehmen und welche im Auftrag außer Haus entwickelt wird. Die Unternehmen mit hoher Softwarekompetenz konzentrieren sich stärker auf die Eigenentwicklung derjenigen Software, die ihre Kernkompetenz betrifft.

Ein wichtiges Motiv für die extensive Ausgliederung der Softwareentwicklung ist der Mangel an qualifizierten Mitarbeitern. Aufträge werden an eigene Niederlassungen oder an Fremdfirmen in Ländern innerhalb und außerhalb der Europäischen Union oder Asiens vergeben. Diese Lieferantenbeziehungen erweisen sich in der Praxis in

vielen Fällen als kompliziert hinsichtlich der Abstimmung der Entwicklungsprozesse zwischen Auftraggeber und -nehmer, sowie hinsichtlich des oftmals fehlenden Anwendungswissens seitens der Lieferanten.

Insbesondere in den Sekundärbranchen wird gegenwärtig die notwendige Fertigungstiefe für Software diskutiert. Welche Software realisiert wettbewerbssichernde Funktionen und muss deshalb im Hause selbst entwickelt werden? Welche Software ist nicht wettbewerbssichernd und kann/soll ausgelagert bzw. eingekauft werden? Hier sind derzeit unterschiedliche Trends zu beobachten. Während Automobilhersteller daran denken, einige der bislang ausgelagerten Softwareentwicklungen wieder selbst vorzunehmen, planen Banken und Versicherungen eine verstärkte Auslagerung. Hierzu liegen vereinzelte Absichtserklärungen (aus den Expertengesprächen) vor, nach denen einige der Banken und Versicherungen ihren Fremdentwicklungsanteil von derzeit ca. 30% auf 70 bis 80% erhöhen wollen. Dabei spielt die Frage, welche Software für das Unternehmen strategische Bedeutung hat, stets eine herausragende Rolle.

Auch bei der Auslagerung der Softwareentwicklung oder Zukauf muss das Anwendungsentwicklungswissen bei den Unternehmen weiter vorhanden sein. Dies bedeutet, dass weniger Programmierer, hingegen umso dringender Anforderungsingenieure, Systemarchitekten und Akzeptanztester benötigt werden. Insofern findet bei den Unternehmen der Sekundärbranchen eine Ersetzung von Programmierern durch Software-Ingenieure statt. Insgesamt ist eine Differenzierung unterschiedlicher Rollen in der Softwareentwicklung zu erkennen, die sich aber nur langsam durchsetzt.

Die geplante Erhöhung der Auslagerung der Softwareentwicklung kann heute durch käufliche Standardprodukte nur unzureichend abgedeckt werden. Dies führt zu einschneidenden Veränderungen. Entweder werden durch Standardisierung von Anwendungsarchitekturen neue Unternehmen der Primärbranche in die Lage versetzt, als Lieferanten zu fungieren, oder Unternehmen der Sekundärbranchen wie Finanzdienstleister gründen Tochterunternehmen.

Die Alleinstellungsmerkmale innovativer Produkte sowie Dienstleistungen wie Telekommunikations- oder Versicherungsprodukte sind ohne Software nicht mehr vorstellbar. Der Wettbewerb wird zunehmend über "software-veredelte" Funktionen der Produkte oder Dienstleistungen entschieden. Dementsprechend gewinnen für Hochlohnländer wie Deutschland Arbeitsplätze mit besonders hoher Wertschöpfung an Bedeutung, wie sie im Umfeld software-veredelter Produkte und Dienstleistungen anzutreffen sind.

Personalsituation in der Softwareentwicklung

Die heutige Personalsituation ist durch ein starkes Defizit an qualifizierten Fachkräften gekennzeichnet. Der in der Befragung ermittelte Fehlbedarf von 28.000 Softwareentwicklern zur sofortigen Einstellung bzw. 55.000 Softwareentwicklern zur Einstellung in den nächsten 12 Monaten zeigt den Mindestbedarf auf. Die zusätzlich auftretende altersbedingte Fluktuation und ein heute kaum zu quantifizierender ergänzender Bedarf an Anwendungsentwicklern werden die Personalnachfrage weiter verschärfen. Viele Unternehmen bezeichnen den Personalmangel als ihr momentan dringlichstes Problem innerhalb der Softwareentwicklung. Die Befriedigung des Bedarfs durch frei auf dem Markt verfügbare Arbeitskräfte ist gegenwärtig derart unzureichend, dass die genaue Anzahl der offenen Stellen in vielen Unternehmen überhaupt nicht mehr ausgewiesen wird. Vielversprechende Projekte werden aufgrund des Mitarbeitermangels zurückgestellt. All dieses lässt vermuten, dass die erhobenen Zahlen eine eher konservative Schätzung des Bedarfs darstellen.

Was die Qualifikation der Beschäftigten betrifft, so überwiegt die akademische Ausbildung. Während dabei in der Primärbranche Informatiker die Mehrheit stellen,

so sind in den Sekundärbranchen die Mitarbeiter mit einer branchenspezifischen Qualifikation in der Überzahl. Große Unternehmen der Sekundärbranchen versuchen den Anteil der Informatiker zu erhöhen. Dies scheitert aber gegenwärtig sowohl am zu geringen Angebot als auch an der vielfach bemängelten, fehlenden Anwendungsorientierung der universitären Ausbildungsgänge zum Informatiker.

Ein wesentliches Problem bei der Zuordnung geeigneter Fachkräfte – auch speziell der effektive Einsatz von Informatikern – liegt in der unklaren Rollendefinition für unterschiedliche Tätigkeiten in der Softwareentwicklung, den ungenügend definierten Qualifikationsanforderungen sowie mangelnder Weiterbildungsmaßnahmen zur Aktualisierung des notwendigen Knowhows. Es wird in der Softwareentwicklung bislang zu wenig zwischen Ingenieurstätigkeiten wie Anforderungsanalyse oder Systementwurf und einfacheren technischen Tätigkeiten wie Programmierung oder Komponententesten unterschieden. Es gibt – anders als bei anderen Technikbereichen – keine breite Akzeptanz dafür, dass für Ingenieurstätigkeiten in der Softwareentwicklung ein Hochschulstudium (z.B. Informatik) erforderlich ist, während Techniker auch über Berufsakademien oder Ausbildungsberufe ihren Weg in die Praxis finden können. Dies hat auch zur Folge, dass hochqualifizierte Informatiker nicht adäquat eingesetzt werden, sich unterfordert fühlen und in die Primärbranche abwandern.

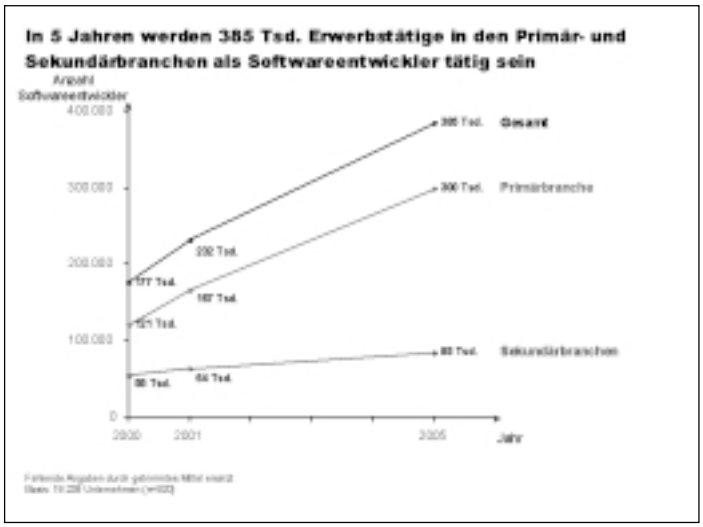


Abb. 4

Die Professionalisierung der Softwareentwicklung erfordert ein klares Rollenbild und darauf abgestimmte Qualifikationen. Insbesondere sollten professionelle Berufsbezeichnungen wie ‚Software-Ingenieur' geschützt sein. Aufgrund der schnellen Innovationszyklen in den Softwarebranchen ist auch ein lebenslanges Qualifikationskonzept notwendig. Allein mit einer soliden Erstausbildung ist es nicht mehr getan. Fortlaufende Weiterbildung muss zur Regel werden. Dies erfordert eine Einstellungsänderung bei Arbeitnehmern und Arbeitgebern.

Der mittelfristige Personalbedarf bis 2005 ist stark ansteigend. Basierend auf dem Befragungsergebnis kann man davon ausgehen, dass bis 2005 der Personalbestand in der Primär- und in den Sekundärbranchen von heute 177.000 Mitarbeitern in der Softwareentwicklung auf schätzungsweise 385.000 ansteigen wird (Abb. 4). Das bedeutet eine Zunahme von knapp 120%. Wesentlicher Wachstumsmarkt ist dabei die Primärbranche mit 179.000 zusätzlichen Stellen. In den Sekundärbranchen wird ein zusätzliches Wachstum um weitere 30.000 Stellen erwartet. Berücksichtigt man die in der Studie nicht einbezogenen Sekundärbranchen, so erhöht sich die Zahl noch einmal beträchtlich. Darüber hinaus ist eine signifikante Verschiebung von Stellen in der Hardware- zur Softwareentwicklung zu erwarten. Da in der Primärbranche traditionell Akademiker die Mehrheit der Softwareentwickler bilden, und in den Sekundärbranchen durch verstärkte Auslagerung reiner Programmiertätigkeiten ebenfalls ein stärkerer Trend hin zu Akademikern zu erwarten ist, ist es offensichtlich, dass dieser hohe Bedarf an hochqualifizierten Mitarbeitern nicht durch die Standardausbildungsgänge der Hochschulen und sonstiger Bildungsträger gedeckt werden kann. Auch bei Ausschöpfung des Rationalisierungspotenzials auf technischer Ebene der Programmierung durch Werkzeugeinsatz ist mit einem weiteren Anstieg des Personalbedarfs zu rechnen.

Vor allem die Expertengespräche haben verdeutlicht, dass in den Sekundärbranchen die Qualifikation der gesuchten Mitarbeiter in Abhängigkeit von der Größe der Unternehmen stark variiert.

Große Unternehmen suchen für den Bereich Softwareentwicklung vorwiegend Ingenieure mit Hochschulabschluss. Die Tätigkeitsschwerpunkte dieser Mitarbeiter liegen im Bereich Anforderungsanalyse und Architektur. Sie entwickeln die Architektur der Software und entscheiden, welche Komponenten von Fremdfirmen zugekauft und integriert werden. Dabei sind das Verständnis der Anwendung sowie Konzepte der Informatik auf hohem Abstraktionsniveau notwendige Voraussetzungen. Diese werden insbesondere durch anwendungsorientierte Informatikstudiengänge (z.B. Wirtschaftsinformatik oder praktische Informatik mit Schwerpunkt Maschinenbau) vermittelt. In kleinen und mittelständischen Unternehmen gestaltet sich das Bild dagegen völlig anders. Hier besteht ein sehr großer Bedarf an Fachhochschulab-

solventen. Der Tätigkeitsschwerpunkt dieser Mitarbeiter liegt in der Programmierung und Anpassung von Applikationen. Die praxisbezogene Ausbildung der Fachhochschulabsolventen ermöglicht eine schnelle Einarbeitung solcher Mitarbeiter. Mit Universitätsabsolventen haben einige der Unternehmen hingegen weniger gute Erfahrung gemacht, da sie häufig wenig Routine im Umgang mit Applikationen besitzen und mit reinen Programmiertätigkeiten eher unterfordert und unzufrieden sind.

Unabhängig von der Größe der Unternehmen ist ein steigender Bedarf an Führungskräften mit Informatikausbildung zu verzeichnen. Dies wird beispielsweise durch die vermehrte Schaffung der Position eines Chief Information Officers (CIO) in softwarelastigen Unternehmen deutlich. Die wachsende Bedeutung von Software insbesondere auch in den Sekundärbranchen zieht auch eine steigende Nachfrage an Mitarbeitern mit Führungsqualifikationen nach sich. Besonders für große Software-Projekte werden verstärkt Projekt-Manager gesucht. Da Software zunehmend wettbewerbbestimmend ist, sind Fragen der Informationstechnik bis auf Vorstandsebene von zentraler Bedeutung für den Erfolg der Unternehmen.

Beim Thema Ausbildung drängen die befragten Unternehmen verstärkt auf interdisziplinäre Studiengänge, in denen Anwendungswissen der Sekundärbranchen mit Informatikkenntnissen verbunden werden. Bei der Informatikausbildung wird der Vermittlung von Methoden und Techniken der Qualitätssicherung von Software, sowie der komponenten-basierten Softwareentwicklung hoher Stellenwert beigemessen. Die gegenwärtige Ausbildung konzentriert sich oft zu stark auf die Fähigkeit, Software neu zu entwickeln, anstatt sich mit Standardkomponenten auseinander zu setzen und diese zu neuen Systemen zu aggregieren. Darüber hinaus wird die Vermittlung von sozialen und kommunikativen Fähigkeiten wie Team- und Führungsfähigkeiten angemahnt.

Kurze Innovationszyklen von Methoden und Werkzeugen im Bereich der Softwareentwicklung sowie die oben beschriebene Verschiebung der Tätigkeitsschwerpunkte verlangen auch neue Konzepte der Weiterbildung. Um mit dem sich schnell ändernden Umfeld in der Softwareentwicklung mithalten zu können und dem steigenden Bedarf an Softwareentwicklern durch Umschulung von Mitarbeitern gerecht zu werden, wünschen sich viele Unternehmen Institutionen, die "lebenslanges Lernen" unterstützen. Großkonzerne begegnen dieser Anforderung mit der Gründung eigener "Corporate Universities". Kleine und mittelständische Unternehmen suchen derzeit nach neuen Möglichkeiten, ihre Mitarbeiter schnell und kostengünstig mit neuen Methoden und Technologien im Bereich der Softwareentwicklung vertraut zu machen. Wiederholt wurde in diesem Zusammenhang ein erweitertes Angebot der Universitäten gefordert, das Ingenieure nicht nur aus-, sondern auch weiterbildet.

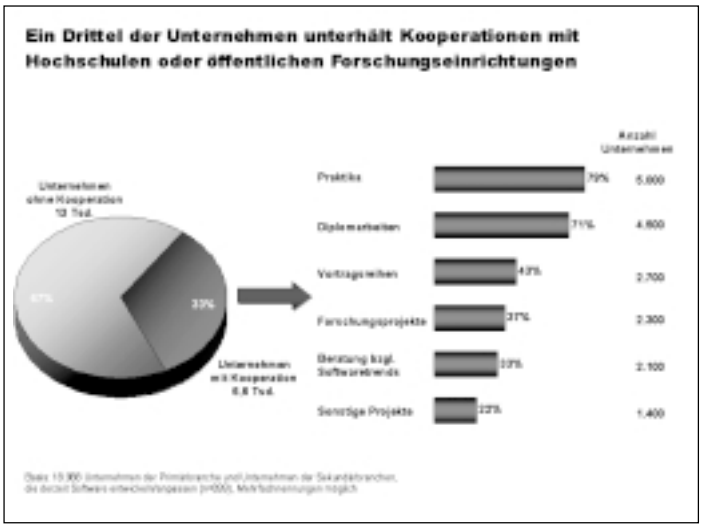


Abb. 5

Technologischer Innovationsstand in der Softwareentwicklung

Die unterschiedlichen Anforderungen an Software begründen sich aus ihren unterschiedlichen Einsatzbereichen. Vielfach dominieren in der Praxis aber auch Kosten- und Terminvorgaben über Qualitätsanforderungen. Dies führt häufig dazu, dass die Qualitätsmängel erst zu spät im Entwicklungsprozess sichtbar werden. Allerdings beginnt sich in der Softwareentwicklung langsam die Erkenntnis durchzusetzen, dass Qualität von Anfang an im Entwicklungsprozess berücksichtigt werden muss, und dass Investitionen in Qualität sich in einer ganzheitlichen Sicht auch positiv auf Kosten und Entwicklungszeiten auswirken. Anzeichen für ein Umdenken in diese Richtung sind bereits durch den verstärkten frühzeitigen Einsatz von Inspektionen bzw. Reviews zu beobachten, durch die Probleme rechtzeitig identifiziert und behoben werden können.

Generell kann ein Trend zu risikominimierenderen Entwicklungsprozessen (z.B. inkrementelle Prozesse) festgestellt werden. Einzelne Unternehmen können durch die Reduktion von Entwicklungsinkrementen auf überschaubare Größenordnungen bereits signifikante Verbesserungen hinsichtlich verbesserter Planbarkeit erreichen und somit eine höhere Erfolgsquote aufweisen.

Methodisch liegt ein starker Fokus auf frühzeitiger Fehlererkennung durch Inspektionen und Reviews, auf der Nutzung der Komponententechnologie zur Kostenreduktion sowie auf verbesserter Interaktion zwischen eigentlicher Softwareentwicklung und den Bedürfnissen aus der Anwendung im Rahmen der Anforderungsanalyse.

Technologisch wird die Diskussion über die künftige Softwareentwicklung durch das Thema Internet dominiert. Sowohl als Plattform für Dienstleistungen als auch als Entwicklungsplattform für Software bestimmt das Internet den Trend. Dies stellt für viele Unternehmen einen gravierenden Paradigmawechsel dar. Beim eigentlich dringend gebotenen Übergang von ihren zentralen, lebenswichtigen Softwaresystemen zu den neuen Plattformen sind sie vielfach überfordert. Die Folge ist ein weiteres Anwachsen des Bestandes an "Legacy Software".

Die Kooperation mit Universitäten und Forschungseinrichtungen liegt immer noch unter dem wünschenswerten bzw. mit Ländern wie den USA vergleichbarem Niveau. Von den befragten Unternehmen der Primär- und Sekundärbranchen geben nur 22% an, überhaupt Forschung zu betreiben (Abb. 5). In den Experteninterviews wurde dieses allerdings in vielen Fällen relativiert, da viele Unternehmen unter Forschung "akademische Grundlagenforschung" verstehen.

In der Tat ist die von vielen Unternehmen durchgeführte "Vorentwicklung" nichts anderes als angewandte industrielle Forschung. Insgesamt tun sich gerade kleinere Unternehmen damit schwer, eine ganzheitliche, langfristige Sichtweise hinsichtlich der Softwareentwicklung zu entwickeln und dabei die Rolle und den Stellenwert der Forschung richtig einzuschätzen. Insgesamt führt der hohe Entwicklungsdruck und Mitarbeitermangel zu einer unzureichenden Auseinandersetzung mit innovativen Techniken. Chancen und Potenziale innovativer Techniken werden nicht oder zu spät genutzt.

Eine verstärkte Kooperation mit Universitäten oder Forschungseinrichtungen zu diesen Themen wird gewünscht, gegenwärtig aber aufgrund der mangelnden Anwendungsnähe vieler Forschungseinrichtungen und Hochschulen als schwer realisierbar bezeichnet. Als Vorbilder für nützliche Kooperationsmodelle wurden die in den USA praktizierte Auftragsforschung oder das Fraunhofer-Modell in Deutschland genannt.

Handlungsempfehlungen

Diese Ergebnisse legen folgende dringende Handlungsempfehlungen nahe:

Nach übereinstimmender Einschätzung aller befragten Experten bestehen die Voraussetzungen für eine günstige Entwicklung der Sekundärbranchen in Deutschland sowie eines Wachstums der Primärbranche in verstärkten Anstrengungen bei der Technologieentwicklung (insbesondere der Softwaretechnik) sowie der kontinuierlichen Qualifikation von Arbeitskräften. Allerdings ist dringlich eine massive Verstärkung der staatlichen Förderung auf dem Feld der Softwaretechnik geboten. Dabei müssen jedoch sorgfältig abgestimmte, differenzierte Formen der Förderung gewählt werden, um den Besonderheiten dieses Gebiets gerecht zu werden.

Eine direkte Wirtschaftsförderung für Unternehmen in der Primärbranche und in den Sekundärbranchen ist nicht erforderlich. Um innovative Techniken in den Unternehmen zu erschließen, sind weniger finanzielle Zuwendungen erforderlich als vielmehr bessere Rahmenbedingungen etwa in Form qualifizierten Nachwuchses und kompetenter Partner in Forschungsinstituten. Erforderlich ist eine Forschungsförderung auf dem Gebiet der Softwaretechnologie, die eine breite Forschungsinfrastruktur in Hochschulen und Forschungseinrichtungen auf den in Deutschland für die Industrie strategischen Themen aufbaut, die für das breite Feld der Unternehmen als Ansprechpartner für Kooperationen außerhalb der öffentlichen Förderung bereitsteht.

Eine substantielle öffentliche Forschungsförderung ist aus mehreren Gründen zwingend erforderlich und für die schnelle Entwicklung der Softwarebranche von zentraler Bedeutung: Erstens wird die Notwendigkeit der Bereitstellung besserer Entwicklungsmethoden (Softwaretechnik) in Unternehmen aller Branchen erkannt und muss deshalb als nationale Aufgabe zur Sicherung der Zukunft in einer der wichtigsten Wachstumsbranchen Deutschlands gesehen werden. Zweitens gibt es spezifisch deutsche Herausforderungen wie die Lösung des Software-Variantenbildungsproblems in den traditionell starken produzierenden Sekundärbranchen wie der Automobilindustrie. Drittens besteht eine große Chance, durch die Förderung branchenspezifischer Softwarekompetenz (z.B. für Branchenarchitekturen) einen Boom von Unternehmensgründungen im primären Softwarebereich zu stimulieren, die als Zulieferer großer Systemintegrationen für die Sekundärbranchen fungieren. Grundsätzlich muss sich die Förderung auf folgende Schwerpunkte konzentrieren:

- Verbesserung des Softwarereifegrads in den Unternehmen durch Weiterentwicklung der Standards (State of the Art, Beste Practice) und Unterstützung der Unternehmen beim Einsatz. Dazu gehört auch das systematische Erarbeiten der Datenbasis zur Einschätzung unterschiedlicher Techniken in der Softwareentwicklung und das Zuschneiden von Techniken auf bestimmte Anwendungsgebiete.

- Grundlagenforschung zur wissenschaftlichen Fundierung der Softwaretechnik in kritischen und zukunftsentscheidenden Bereichen (Safety, Security, Methodik, Werkzeuge, Modelle etc.).

- Erarbeiten von und Experimentieren mit innovativen Konzepten in der Softwaretechnik.

Diese drei Felder ergänzen und befruchten sich. Dazu ist neben einer schnellen, entschlossenen, breit angelegten, erheblichen Forschungsförderung auch eine massive Erhöhung der Ausbildungskapazitäten in Schule, beruflicher Bildung, Hochschule und Universitäten erforderlich.

Die Experten lieferten sehr spezifische Vorstellungen über die Art der Forschungsförderung. Zum einen wurde die Frage nach "marktnaher Forschung" oder "Grundlagenforschung" mit einem eindeutigen "Beides" beantwortet. Es setzt sich immer mehr die Meinung durch, dass in einem sich so rasant entwickelnden Bereich (man spricht von Technologiehalbwertszeiten von 3 bis 5 Jahren) nur die themenspezifische Parallelförderung von Grundlagenforschung und angewandter Forschung Erfolg verspricht. Deshalb werden als wichtigste Merkmale eines zielführenden Förderprogramms folgende Punkte angesehen:

- kleine Projekte (keine großen Konsortien, sondern besser wenige aktive Unternehmen und Forschungseinrichtungen mit effizienter Dissemination der Ergebnisse),

- durchgängige Struktur (Integration von Grundlagen und Anwendungsfragen, Integration von Forschungs- und Anwendungspartnern),

- Interdisziplinarität (viele Herausforderungen erfordern fachübergreifendes Know-how) und

- schnellere Projektvergabe (Auflage von Forschungsprogrammen und Projektvergabe müssen den zeitlichen Bedürfnissen des Gebiets entsprechend beschleunigt werden).

Dabei erfordert die thematische Steuerung Instrumentarien für eine schnellere und zielgerichtetere Reaktion auf neue innovative Themen. Dies erfordert die Einrichtung eines kleinen, effektiven Steuergremiums aus Experten aus Wirtschaft, Wissenschaft und Politik, das die Förderstrategie überprüft und fortschreibt.

Bei der Identifizierung wichtiger Forschungsthemen müssen die spezifischen Stärken des Standorts Deutschland – starkes produzierendes Gewerbe, Einzel- statt Massenproduktionskultur – berücksichtigt werden. Deshalb sollte sich die Förderung besonders auf folgende Anwendungsfelder konzentrieren:

- Software in Produkten ("Embedded Software", z.B. Automobil, Mobilfunk)
- Software zur Unterstützung von Dienstleistungen (z.B. Versicherungen, Öffentliche Verwaltung, Gesundheitswesen, Planung und Logistik)
- Software für produktbegleitende Mehrwertdienstleistungen (z.B. Verkehrsleitsysteme für Fahrzeuge)

Die Forschung zur Softwaretechnik sollte sich folgenden Aufgabenfeldern stellen:

- Verbesserung der Softwarekompetenz der Unternehmen auf breiter Front durch schrittweises Verbessern der Prozesse, Verfahren, Werkzeuge und Methoden
- Erarbeitung der wissenschaftlichen Grundlagen zur Vervollständigung der Softwaretechnik als Ingenieurdisziplin und als Basis innovativer Techniken
- Bereitstellen und Experimentieren mit innovativer Softwaretechnik

Alle drei genannten Felder sind von zentraler Bedeutung und bedingen sich gegenseitig.

Thematische Schwerpunkte könnten wie folgt gesetzt werden:

- Prozesse, Methoden und Werkzeuge zur Erstellung und Integration wiederverwendbarer Softwarekomponenten ("Componentware") auf Basis langlebiger Softwarearchitekturen
- Prozesse, Methoden und Werkzeuge zur rationellen Erstellung von Software hoher Qualität
- Prozesse, Methoden und Werkzeuge zur rationellen Erstellung von Software-Varianten
- Prozesse, Methoden und Werkzeuge zur Unterstützung räumlich verteilter Produkt- und Softwareentwicklung
- Konfigurierbarkeit und Skalierbarkeit von Softwaresystemen in heterogenen Anwendungssystemen
- Aufbereitung, Repräsentation und Personalisierung von Informationsinhalten aus heterogenen Datenquellen ("Knowledge Management", "Contentware Engineering")
- Entwicklung von Mensch-Maschine-Schnittstellen, die auf die Bedürfnisse der Anwender zugeschnitten sind ("Human Centered Engineering")
- Entwicklung und Integration heterogener Netzinfrastrukturen mit skalierbaren Leistungen ("Network Engineering")
- Requirements Engineering zur Ermittlung, Dokumentation, Validierung und Verfolgung komplexer Anforderungen
- Innovative zukunftsweisende Softwaretechnik wie etwa Ad Hoc Systems, Extreme Programming, Netzbasierte Softwareinfrastrukturen.

Zusätzliche Querschnittsthemen für alle Anwendungsbereiche beinhalten

- Digitale Modellierung und Simulation: Umsetzung komplexer Modelle auf Computer, um Experimente zu ersetzen
- Hochleistungsinformationsverarbeitung zur Verarbeitung großer Datenmengen
- Sicherheit: vor unberechtigtem Zugriff bei der Übertragung von Daten über heterogene Netzwerke

Parallel zu einer Softwaretechnologie-Forschungsförderung sind in der Aus- und Weiterbildung Weichenstellungen quantitativer und qualitativer Art unerlässlich. Der Bedarf an qualifizierten Arbeitskräften erfordert eine Ausdifferenzierung und Verbreiterung des Ausbildungsangebots im Softwarebereich. Dies kann durch

- Ausbau der Kapazitäten im Informatikbereich,
- bessere Durchdringung anderer Studiengänge mit informationstechnischem Anwendungswissen,
- Verkürzung der Studienzeiten,
- zusätzliche Förderung der Ausbildungsberufe im IT-Bereich sowie
- verstärkte Weiterbildungsmaßnahmen

unterstützt werden.

Qualitativ wird allerdings eine generelle Erneuerung des deutschen Aus- und Weiterbildungssystems im IT-Bereich als notwendig angesehen. Dabei sollten die Internationalisierung der Lehre, eine Aktualisierung der Bildungsinhalte, Interdisziplinarität sowie der Praxisbezug in den Mittelpunkt gestellt werden. Dass IT-Anwendungswissen in andere Ausbildungsgänge integriert wird sowie Aus- und Weiterbildung im Sinne lebenslangen Lernens angeboten wird, sind weitere dringliche Anforderungen.

Ein entscheidender Punkt wird die Ausbildung höchstqualifizierter Softwareexperten sein, die in den Unternehmen die Zukunftsfähigkeit der Softwaresysteme bestimmen und die neuen Einsatzfelder von Software erschließen. Solche Experten können nur auf dem Nährboden eines Netzwerks von ambitionierten Projekten und Kompetenzzentren herausgebildet werden und sind vielleicht die wertvollsten Spin-Offs einer zielgerichteten Forschungsförderung.

Grundsätzlich ist festzustellen, dass sich die Forschungslandschaft in der Bundesrepublik Deutschland zu schwerfällig für das innovative, sich schnell entwickelnde Gebiet der Softwaretechnik erweist. Die vorhandenen Institute beschäftigen sich überwiegend mit Themen überkommener Disziplinen, zu modernen Themen der Software wird kaum oder unkritisch gearbeitet. Dringend sind weitere Kompetenzzentren und Institute erforderlich.

Die Chancen für Deutschland stehen in diesem Know-how-orientierten Zukunftsfeld hervorragend. Allerdings müssen die wichtigen forschungs- und bildungspolitischen Weichenstellungen umgehend erfolgen, um frühzeitig eine starke Präsenz deutscher Softwareproduzenten auf den globalen Wachstumsmärkten der Zukunft zu sichern und weiter auszubauen.

Network in Science and Industry

Industrial Partners

- ABB Corporate Research Ltd.
- Alcatel Alsthom
- Allianz Lebensversicherungs-AG
- BASF AG
- Bauer & Partner AG
- BMW
- Boeing Company
- Brose AG
- CAP Gemini Ernst & Young
- CAS Computer Anwendungs- und Systemberatung GmbH
- DaimlerChrysler Aerospace AG
- DaimlerChrysler AG, Forschung und Technik
- DaimlerChrysler Services (debis) AG
- Deutsche Bahn AG
- Deutsche Bank AG
- Deutsche Lufthansa AG
- Deutsche Telekom AG
- DFS Deutsche Flugsicherung GmbH
- Deutsches Zentrum für Luft- und Raumfahrt e.V.
- Dräger Medical Electronic B.V.
- Dresdner Bank AG
- Ericsson Eurolab Deutschland GmbH
- European Space Agency
- Etnoteam S.p.A.
- F. Hoffmann-La Roche Ltd
- Fannie Mae
- GCE - Gesellschaft für Computer Engineering mbH
- GEVA-Datentechnik GmbH
- Heidelberger Druckmaschinen AG
- Honeywell Regelsysteme GmbH
- Horst Klaes GmbH u. Co KG
- ICON Intelligent Control Gebäudetechnik GmbH
- InfoGraph GmbH
- Insead
- Insiders GmbH
- Interpares-Mobau GmbH & Co. KG
- Kommunikations- und Datentechnik GmbH
- Kretz Software GmbH
- LMS Durability Technologies GmbH
- Lucent Technologies Network Systems GmbH
- Mannesmann-VDO
- MARKET MAKER Software AG
- maxess systemhaus gmbh (formerly: Markant Südwest Software und Dienstleistungs GmbH)
- MEDIASYS GmbH
- Motorola Inc.
- Nokia Group
- Philips
- PMS Mikado Software Consult GmbH
- Preussen Elektra AG
- proalpha AG
- Psipenta
- Q-Labs GmbH
- Robert Bosch GmbH
- SAP
- Schneider Automationstechnik GmbH
- sd&m software design & management GmbH & Co. KG
- Siemens AG
- SoftLab GmbH
- STOTAX GmbH & Co. KG
- SWA AG
- SYSTEM NET
- tec:inno GmbH
- tecmath AG
- Tenovis GmbH & Co. KG (formerly: Bosch Telecom)
- Tengelmann Warenhandelsgesellschaft
- Thomson-CSF Elektronik GmbH
- T-Mobil GmbH
- Tokheim Corporation (formerly: Schlumberger)
- Viva Software GmbH
- VTT Electronics
- ZF Lenksysteme GmbH

National Research Partners

- Autonomous Intelligent Systems (AiS), GMD, Sankt Augustin
- Centre for Learning Systems and Applications (LSA), University of Kaiserslautern, Kaiserslautern
- Department of Programming Languages and Compilers, Institute of Computer Science, University of Stuttgart, Stuttgart
- Fernuniversität Hagen, Hagen
- Forschungszentrum für Informatik, FZI, Karlsruhe
- GMD First, Berlin
- Institute for Computer Graphics, Fraunhofer Gesellschaft, Darmstadt
- Institute for Computer Science in Economics, University of Leipzig, Leipzig
- Institute for Image Processing and Applied Informatics e.V., University of Leipzig, Leipzig
- Institute for Manufacturing Engineering and Automation (IPA), FhG IPA, Stuttgart
- Knowledge Discovery and Machine Learning, Otto-von-Guericke Universität Magdeburg, Magdeburg
- Special Research Institute Development of Large Systems with Generic Methods (SFB 501), University of Kaiserslautern, Kaiserslautern
- The Research Institute for Validation of AI Systems (VAIS), University of Technology Ilmenau, Illmenau
- University of Essen, Essen
- University of Kaiserslautern, Kaiserslautern

International Research Partners

- Academic Medical Center, University of Amsterdam, Amsterdam, The Netherlands
- Artificial Intelligence and Machine Learning, University of Wyoming, Laramy, USA
- Associação CCG/ZGDV, Centro de Computação Gráfica, Coimbra, Portugal
- BOOTSTRAP Institute, Oulunsalo, Finland
- Carleton University, Ottawa, Canada
- 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
- Centre for Object Technology Applications and Research, University of Technology, Sydney, Australia
- Centro de Computação Gráfica (CCG), Coimbra, Portugal
- Communicación Interactiva S.L., Madrid, Spain
- Department of Computer Science, University of Utrecht, Utrecht, The Netherlands (Cooperation Contract)
- Department of Systems and Informatics, University of Florence, Florence, Italy
- European Software Institute (ESI), Bilbao, Spain (formal affiliation agreement)
- Experimental Software Engineering Group of the University of Maryland (UMD/ESEG), University of Maryland, College Park, USA (formal affiliation agreement)
- Expert Systems Group, Computer Sciences Corporation, St. Leonards, Australia
- Federal University of Santa Catarina, Florianopolis, Brazil
- Georg Mason University, Fairfax, USA
- Georgia Tech University, Atlanta, USA
- GrafP Technologies Inc., Montreal, Canada
- Helsinki University of Technology, Helsinki, Finland
- HIGHWARE sarl, La Salvetat Saint-Gilles, France
- Independent Verification and Validation Facility, NASA Ames Research Center, Fairmont, USA
- Information and Software Engineering, George Mason University, Fairfax, USA
- INRIA Rennes, Rennes, France
- Institut für Informationsverarbeitung und computergestützte neue Medien (IICM), Technische Universität, Graz, Austria
- Institute for Information Technology, National Research Council of Canada, Ottawa, Canada
- Institute for Representation and Reasoning, University of Edinburgh, Edinburgh, Scotland, UK
- Istituto Trentino di Cultura (ITC), Istituto per la Ricerca Scientifica e Tecnologica, Trento, Italy (formal affiliation agreement)
- IVF Industrial Research and Development Corporation (formerly: Swedish Institute of Production Engineering Research), Mölndal, Sweden
- Joint Research Centre for Advanced Systems Engineering, Macquarie University, Sydney, Australia
- Knowledge Media Institute, Open University, Milton Keynes, UK
- Northern Ireland Knowledge Engineering Laboratory, University of Ulster, Newtownabbey, Northern Ireland, UK
- Norwegian University of Science and Technology, Trondheim, Norway
- Semantics Designs, Austin, USA
- Software Engineering Institute (SEI), Carnegie Mellon University, Pittsburgh, USA (formal affiliation agreement)
- Software Engineering Laboratory (SEL), NASA/Goddard Space Flight Center, Greenbelt, USA
- Software Engineering Research Centre (SERC), Utrecht, The Netherlands
- Software Engineering Technology Inc. (SET), Knoxville, USA
- Software Process Support Lab, University of Calgary, Calgary, Canada
- Software Productivity Consortium NFP, Herndon, USA
- Software Technology Transfer Finland, Espoo, Finland
- SQI Software Quality Institute, Brisbane, Australia
- Technical University Delft, Delft, The Netherlands
- Technical University Eindhoven, Eindhoven, The Netherlands
- The Eindhoven Embedded Systems Institute (EESI), Eindhoven, The Netherlands
- Universidad Politecnica de Madrid, Department of Telematics Engineering, Madrid, Spain
- University of British Columbia, Electrical and Computer Engineering, Vancouver, Canada
- University of Karlskrona, Ronneby, Sweden
- University of Oulu, Oulu, Finland
- University of Tennessee, Knoxville, USA
- University of Ulster, Northern Ireland Knowledge Engineering Laboratory, Jordanstown, UK
- VTT Electronics, Oulu, Finland (formal affiliation agreement)

International Software Engineering Research Network (ISERN)

- Brincos Inc., USA
- Carleton University, Canada
- Central Research Institute of Electric Power Industry, Japan
- DaimlerChrysler Research Center Germany
- Ericsson Radio Systems AB, Sweden
- Fraunhofer Center for Experimental Software Engineering, Maryland (FC-MD), USA
- Fraunhofer Institute for Experimental Software Engineering, Germany
- Lucent Technologies - Bell Laboratories, USA
- Lund University, Sweden
- Nara Institute of Science and Technology, Japan
- Norwegian University of Technology & Science, Norway
- NTT Data Corporation, Japan
- Quality Laboratories Sweden AB (Q-Labs), Sweden
- Universita' degli Studi di Roma "Tor Vergata", Italy
- 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 Strathclyde, Scotland, UK
- VTT Electronics, Finland

Visitors hosted

- Prof. Chris Verhoef, Department of Information - Management & Software Engineering, Free University Amsterdam, Amsterdam, The Netherlands, January 31

- Prof. Ray Offen, Director, CSIRO-Macquarie University Joint Research Centre for Advanced Systems Engineering (JRCASE), Sydney, Australia, February 02-05

- Prof. Ross Jeffery, Centre for Advanced Emprical Software Research, University of New South Wales, Sydney, Australia, April 13-17

- Prof. Giovanni Cantone, University of Rome at Tor Vergata, Department of Informatics, Systems and Management Engineering, Rome, Italy, April 17

- Mr. Torgeir Dingsoyr, Div. of Computer Systems and Telematics, Norwegian Institute of Technology, Trondheim, Norway, May 3

- Prof. Reidar Conradi, Div. of Computer Systems and Telematics, Norwegian Institute of Technology, Trondheim, Norway, May 3

- Dr. Egon Berghout, University of Delft, Delft, The Netherlands, May 21-23

- Prof. Marcelo Morandini, Professor di Curso de Ciencias da Computação, Universidade Estadual de Maringa, Maringa, Brazil, May 17

- Prof. Katsuro Inoue, Department of Informatics and Mathematical Science, Graduate School of Engineering Science, Osaka University, Osaka, Japan, June 14

- Prof. Mike Mannion, Department Head of Computing, Glasgow Caledonian University, Glasgow, UK, June 30

- Dr. Michael Evangelist, Director, National Science Foundation (NSF), Washington DC, USA, July 26

- Prof. Ross Jeffery, Center of Advanced Empirical Software Research (CAESAR), University of New South Wales, Sydney, Australia, September 05-06

- Dr. Nick Scerbakov, Graz University of Technology, Graz, Austria, September 06

- Dr. Michael Mehlich, Semantic Designs Inc., Austin, TX, USA, October 02

- Dr. Aybuke Aurum, University of New South Wales, New South Wales, Australia, November 20

- Dr. Björn Regnell, Lund University, Sweden, November 20

- Prof. Claes Wohlin, Blekinge Institute of Technology, Sweden, November 20

- Dr. Paul Clements, Carnegie Mellon University, Software Engineering Institute, Pittsburgh, PA, USA, November 20-24

- Dr. Alan Dutoit, Technical University Munich, Munich, Germany April 14

- Prof. Daniel Berry, Computer Systems Group, University of Waterloo, Waterloo, Canada March 19-20

Lecturing Assignments

Althoff, K.:
Lecture:
Constructing Knowledge-Based Systems for Decision Support and Diagnosis
Department of Computer Science, University of Kaiserslautern
Summer 2000

Althoff, K.:
Lecture:
Development and Organizational Implementation of Case-Based Systems
Department of Computer Science, University of Kaiserslautern
Winter 2000

Atkinson, C.:
Lecture:
Entwicklung von Softwaresystemen I
Dept. of Computer Science, University of Kaiserslautern
Winter 1999/2000

Atkinson, C.:
Lecture:
Entwicklung von Softwaresystemen II
Dept. of Computer Science, University of Kaiserslautern
Summer 2000

Becker-Kornstaedt, U.:
Industrial Training:
Modellierung von Geschäftsprozessen u. Kontrollflüssen bei der maxess Systemhaus GmbH
maxess Systemhaus Gmbh
27 July 2000

Girard, J.-F.:
Lecture:
Re-and Reverse Engineering
Department of Computer Science, University of Kaiserslautern
Winter 1999/2000

Kamsties, E.
Seminar:
Use-Case basierte Anforderungs-beschreibung
SWA Software-Akademie AG
February 24-25, 2000

Kamsties, E.:
Seminar:
Anforderungsspezifikationen und -management
SWA Software-Akademie AG
September 26-27, 2000

Kamsties, E.:
Seminar:
Anforderungsspezifikationen und -management
SWA Software-Akademie AG
October 19-20, 2000

Knauber, P.:
Lecture:
Software Re- und Reverse Engineering
Dept. of Computer Science, University of Kaiserslautern
Winter 1999/2000

Knauber, P.:
Lecture:
Software Product Lines and Reengineering
Dept. of Computer Science
University of Kaiserslautern
Winter 2000/2001

Kohler, K.:
Seminar:
Qualitätsverbesserung und Kosten-reduktion durch Software Inspektionen
SWA Software-Akademie AG
November 13-14, 2000

Müller, W.:
Seminar:
Qualitätsmanagement in der Software-Entwicklung
Management Circle, Frankfurt
August 14-15, 2000

Müller, W.:
Seminar:
Qualitätsmanagement in der Software-Entwicklung
Management Circle, Frankfurt
August 28-29, 2000

Paech, B.:
Seminar:
Use-Case basierte Anforderungs-beschreibung
SWA Software-Akademie AG
February 24-25, 2000

Paech, B. :
Lecture:
Requirements Engineering
Dept. of Computer Science
University of Kaiserslautern
Summer 2000

Paech, B.:
Seminar:
Anforderungsspezifikationen und -management
SWA Software-Akademie AG
April 06-07, 2000

Paech, B.:
Seminar:
Anforderungsspezifikationen und -management
SWA Software-Akademie AG
July 11-12, 2000

Rombach, D.:
Lecture:
Software Engineering I,
Dept. of Computer Science,
University of Kaiserslautern
Winter 1999/2000

Rombach, D., Ruhe, G.:
Lecture:
Software Engineering II,
Dept. of Computer Science,
University of Kaiserslautern
Summer 2000

Rombach, D.:
Seminar:
Forschungsmethoden im Software Engineering
Department of Computer Science, University of Kaiserslautern
Winter Semester 2000/2001

Ruhe, G.:
Seminar:
Methoden zur systematischen Software-Qualitätsverbesserung: Grundlagen, industrieller Einsatz und praktische Erfahrungen, SWA Software Akademie AG,
03-04 April 2000
08-09 May 2000

Schlich, M.:
Seminar:
Qualitätsmanagement in der Software-Entwicklung
Management Circle, Frankfurt
September 18-19, 2000

Journal Editorships

Rombach, D.
- Member, Editorial Board, Informatik: Forschung und Entwicklung, Gesellschaft für Informatik, Springer-Verlag, since 1993

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

- Associate Editor, International Journal of Empirical Software Engineering, McKluwer Academic Publishers, since 1996

- Member of Editorial Board, IEEE Computer Magazine, since 1999

Ruhe, G.:
- International Journal of Software Engineering and Knowledge Engineering, Special Issue on Knowledge Discovery from Empirical Software Engineering Data (Guest Editor)

- Software Engineering Decision-Making to the International Journal of Software Engineering and Knowledge Engineering, Area Editor

Committee Activities

Althoff, K.:

- Co-Speaker, Special Interest Group on Machine Learning of the German Computer Science Society (GI), since 1994

- PC Member, International Conference on Case-Based Reasoning ICCBR, since 1995

- Member, Virtual Research Institute on Validation of AI Systems (VAIS), since 1997

- PC Member, European Workshop on Case-Based Reasoning EWCBR, since 1998

- Board Member (Scientific Advisory Board) , tec:inno GmbH Kaiserslautern, since 1999

- Management Board Member, German Computer Science Society (GI), Department of Artificial Intelligence, since 1999

- Editorial Board Member, German Journal on Artificial Intelligence (KI), since 2000

- PC Member, European Conference on Machine Learning ECML, since 2000

- Program Chair, International Workshop on Learning Software Organizations (LSO'00), since 2000

- PhD Committee Member, Department of Computer Science, University of Ulster, since 2000

- Licentiate Degree Examiner, Department of Computer Science, University of Ronneby, since 2000

- Workshop Chair, PROFES 2000, 2nd Intern. Workshop on Learning Software Organizations (LSO)

Atkinson, C.:

- Steering Committee Member, EDOC 2000, Workshop "Modelle und Modellierungssprachen in Informatik und Wirtschaftsinformatik"

- PC Member, UML 2000, 3rd International Conference on the Unified Modeling Language

Birk, A.:

- Panel, Workshop & Tutorial Chair, PROFES 2000

Bomarius, F.:

- Program Co-Chair, PROFES 2000

Gacek, C.:

- Co-Organizer, First Software Product Line Conference (SPLC-1), Product Line Architecture Workshop in conjunction with ICSE 2000

- Program Committee Member, 3rd Nordic Software Architecture Workshop (NOSA 2000)

Girard, J.-F.:

- Program Committee Member, International Conference on Software Maintenance (ICSM), since 1999

Hartkopf, S.:

- Workshop Chair, PROFES 2000, 2nd Intern. Workshop on Learning Software Organizations (LSO)

Knauber, P.:

- Organizer and Program Comittee Member, in conjunction with ICSE 2000, Software Product Lines: Economics, Architectures and Implications

- Organizer and Program Comittee Member, 1. Deutscher Software Produktlinien Workshop, Kaiserslautern

- Program Committee Member, RACDIS 2000, 2nd Symposium on "Reusable Architectures and Components for Developing Distributed Information Systems"

- Program Comittee Member, NetObject Days 2000, 2nd Intern. Symposium on "Generative and Component-Based Software Engineering (GCSE)"

Müller, M.:

- Workshop Chair, PROFES 2000, 2nd Intern. Workshop on Learning Software Organizations (LSO)

Paech, B.:

- Program Committee Member, Modellierung 2000, 3rd Workshop on Requirements Engineering

- Program Committee Member, WER 2000

Pfahl, D.:

- Program Committee Member, SEKE 2001, Workshop on "Individual and Organizational Learning for Software Improvement"

- Panel Chair, PROFES 2000, Panel on "Corporate Software Engineering Knowledge Networks: How Can They Improve Training of the Workforce in Software Organisations?"

Rombach, D.:

- Member of the German Computer Science Association (GI),Gesellschaft für Informatik, since 1978

- Senior Member of the IEEE Computer Society, since 1985

- Member of the Software Maintenance Association Inc., since 1985

- Member of the Technological Advisory Council (TBR), Rheinland-Pfalz, since 1993

- Member of the Advisory Board of Q-Labs, Lund, Sweden, since 1996

- Member of the Advisory Board German National Research Center for Information Technology (GMD), since 1996

- Coordinator of ISERN (International Software Engineering Research Networks), since 1996

- Head of Scientific Advisory Board, SWA Software Akademie AG, Kaiserslautern, since 1998

- Member of the Steering Committee, SEC Software Experience Center Project, since 1998

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

- Member of the Advisory Board of "Arbeitsgemeinschaft der Bayrischen Forschungsverbünde", München, since 1999

Ruhe, G.:

- Program Committee Member, Software Technic 2000
- Program Committee Member, PROFES 2000
- Program Committee Member, COMPSAC 2000
- PC Member, Fachtagung Softwaretechnik 2000 (September 2000, Berlin)
- PC Member, Product Focused Software Process Improvement (PROFES 2000)
- PC Member, 24th Annual International Computer Software & Applications Conference (COMPSAC 2000), Taipei, October 2000
- PC Member, 11th International Conference on Software Technology CITS, Brazil

Schmid, K.:

- Working Group Leader, Working Group Requirements Engineering for Product Lines

Steffens, P.:

- Publicity Co-Chair, PROFES 2000

Tautz, C.:

- Program Committee Member, PROFES 2000, Workshop on "Learning Software Organizations"
- Co-Organizer, SEKE 2001, Workshop on "Individual and Organizational Learning for Software Improvement"

van Solingen, R.:

- Program Committee Member, PROFES 2000

Keynotes

Rombach, D.:
Capitalizing on Experience - What is missing in CMM&PSP/TSP
SEPG-Conference, Bangalore, India,
February 25, 2000

Rombach, D.:
Globalisierung des Wissens - Revolution von Ausbildung, Wissenschaft und Praxis
Regionalwettbewerb "Jugend forscht - Schüler experimentieren",
DaimlerChrysler, Wörth, Germany,
February 16, 2000

Rombach, D.:
Wie sieht die Welt von morgen aus? Einfluss von Globalisierung und Informationstechnik
"Forum des Westens" CDU-Veranstaltung, Kaiserslautern, Germany,
March 16, 2000

Rombach, D.:
Capitalizing on Experience
PROFES 2000
2nd International Conference on Product Focused Software Process Improvement, Oulu, Finland,
June 2000

Rombach, D.:
Fraunhofer: The German Model for Applied Research and Technology Transfer
ICSE 2000, 22nd International Conference on Software Engineering,
Castletroy, County Limerick, Ireland,
June 06, 2000

Rombach, D.:
Multimedia Aus- und Fortbildung: Multimedia-Qualifikation als entscheidender Erfolgsfaktor im Standort-Wettbewerb
Multimediaforum 2000,
Mainz, Germany,
May 30, 2000

Rombach, D.:
Capitalizing on Software Development Experience
20th Annual Congress of the Brazilian Computer Science Association, Curitiba, Brazil
July 19, 2000

Rombach, D.:
Wie sieht die Welt von morgen aus? Wandel der Arbeitswelt
Arbeitsberatertag 2000, Mannheim, August 28, 2000

Rombach, D.:
Capitalizing on Experience: What is missing from CMM & PSP/TSP?
EuroSPI2000, Copenhagen, Denmark, November 11, 2000

Rombach, D.:
Neue Trends in der Softwaretechnik - Forschung und Ausbildung: Reaktion auf die zunehmende Professionalisierung der industriellen Software-Entwicklung
4. Fachtagung "Industrielle Software-Produktion", Stuttgart, Germany, November 11, 2000

Presentations

Althoff, K.:
Case-Oriented Knowledge Representation and Processing in the Intelligent Storage and Retrieval System, Invited Talk, Graduiertenkolleg "Knowledge Representation", University of Leipzig, Leipzig, Germany, 19 January 2000

Althoff, K.:
Case-Based Reasoning in Practice - Current Status and Future Perspectives, Invited Talk, University of Bremen, Department of Computer Science, Bremen, Germany, 21 January 2000

Althoff, K.:
Case-Based Reasoning for Supporting Continuous Improvement Processes, Invited Talk, University of Bremen, Department of Computer Science, Bremen, Germany, 21 January 2000

Althoff, K.:
Case-Based Reasoning for Supporting Continuous Improvement Processes, Invited Talk, University of Dresden, Department of Economics, Bremen, Germany, 21 February 2000

Althoff, K.:
Experience Factory: Knowledge Discovery in Project Experience Bases, Invited Talk, GMD, Sankt Augustin, Germany, 11 April 2000

Althoff, K.:
Experience Factory: Combining Experimental Software Engineering Methods and Artificial Intelligence Techniques for Knowledge Management, Invited Talk, Seminar on "Knowledge Management: An Interdisciplinary Approach", Dagstuhl, Germany, 13 July 2000

Althoff, K.:
KM-PEB - An Online Experience Base on Knowledge Management Technology, Conference, EWCBR'00, Trento, Italy, 08 September 2000

Althoff, K.:
Learning from Project Experience - An Experience Factory Case Study, Conference, FGML'00, Sankt Augustin, Germany, 19 September 2000

Atkinson, C.:
To Meta or not to Meta - That is the Question, Workshop, GROOM-Workshop UML, University of Koblenz-Landau, Koblenz, Germany, 04 - 05 April 2000

Atkinson, C.:
Component-Based Software Engineering, Workshop, 3rd International Workshop on Component-based Software Engineering, Limerick, Ireland, 05 - 06 June 2000

Atkinson, C.:
Component-based Product Line Engineering, Tutorial, EDOC 2000, Makuhari, Japan, 23 - 28 September 2000

Atkinson, C.:
Component-based Product Line Engineering, Tutorial, UML 2000, York, UK, 03 October 2000

Atkinson, C.:
Component-based Product Line Engineering, Invited Talk, University of Nuremberg-Erlangen, Erlangen, Germany, 25 October 2000

Atkinson, C.:
Component-based Product Line Engineering, Colloquium, University of Kaiserslautern, Kaiserslautern, Germany, 08 November 2000

Atkinson, C.:
Component-based Product Line Engineering, Invited Talk, SAP, Walldorf, Germany, 09 November 2000

Bayer, J.:
Traceability from Domain Characteristics to Architectural Components, Project Meeting, ESAPS Work Package 3 Meeting, Helsinki, Finland, 30 May 2000

Bayer, J.:
Towards Engineering Product Lines Using Concerns, Conference, ICSE 2000, Limerick, Ireland, 10 June 2000

Bayer, J.:
Helping Small and Medium-Sized Enterprises In Moving Towards Software Product Lines, Conference, ICSE 2000, Limerick, Ireland, 10 June 2000

Bayer, J.:
Introducing Separation of Concerns to Product Line Engineering, Symposium, GCSE 2000, Erfurt, Germany, 10 October 2000

Bayer, J.:
Maintenance Aspects of Software Product Lines, Workshop, 1. Dt. SW-Produktlinien WS, Kaiserslautern, Germany, 10 November 2000

Becker-Kornstaedt, U.:
Descriptive Process Modeling in an Industrial Environment: Experience and Guidelines, Workshop, 7th EWSPT 2000, Kaprun, Austria, 24 February 2000

Becker-Kornstaedt, U.:
Knowledge Elicitation for Descriptive Software Process Modeling, Workshop, ICSE 2000, Limerick, Ireland, 05 June 2000

Becker-Kornstaedt, U.:
A Strategy for the Integration of Software Process Support Technology into Organizations, Workshop, ICSE 2000, Limerick, Ireland, 06 June 2000

Becker-Kornstaedt, U.:
Process Modeling with Spearmint, Industrial Presentation, Robert Bosch GmbH, Frankfurt, Germany, 19 July 2000

Becker-Kornstaedt, U.:
Knowledge Elicitation for Descriptive Software Process Modeling, Fraunhofer Center Maryland, College Park, Maryland, USA, 25 September 2000

Birk, A.:
Aspects of Large-Scale Process Studies in Industrial Settings, Conference, ICSE 2000, Limerick, Ireland, 04 - 11 June 2000

Birk, A.:
PBR applied to OO designs, Conference, ISERN 2000, Honolulu, Hawaii, USA, 09 October 2000

Birk, A.:
Experience from qualitative Empirical Research at Fraunhofer IESE, Conference, ISERN 2000, Honolulu, Hawaii, USA, 10 October 2000

Birk, A.:
A knowledge management infrastructure for experience about product/process dependency and technology application, Conference, ISERN 2000, Honolulu, Hawaii, USA, 10 October 2000

Birk, A.:
The Learning Software Organization: No Improvement without Learning, Invited Talk, Computas, Oslo, Norway, 27 October 2000

Birk, A.:
The Learning Software Organization: Integrated Improvement and Knowledge Management in Software Engineering, Invited Talk, Norwegian University of Science and Technology, Trondheim, Norway, 30 October 2000

Birk, A.:
A knowledge management infrastructure for systematic improvement in Software Engineering, Invited Talk, Norwegian University of Science and Technology, Trondheim, Norway, 31 October 2000

Birk, A.:
Improving Software Development of Embedded Systems, Conference, Embedded Systems Conference Europe (ESCE 2000), Maastricht, The Netherlands, 09 November 2000

Birk, A.:
Systematic Improvement Management: A Method For Defining And Controlling Customized Improvement Programs, Conference, 4th International Software Quality Week Europe (QWE 2000), Brussels, Belgium, 22 November 2000

Bomarius, F.:
Qualitätsmanagement als Quelle für permanentes Verbesserungspotential, Tagung, Runder Tisch der Versicherer, CMG Finance GmbH , Lahnstein, Germany, 25 May 2000

Bomarius, F.:
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Advisors: Prof. Dr. Rombach, Prof. Dr. Atkinson

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Supervisors: Rombach, D., Decker, B.
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Supervisors: Rombach, D., Nick, M.
Kaiserslautern, Germany, March 2000

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Internal

Michael Ochs
The Fraunhofer IESE 2000 Award for Project Excellence

Ralf Weigerding
The Fraunhofer IESE 2000 Award for Infrastructure Excellence

Patrick Leibbrand
The Fraunhofer IESE 2000 Award for Infrastructure Excellence

Christian Bunse
The Fraunhofer IESE 2000 Award for Research Excellence

Klaus Schmid
The Fraunhofer IESE 2000 Award for Research Excellence

Oliver Swienty
The Fraunhofer IESE 2000 Award for Thesis Excellence

Heidrun Herrmann
The Fraunhofer IESE 2000 Award for Thesis Excellence

External

Dieter Rombach
Landesverdienstorden Rheinland-Pfalz (Rhineland Palatinate State Service Medal), Land Rheinland-Pfalz, Mainz, November 2000

Dieter Rombach
Senior Member of the Institute of Electrical and Electronics Engineers (IEEE)

Die Rheinpfalz, Nov. 8, 2000

Landesverdienstorden für Professoren der Uni

Für außerordentliche Verdienste um das Land Rheinland-Pfalz und vorbildliches Engagement für das Wohl der Gemeinschaft hat Ministerpräsident Kurt Beck gestern in Mainz die Professoren Dieter Rombach und Helmut Neunzert von der Universität Kaiserslautern mit dem Landesverdienstorden ausgezeichnet. Die beiden Professoren hätten sich im wissenschaftlichen Bereich hervorragende Verdienste erworben, erklärte Beck. Mit außergewöhnlichem Engagement habe Rombach das Institut für Experimentelles Software-Engineering aufgebaut, das als erstes Institut in Rheinland-Pfalz in die Fraunhofer-Gesellschaft aufgenommen wurde. Darüber hinaus habe er sich für die Weiterentwicklung der Computerbildung in den Schulen in Rheinland-Pfalz eingesetzt. Neunzert sei der Initiator und weltweite Pionier der Einbettung der Mathematik in die angewandten Wissenschaften. Durch seinen außergewöhnlichen Einsatz sei es ihm gelungen, das Institut für Techno- und Wirtschaftsmathematik an der Uni Kaiserslautern zu gründen, das in die Fraunhofer-Gesellschaft aufgenommen wurde. Damit sei zum ersten Mal das Fachgebiet Mathematik in der auf anwendungsorientierten Forschung spezialisierten Fraunhofer-Gesellschaft etabliert. (red)

Mit dem Landesverdienstorden wurden gestern die Uniprofessoren Dieter Rombach (links) und Helmut Neunzert (rechts) von Ministerpräsident Kurt Beck ausgezeichnet. —FOTO: VIEW

Chronicle

02 February 2000
Visit of the Lord Mayor and members of the Christian Democratic Party group (CDU Stadtratsfraktion), City of Kaiserslautern (B. Deubig, J. Deubig, Mrs. Kolb, Mrs. Hannah, Mrs. Niederer, Mr. Rottmüller, Mr. Weisenstein, Mr. Wimmer) in Kaiserslautern

09 - 10 May 2000
Meeting of the FhG Employee Representatives

27 September 2000
Visit of a Student Delegation from Moscow University

13 November 2000
Visit of a Delegation of RLP Career Counselors

Minister President of the State of Rhineland Palatinate Kurt Beck congratulating Prof. Dieter Rombach

Media Coverage

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

Allgemeine Zeitung
04-27-2000
04-27-2000

Amtsblatt Enkenbach-Alsenborn
02-02-2000

Berliner Zeitung
04-27-2000

Bild der Wissenschaft
01/2000

Bit
03/2000

Computerwoche
07-28-2000

Maifelder Chronik, September, 2000

Ein wahrer Informatikfan

Volker Gersabeck absolvierte ein vierwöchiges Praktikum am Fraunhofer Institut für „Experimentelles Software Engineering" (IESE) in Kaiserslautern

Volker Gersabeck ist Schüler des Kurfürst-Balduin-Gymnasiums Münstermaifeld. Foto: iv

Polch/Kaiserslautern. Ein vierwöchiges Praktikum absolvierte der 17-jährige Gymnasiast Volker Gersabeck aus Polch am Fraunhofer Institut für „Experimentelles Software Engineering" (IESE) in Kaiserslautern. Dies war der Sonderpreis, den der Schüler des Kurfürst-Balduin-Gymnasiums Münstermaifeld beim Landeswettbewerb „Jugend forscht" gewann. Unter fünf Mitbewerbern in der Sparte Mathematik/Informatik hatte er einen hervorragenden zweiten Platz im Landesentscheid belegt.

Als der Oberstufenschüler die Programmiersprache Turbo-Pascal kennen lernte, war sein Interesse an dieser Materie geweckt. Mit Hilfe von Fachbüchern arbeitete er sich in die professionellen Programmiersprachen C++ und Java ein. Auch mit Perl und UML weiß der Computerfreak umzugehen.

Nachdem Volker für die Mosel-regatta seines Rudervereins Treis-Karden ein Programm geschrieben hatte, legte sein Gymnasium die Teilnahme beim Regionalwettbewerb „Jugend forscht" an. Für den Wettbewerb überarbeitete Volker sein Programm, mit dem die Ergebnisse der Wettbewerbe erfasst und ausgewertet werden konnten. Er löste die Problematik des Datentransfers zwischen dem Zeit- und dem Regattabüro durch eine Internetverbindung. Darüber hinaus gelang es ihm, die Datenstruktur so dynamisieren, dass auch mehrere Rennen gleichzeitig und eine unbegrenzte Zahl von Teilnehmern arbeiten und ausgewertet werden können. Mit seiner Arbeit überzeugte er die Jury an der Fachhochschule Koblenz und belegte vor seinen beiden Konkurrenten den ersten Platz in der Sparte Mathematik/Informatik. Somit hatte er sich als einziger in dieser Sparte für den Landeswettbewerb qualifiziert.

Beim Fraunhofer Institut, das vom Minister für Wirtschaft, Verkehr, Landwirtschaft und Weinbau des Landes Rheinland-Pfalz, Hans-Artur Bauckhage, in Zusammenhang mit der Greencard Initiative mit der Erschließung des „IT-Vermittlungs-Netzwerk" (IT Job Network) beauftragt worden war, arbeitete auch Volker Gersabeck in die ihm bislang noch unbekannte „Programmiersprache" Perl ein und verbesserte daraufhin die Internetseite (www.gradcard.rlp.de) dahingehend, dass Jobsucher oder -anbieter Eintragungen nachträglich mit großem Aufwand ändern können. Im Anschluss daran schrieben der Schüler anhand einer neuen Projektes die Abläufe des Instituts beim Software engineering nahegebracht. Schon jetzt freut sich die Institutsleitung auf ein weiteres Praktikum, das ihm das Institut sicherlich gestellt hat. Diese wird er noch vor Aufnahme seines Studiums absolvieren.

Die Rheinpfalz, January 03, 2000

INTERVIEW

War Jahr-2000-Problem nur eine Erfindung?

War die ganze Aufregung um das Jahr-2000-Problem überflüssig? – Unser Redakteur Jürgen Müller befragte dazu den Kaiserslauterer Informatik-Professor Dieter Rombach. Der Software-Spezialist lehrt an der Universität Kaiserslautern und leitet das Fraunhofer-Institut für experimentelles Software-Engineering.

War das Jahr-2000-Problem nur eine Erfindung von cleveren Geschäftemachern?

In der langen Vorbereitung auf das Jahr 2000 wurde in Firmen und Verwaltungen durch Inspektion aller Softwaresysteme sowie vorzeitige Simulation des Datumswechsels eine Vielzahl von Fehlern gefunden und behoben. Insofern gab es tatsächlich ein Jahr-2000-Problem. Der reibungslose Übergang war das Resultat sorgfältiger Vorarbeiten. Diese Vorarbeiten haben allein in Deutschland nach vorsichtigen Schätzungen einen dreistelligen Milliardenbetrag verschlungen. Weiter müssen wir uns bewusst sein, dass zum Jahreswechsel nur die versorgungskritischen Systeme in Betrieb waren. Diese Systeme waren besonders intensiv vorbereitet worden. Es ist nicht auszuschließen, dass es im Routinebetrieb weniger kritischer Systeme in den kommenden Wochen noch zu vereinzelten Problemen kommen wird.

„Der reibungslose Übergang war das Resultat sorgfältiger Vorarbeiten."

DIETER ROMBACH

Gibt es in absehbarer Zeit noch weitere problematische Termine?

Auf Grund des Schaltjahres 2000 könnte der 29. Februar ein weiterer kritischer Zeitpunkt sein. Ich gehe allerdings davon aus, dass bei all denjenigen Systemen, die erfolgreich auf das Jahr 2000 umgestellt wurden, auch diesem Sachverhalt Rechnung getragen wurde.

Was können wir aus dem Jahr-2000-Problem lernen?

Angesichts der immensen Kosten sollten wir die Frage nach der Ursache stellen. Nicht die Ablage der Jahreszahl in zwei statt vier Ziffern war die Ursache, sondern die unprofessionelle Repräsentation dieser Entscheidung in Softwaresystemen. Softwaresysteme sind nur dann leicht zu ändern, wenn die zu variierende Entscheidung an einer zentralen Stelle zu ändern ist. Die Hauptursache des Jahr-2000-Problems ist, dass derartige Architekturprinzipien bei der Erstellung großer Softwaresysteme häufig nicht berücksichtigt werden. Wenn diesem Grundprinzip bei der Erstellung zukünftiger Softwaresysteme nicht besser Rechnung getragen wird, sind weitere kostspielige Umstellungen vorhersagbar. So zum Beispiel bei der Änderung von Gesetzen für Versicherungssysteme. Ich kann nur an alle Beteiligten appellieren, für alle kritischen Softwaresysteme in Zukunft auf die Einhaltung professioneller Grundregeln zu bestehen: Wer Software kaufen will, sollte sich von Experten beraten lassen, Gesetzgeber sollten Abnahmekriterien für Software vorgeben und die Produzenten der Softwaresysteme sollten ihre internen Entwicklungslinien dem Stand der Technik anpassen. (Foto: Archiv/View)

Die Zeit, January 20, 2000

Software in den Wechseljahren

Erfolgreiche Programme müssen auch im Alter anpassungsfähig bleiben / Von Wolfgang Blum

Mit Computerprogrammen ist es wie mit Menschen: Sie reifen – und sie altern. Manche Software wird bis zu 30 Jahre lang genutzt und im Lauf ihres Lebens ständig modifiziert. Die Entwickler korrigieren anfängliche Fehler oder reagieren auf wandelnde Geschäftsbedingungen. Das ist allemal einfacher, als neue Programme zu schreiben und zum Laufen zu bringen. Nur ein Fünftel ihrer Arbeitszeit stecken Programmierer heute in die Entwicklung neuer Software, vier Fünftel dagegen verschlingt die Wartung alter Programmpakete. Doch mit jeder Änderung wird die Struktur unübersichtlicher. Und irgendwann wird das Programm zum Sicherheitsrisiko: Es bleibt zwar weiter in Gebrauch, doch niemand darf mehr daran rühren – denn jeder weitere Eingriff hat unvorhersehbare Folgen.

Für Herbert Weber ist das ein unhaltbarer Zustand. „Was wir brauchen, ist evolutionsfähige Software", fordert der Leiter des Fraunhofer-Instituts für Software- und Systemtechnik (ISST) in Berlin. Bis heute denke kaum ein Programmierer an die lange Lebenszeit seiner Produkte, kritisiert Weber. Die Programme seien durchweg schlecht dokumentiert und ließen sich nur schwer an neue Bedingungen anpassen. Allein die Jahr-2000-Umstellung kostete weltweit mehr als eine halbe Billion Mark. Auch die Einführung des Euro schlägt mit Milliarden zu Buche. Das soll mit „änderungsfreundlicher" Software anders werden.

Mit einem Industriepartner, der aus Kostengründen möglichst viele seiner Programme „in die neue Welt retten" will, arbeitet das Berliner Fraunhofer-Institut derzeit an einer evolutionsfähigen Finanzsoftware, die mehrere tausend Unterprogramme und Hunderte Datenbanken umfasst. Um sie änderungsfreundlich zu gestalten, sagt Weber, müsse man sie in Komponenten zerlegen, die unabhängig voneinander funktionieren und sich flexibel kombinieren lassen. Das Bundesforschungsministerium steckt drei Millionen Mark in das Berliner Projekt. Dennoch bemängelt Weber: „In Europa wird evolutionsfähige Software viel zu wenig gefördert." In den USA dagegen würden bis 2004 gut acht Milliarden Mark in die Grundlagenforschung investiert.

Denn jetzt, so meint der Berliner Informatiker, sei es so günstig wie nie zuvor, alte Software evolutionsfähig zu machen. Viele Fachleute haben die Fehler ihrer Produkte kennen gelernt und Erfahrung im Weiterentwickeln gesammelt, als sie ihre Programme für das Jahr 2000 rüsteten. In die Lösung des Y2K-Problems steckten die Firmen Millionen – doch die Gelegenheit, ihre Software bei dieser Gelegenheit auch zu flexibilisieren, nutzten sie nicht. Kommt es etwa zu Gesetzesänderungen, müssen die Programme wieder mühevoll umgestrickt werden.

Software entwickeln gleicht einem Glücksspiel: Ein Drittel der Vorhaben scheitert. Von den restlichen werden über 80 Prozent teurer und dauern länger als vorgesehen. Dieter Rombach, Chef des Fraunhofer-Instituts für Experimentelles Software Engineering (IESE) in Kaiserslautern, fordert daher ein Umdenken der Branche. Ingenieursprinzipien seien gefragt. „Wenn man ein kleines Gartenhäuschen bauen will, reicht ein Maurer aus", zieht Rombach einen Vergleich. Werde das Gebäude größer und komplexer, brauche es dagegen Poliere, Ingenieure und Architekten. Niemand komme auf die Idee, ein Hochhaus allein mit tausend Maurern zu errichten.

Genau das aber geschehe in der Softwarebranche. Dort schreiben unzählige Informatiker gleichzeitig an Programmen mit Millionen Zeilen und schaffen so die „komplexesten Artefakte, die je von Menschen entwickelt wurden", sagt Rombach. Fehler könnten dabei nur mithilfe bewährter Verfahren aus den Ingenieursdisziplinen vermieden werden. „Die Anforderungen müssen exakt erfasst, Prozesse klar definiert und messbare Ziele vorgegeben werden", fordert Rombach. Jeder müsse seine Arbeit genau dokumentieren und auf Fehler abklopfen. „Man kann auch keine Brücke bauen und hinterher prüfen, ob sie trägt."

Brücken und andere Werke der Ingenieurskunst halten Jahrhunderte lang. Bis die Informatik in solchen Zeiträumen denkt, werden wir wohl noch einige Systemabstürze erleben.

Der Forschungsdienst dfd
02/2000

Deutscher Drucker
02-10-2000

Die Rheinpfalz
01-03-2000
01-03-2000
01-07-2000
01-08-2000
01-20-2000
03-15-2000
02-16-2000
02-18-2000
06-03-2000
06-14-2000
06-15-2000
04-01-2000
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04-27-2000
05-15-2000
06-03-2000
06-23-2000
06-27-2000
07-28-2000
07-29-2000
08-01-2000
08-09-2000
09-28-2000

Die Rheinzeitung
04-27-2000
04-27-2000

Die Zeit
01-20-2000

DPA
02-23-2000
04-26-2000
05-11-2000
07-24-2000
07-24-2000

Fraunhofer Magazin
03/2000

Iserlohner Kreisanzeiger
03-11-2000

Die Rheinpfalz, June 3, 2000

KAISERSLAUTERN KOMPAKT

Fraunhofer: Kooperation mit Finnland

Unterzeichneten gestern einen Kooperationsvertrag: der Leiter des Fraunhofer-Instituts für Experimentelles Software Engineering Kaiserslautern, Dieter Rombach (rechts), und der Leiter der finnischen Organisation für angewandte Forschung VTT, Markku Oivo. —FOTO: VIEW

Der Austausch von Forschungsergebnissen, Ideen und Mitarbeitern zwischen dem Fraunhofer-Institut für Experimentelles Software Engineering (IESE) und Informatikern der größten finnischen Organisation für angewandte Forschung VTT soll zukünftig intensiviert werden. Das erklärten der Leiter des Fraunhofer IESE, Dieter Rombach, und der Leiter der Embedded Software Forschung im VTT, Markku Oivo, gestern bei der Unterzeichnung eines Kooperationsvertrages. Das Abkommen habe zum Ziel, ein gemeinsames Forschungsprogramm aufzustellen, um damit die technische Entwicklung auf dem Gebiet Software Engineering voranzutreiben. Darüber hinaus sei geplant, technische Fragestellungen gemeinsam zu bearbeiten und praktische Lösungen zu entwickeln, die für industrielle Nutzer interessant sind. Das Abkommen ist nach den Worten von Rombach ein weiterer wichtiger Meilenstein auf dem Weg zu einer grenzüberschreitenden Zusammenarbeit zwischen großen europäischen Forschungsorganisationen. Die Fraunhofer-Gesellschaft, mit insgesamt etwa 10.000 Mitarbeitern die größte deutsche Organisation in der angewandten Forschung, habe mit dem VTT (etwa 3000 Mitarbeiter) einen gleichrangigen Partner gewonnen, der nicht nur ähnliche Ziele verfolge, sondern auch auf Grund seines Auftrages und seiner Strategie als finnisches Pendant zur Fraunhofer-Gesellschaft betrachtet werden könne. (red)

Uni Spectrum, April, 2000

Die Uni auf der Landesgartenschau

Fraunhofer IESE, AGSE und SWA präsentieren sich auf der Landesgartenschau

Bin ich ein Software-Typ?

Berufsfelder von Software-Experten stehen im Mittelpunkt eines Standes des Fraunhofer-Institutes für Experimentelles Software Engineering auf der Landesgartenschau. Gemeinsam mit der Arbeitsgruppe Software Engineering AGSE (Fachbereich Informatik) und der Software Akademie AG informieren hier Kenner der Software-Szene über Anforderungen, Aktionsfelder und Aussichten auf einem Gebiet, das durch akuten Arbeitskräftemangel und rasantes Wirtschaftswachstum gekennzeichnet ist.

Neugierige junge Leute, die sich für technische Themen begeistern können und einen Beruf anstreben, in dem Ideenreichtum und Kommunikationsfähigkeit gefragt sind, sollen mit diesem Stand angesprochen werden. Ihnen soll ein Blick hinter die Kulissen des Software-Business geboten werden.

Software-Experten stellen sich persönlich vor. Auf großen Bildtafeln beschreiben sie ihren Arbeitsalltag und geben Auskunft über ihren Werdegang. Ein Multimedia-Informationssystem lädt zu einem heiteren „Beruferaten" ein. Dem Benutzer werden Fragen gestellt, die für Berufs- und Studienwahl wichtig sind: „Bin ich ein Software-Typ?" „Eigne ich mich für einen Beruf als Software-Entwickler?" „Kann ich meine Stärken als Software-Projektmanager gut einsetzen?" Das System soll keine fundierte Studien- bzw. Berufsberatung ersetzen. Es soll vielmehr auf spielerische Weise Einblick in eine Berufswelt verschaffen, die heute immer noch zu Unrecht als exotisch und einseitig technisch angesehen wird. Berührungsängste sollen abgebaut und insbesondere auch junge Frauen dazu ermutigt werden, eine Ausbildung mit Ziel Software-Branche zu erwägen.

Besonders interessant für „ältere Semester": die Fortbildungsangebote der Software Akademie. Studienabbrechern, Quereinsteigern und Personen, die sich nach längerer Erwerbspause auf dem Arbeitsmarkt zurückmelden, bietet die SWA mit praxisorientierten Crash-Kursen vielversprechende Chancen. Viele Absolventen konnten nach einer Ausbildung als Entwickler oder technischer Redakteur eine attraktive Position besetzen. Wer einen Neuanfang wagen will, findet hier also erste Informationen.

Joachim Müller-Klink

Die Rheinpfalz, September 28, 2000

Lauterer Institut bei Chancengleichheit vorn

Untersuchung der Fraunhofer-Gesellschaft

Das Fraunhofer-Institut für Experimentelles Software Engineering in Kaiserslautern (IESE) nimmt innerhalb der Fraunhofer-Gesellschaft eine herausragende Rolle bei der Besetzung von wissenschaftlichen Positionen mit weiblichem Personal ein. Dies geht aus einer von der Fraunhofer-Gesellschaft, München, vorgelegten Untersuchung zum Thema Chancengleichheit in der Fraunhofer-Gesellschaft hervor.

Junge Wissenschaftlerinnen würden nicht als „Quotenfrauen" gesehen. „Maßgeblich für ihre Beschäftigung ist ihre Qualifikation, nicht das Geschlecht", betont Institutsleiter Professor Dr. Dieter Rombach.

Nach der Fraunhofer-Studie hat sich der Wissenschaftlerinnenanteil in der gesamten Fraunhofer-Gesellschaft innerhalb von zehn Jahren mehr als verdoppelt. Das IESE belegt Platz drei. Nur beim Stuttgarter Schwester-Institut für Grenzflächen und Bioverfahrenstechnik sowie dem ebenfalls dort ansässigen Informationszentrum Raum und Bau ist der prozentuale Anteil weiblicher Vollzeitbeschäftigter noch höher. Beim Vergleich der Fraunhofer-Institute, die sich mit Informations- und Kommunikationstechnik befassen, schneidet das IESE am besten ab. 1996 betrug der Frauenanteil am IESE elf Prozent, aktuell liegt er bei 27 Prozent. Damit verzeichnete das IESE mit acht Prozent den höchsten prozentualen Zuwachs an Wissenschaftlerinnen aller Insitute. Im Bereich der Führungskräfte zeichnet sich ein ähnlicher Trend ab. Derzeit liegt der Anteil weiblicher Abteilungs- und Gruppenleiter am IESE allein im wissenschaftlichen Bereich bei 20 beziehungsweise 27 Prozent. (red)

Maifelder Chronik
09/2000

Mannheimer Morgen
04-27-2000

Markt + Chance
09-01-2000

Pfälzischer Merkur
04-27-2000
07-12-2000
07-26-2000
09-22-2000

Pirmasenser Rundschau
06-03-2000
06-28-2000

Die Rheinpfalz, March 15, 2000

Computerspezialisten sind Mangelware

Kaiserslauterer IT-Unternehmen suchen händeringend Arbeitskräfte – Greencard-Regelung begrüßt

Auch in Kaiserslauterer IT-Unternehmen sind Computerspezialisten Mangelware und werden händeringend gesucht. Das ergab gestern eine RHEINPFALZ-Umfrage. Die Greencard-Regelung für ausländische Fachleute stieß deshalb auf große Zustimmung.

Kommt schon seit Jahren nicht ohne Spitzenkräfte aus dem Ausland aus: das Fraunhofer-Institut in Siegelbach. Die Wissenschaftler Andrew Beitz und Louise Scott beispielsweise kommen aus Australien. Da ist es vorteilhaft, dass die Institutssprache Englisch ist. —FOTO: VIEW

Professor Dieter Rombach, Leiter des Fraunhofer-Instituts für Experimentelles Softwareengineering, sagte: „Ohne Arbeitskräfte-Importe werden wir die nächsten fünf bis zehn Jahre nicht auskommen." Der Bedarf an Spezialisten sei enorm hoch, allein in der Großregion um Kaiserslautern könnten sofort 500 bis 1000 Spitzenleute untergebracht werden. Deshalb sei die Initiative der Bundesregierung uneingeschränkt zu unterstützen. Einrichtungen wie die Software-Akademie, die er ihm mitbegründet wurde und Leute für die IT-Branche fit macht, könnten momentan nur bedingt helfen. „Wir können durch Umschulung niemand zum Software-Ingenieur machen. Dazu bedarf es schon einer längeren Ausbildung." Auch an seinem Institut habe er den Bedarf an Fachleuten nur stillen können, in dem er Ausländer geholt und Englisch zur Institutssprache gemacht habe. In der dynamischen IT-Branche sei es für die Zukunft ganz wichtig, dass Unternehmen ihre Mitarbeiter mehr als bisher am Erfolg partizipieren ließen. Auch in der Forschung müsse sich etwas tun. „Man bekommt nur schwer Topleute, wenn man durch Festgehälter nach BAT stranguliert ist."

Beim Kampf um die Besten auf dem IT-Markt rechnet Rombach dem Standort Kaiserslautern indes gute bis sehr gute Chancen aus. „Die Lebenshaltungskosten sind niedriger als in München, die Lebensqualität ist auch nicht schlecht. Vor allem aber bietet Kaiserslautern die Nähe zu Forschung und Lehre, zu gut ausgebildeten Leuten, die Nachschub an innovativen Ideen produzieren."

„Die Greencard-Regelung ist kein Allheilmittel, hilft aber, Engpässe zu überbrücken", meinte Florian Bernauer, Geschäftsführer der Markant-Südwest Software & Dienstleistungs GmbH. Die Frage sei jetzt, ob der Mittelstand davon profitieren könne. „Gute Leute sagen mir immer wieder, dass sie eine Weltstadt Kaiserslautern vorziehen." Was für Bernauer beweist, dass die Nachfrage nach Spitzenleuten riesig ist: „Die Headhunter telefonieren direkt in die Unternehmen rein und wollen Leute abwerben. Das passiert immer öfter." Sein Unternehmen mit 87 Mitarbeitern ziehe im Mai in den PRE-Park und wolle dann wachsen, in den nächsten drei Jahren auf 125 Leute. „Es wird schwer, Fachkräfte zu finden", schätzt er. Schon jetzt sei er eine Kooperation mit einem indischen Entwicklungslabor eingegangen, aus der Not heraus. Worauf Bernauer setzt: Dass es mit der Greencard leichter wird, ausländische Studenten zu halten.

Ausdrücklich begrüßte gestern auch Professor Andreas Dengel, Geschäftsführender Gesellschafter der Insiders Information Management GmbH, die Greencard für ausländische Computerspezialisten. „Der Bedarf an Arbeitskräften ist in der Branche enorm, der deutsche Markt ist leer gefegt." Der Walldorfer Software-Konzern SAP könnte fast alleine alle Informatikabsolventen der Republik einstellen. Über Stellenanzeigen bekomme Insiders so gut wie keine hochqualifizierten Leute mehr. Dengel: „Das läuft nur noch über persönliche Kontakte und Abwerben." Insiders beschäftigt derzeit 40 Mitarbeiter, will bis zum Jahresende 15 neue Kräfte einstellen. Dengel: „Das wird uns sehr, sehr schwer fallen." Schon heute müsse Insiders Aufträge am Deutschen Forschungszentrum für Künstliche Intelligenz (DFKI) platzieren, weil Personal fehle. Auch mit Blick auf die Regio befürchtet Dengel Engpässe. „Viele Unternehmen vor Ort wachsen so stark, wenn ich sehe, was die auf d Plan haben für die nächsten Ja wird es nicht einfach." Auf keinen wollte Dengel den Standort Kaiser tern für den Arbeitskräftemange antwortlich machen. „Natürlich nen wir mit einer Großstadt nich halten. Aber wir kriegen auch aus Ballungsgebieten, weil wir sante Jobs zu bieten haben u Lautern als IT-Zentrum langsa kanntheit gewinnt."

Für den Vorstandsvorsitze Tecmath AG, Wilhelm Krü die Greencard-Regelung vorübergehend helfen, langfristig fordert er aber ein Umdenken, vor allem bei der Ausbildung. Gefragt sei ein starkes Fundament, auf dem man starten könne. Da- [illegible] Lernen notwen-

Wirtchaftsmagazin Pfalz
04/2000
09/2000

Wochenblatt
09-20-2000

ZIRP Zukunftsinitiative Rheinland-Pfalz

Markt und Chance, September 1, 2000

Integration planen und realisieren

Professor Dr. Dieter Rombach

Strukturwandel erfordert hohe Mobilität – neue Ausgabe der „Mitteilungen aus der Arbeitsmarkt- und Berufsforschung" erschienen

Pirmasenser Zeitung
04-27-2000
06-23-2000
07-12-2000

Süddeutsche Zeitung
01-10-2000

TechnikForum
02/2000

TOP inform
02/2000
03/2000

Trierischer Volksfreund
04-27-2000

Uni-Spectrum
01/2000
02/2000

Vis-à-vis
01/2000

Westfalenpost
01-11-2000

WFK
09/2000

Pfälzischer Merkur, July 26, 2000

Eine Portion Disziplin für die genialen Köpfe

Fraunhofer Institut in Kaiserslautern bringt Software-Firmen auf Trab — Verbesserte Arbeitsabläufe sparen Zeit und Geld und bringen Qualität

Die Zeiten genialer Hinterhofbastler in der Software-Branche sind vorbei. Nur mit Ingenieursdisziplinen lasse sich ein IT-Unternehmen führen, sagt das Fraunhofer Institut in Kaiserslautern-Siegelbach.

— Von CLAUDIA TIETZ —

Kaiserslautern. Die Software-Branche boomt — auch in der Westpfalz, wo sich dank der Konversionsbemühungen, der Fachhochschule und der Universität die Informationstechnologie auch in Lehre und Forschung angesiedelt hat. Ein günstiges Klima für neue Firmen, die Software entwickeln. „Doch die Zeiten, in denen es reicht, ein genialer Kopf zu sein, sind vorbei", sagt Petra Steffens, zuständig für Marketing und Öffentlichkeitsarbeit des Fraunhofer Instituts, das seit 1996 in Kaiserslautern ansässig ist. Wenn kleine, mittlere und auch größere Unternehmen in dieser Branche bestand haben wollen, müssen sie Produkte anbieten, die genauso zuverlässig sind wie andere industrielle Erzeugnisse. Funktionsweise, Bedienbarkeit, Wartungsaufwand, eben die „Architektur" muss stimmen.

An diesem Punkt setzt das Fraunhofer Institut, das auf „Experimentelles Software Engineering" spezialisiert ist, sein Angebot an. Das bestreben des Institutes ist es, den Firmen Methoden, Verfahren und Werkzeuge an die Hand zu geben. Auch Computerprogramme müssen geordnet, gegliedert, recycelbar sein. Dazu brauche man eben jene Ingenieurs-Disziplinen, die das Institut — selbst zum Teil ein Unternehmen, zum Teil öffentliche Forschungseinrichtung — hilfesuchenden Firmen vermitteln will.

Typische Probleme in der Software-Entwicklung seien die Einhaltung der Zeitpläne und des Budgets, wobei gleichzeitig die Qualität natürlich stimmen muss, erläutert Steffens. So werde aus Zeitgründen die Qualitätskontrolle erst spät vorgenommen oder manchmal erst am fertigen Produkt ausgetestet. Zu wenig Zeit werde in die Planungsphase investiert. Doch wenn Fehler erst spät entdeckt würden, könne das bedeuten, dass umfangreiche Umbauten der Software vorgenommen, vielleicht nachträglich „Stützpfeiler" errichtet werden müssten — ein kostspieliges Unterfangen.

Steffens vergleicht dies mit dem Bau eines Hauses. Habe an der Software ein Architekt gearbeitet, der in seinen Plänen eine sinnvolle Gliederung, ein „gutes Raumkonzept" umsetzt, könnten Komponenten möglichst oft wiederverwendet werden, ohne großen Aufwand. Denn die Firmen produzierten zwar verschiedene Produkte, die auf die Bedürfnisse der Kunden zugeschnitten seien, aber viele Teile enthielten ähnliche Funktionen.

Ein weiterer Schritt zur Qualität an der „Software-Baustelle", sei die regelmäßige Abnahme der Bauabschnitte. Dazu hat das das Institut bestimmt Verfahren entwickelt, wie das „Lesen aus unterschiedlichen Perspektiven". „Der Inspekteur setzt sich verschiedene Hüte auf, mal den des Endanwenders, mal den des Systemadmisitrators," berichtet Steffens. „So kann er Fehler besser herausfiltern." Besonders wichtig sei auch die Dokumentation, das Notieren der gesamten Entwicklung, denn durch sie werde ein Erfahrungsschatz zusammengestellt, aus dem bei weiteren Produkten gelernt und profitiert werden könne. Ein Schuss Genialität werde dabei schon gebraucht, aber die Disziplin müsse stimmen, sonst finde man später im „Software-Haus" weder Leitungen noch tragende Wände.

Um dies den Firmen zu vermitteln, gebe es kein Patentrezept, sagt Steffens. Experimentelles Software Engineering heißt: „Zunächst schaut man sich den Ist-Zustand bei einem Software-Entwickler an, untersucht, wie Arbeitsprozesse verbessert werden können und beginnt mit einer kleinen Gruppe der Entwicklungsabteilung. Bewertet wird zunächst, wie sich die Neuerungen im Kleinen auswirken, erst dann geht man weiter." Ein bekanntes Beispiel dafür ist die Zusammenarbeit mit Markant Südwest. Am Anfang stand, wie in vielen Fällen, die Beratung bei der Verbesserung der Software-Entwicklung für den eigenen Bedarf des Lebensmittelkonzerns. Eine eigene Software-Firma, die ihre Produkte auch außerhalb des Konzerns vermarktet, war das zunächst überraschende Ergebnis.

Wer selbst lehrt, muss auch ständig auf dem Laufenden bleiben, vor allem wenn die Entwicklung so rasend schnell voran geht. Ihr eigenes Wissen beziehen die rund 120 Mitarbeiter der Instituts, das ein „Ableger" des Institutes in Amerika ist, unter anderem aus ihrer Forschungstätigkeit, die sich teilweise direkt auf industrielle Anwendungen bezieht, teilweise ohne direkten Bezug meist in EU-Projekten geleistet werden kann.

Top inform, April, 2000

INTERVIEW

Info-Technik in die Schulen!

Prof. Dieter Rombach über den Personalnotstand in der IT-Branche

TOP inform: Den Unternehmen in der Bundesrepublik fehlen kurzfristig etwa 30 000 Computerspezialisten. Von dieser Quote gehen Bundesregierung, Wirtschaft und Gewerkschaften aus. Bald sollen es nach den Angaben der Wirtschaft schon 100 000 sein. Wie ernst ist die Situation?

Professor Dieter Rombach: Wir haben in Deutschland Defizite auf allen Qualifikationsebenen von Computerspezialisten – bei den Ingenieuren, bei den Technikern und bei den Benutzern von IT.

TOP inform: Gehen wir einmal davon aus, dass demnächst die ersten 20 000 Spezialisten aus dem Ostblock oder Indien via Greencard kommen werden – wie ist das Problem langfristig zu lösen?

Rombach: Auf den Ebenen der Nutzer und Techniker lässt sich durch Weiterbildung ziemlich schnell einiges erreichen. Auf Ingenieurs-Ebene, also im wissenschaftlichen Bereich, werden wir nicht so schnell vorankommen. Von den Universitäten und Fachhochschulen in Deutschland werden in diesem Jahr etwa 4500 Abgänger in den Markt kommen. Wir werden mindestens zehn Jahre benötigen, um die Engpässe auf dieser Ebene durch wissenschaftlichen Nachwuchs zu beseitigen.

TOP inform: Wie schätzen Sie den aktuellen Bedarf an EDV-Experten ein?

Rombach: Es gibt zwischen 40 000 und 50 000 offene Stellen. Die Quote liegt eher höher als offiziell bekannt gegeben. Die IT-Branche hat Stellenangebote zuletzt gar nicht mehr veröffentlicht, weil ohnehin keine Kräfte zu bekommen waren.

TOP inform: Seit öffentlich über Greencards geredet wird, gibt es auch wieder einen politischen Streit um das Einwanderungsgesetz. Halten Sie den für berechtigt?

Rombach: Wir werden in Deutschland kein zweites Gastarbeiter-Problem bekommen, sondern sollten froh sein, dass wir gute Leute bekommen. Enorm qualifiziert sind die Inder. Davon habe ich mich gerade an Ort und Stelle überzeugen können. Diese Menschen sind nicht nur außergewöhnlich qualifiziert, sondern auch teamfähig. Viele von ihnen werden später in ihre Heimat zurückkehren. Wichtig erscheint mir: Wir müssen der Bevölkerung klar machen, dass die existierenden Löcher kurzfristig nicht anders zu stopfen sind.

Professor Dr. rer. nat. Dieter Rombach vom Fraunhofer-Institut hat an der Universität Kaiserslautern den Lehrstuhl für Informatik und ist Vorsitzender des wissenschaftlichen Beirats an der Software-Akademie

Pirmasenser Zeitung, July 12, 2000

Kontakte zwischen „Braut und Bräutigam“

Rheinland-pfälzische Firmen suchen via Internet IT-Fachkräfte aus dem Ausland

Kaiserslautern. Die „Greencard“ soll helfen, den Mangel an Computer-Fachkräften in Deutschland zu beheben. Doch wie findet die Firma aus Montabaur, Zweibrücken oder Pirmasens den richtigen Bewerber? Ein Blick ins Internet unter www.greencard.rlp.de hilft.

300 Bewerber tummeln sich bereits im Angebot des Wirtschaftsministeriums, das vom Fraunhofer-Institut in Kaiserslautern entwickelt wurde und betreut wird. Kaum ist das Angebot im Netz, sind auch die ersten 50 Stellenangebote drin.

Per E-Mail hat das Wirtschaftsministerium in Mainz Anfang des Monats die rheinland-pfälzischen Firmen auf das kostenlose Vermittlungsangebot aufmerksam gemacht. Dass auch in Rheinland-Pfalz Bedarf besteht, zumindest zeitlich befristet Fachkräfte der Informationstechnologien aus dem Ausland anzuwerben, zeigt die prompte Resonanz von 15 Firmen aus Mainz, Ludwigshafen, Kaiserslautern und eben Zweibrücken, Montabaur und Pirmasens, die zusammen genau 50 Stellen zu besetzen haben.

Dabei spielt die wichtigste Rolle das Fraunhofer-Institut „Experimentelles Software Engineering“, das wie ein „Anbahnungs-Institut“ den Kontakt zwischen den potenziellen Partnern vermittelt. Um den Experten aus dem Ausland die Bewerbung zu erleichtern, läuft alles anonym. „Viele befürchten, in ihrem Land unter Druck gesetzt zu werden, wenn ihre Bewerbung bekannt wird“, berichtet Petra Steffens, Leiterin der PR- und Marketingabteilung des Institutes.

Damit die Firmen trotzdem die zu ihnen passenden Mitarbeiter finden können, müssen sie mit ihrer Stellenausschreibung selbst ins Netz. Auch diese bleiben anonym, nur der Sitz der Firma wird veröffentlicht. Beide Seiten passend zusammenzubringen, hat sich das Institut vorbehalten.

Besonders ausführlich, wesentlich genauer als bei einer Zeitungsanzeige, müssten deshalb die Stellenprofile und die Kenntnisse der Bewerber beschrieben sein, erläutert Steffens. Das Institut helfe dabei den Firmen. Wesentlich mehr als schon im Netz zu finden seien, hätten sich bereits angemeldet. Um weitere auf das Vermittlungsangebot aufmerksam machen zu können, greifen die Mitarbeiter nach dem Studium der Stellenanzeigen in den Tageszeitungen auch zum Telefon.

Darüber hinaus macht sich das Institut seine weltweiten Kontakte zunutze, um für das Internet-Angebot zu werben. Bewerber haben schon seit Mitte Mai die Möglichkeit, sich bei der „Greencard-Aktion“ einzutragen. Hauptsächlich aus Pakistan kämen die Anfragen, sagt Steffens, sowie aus den osteuropäischen Ländern wie Bulgarien, Rumänien und Russland. Sich bereits jetzt um Arbeitskräfte zu bemühen, auch wenn die Regelung erst im August in Kraft treten soll, rät auch die Bundesanstalt für Arbeit den Firmen. Sie bietet eine ähnliche Vermittlungsbörse im Internet an, bei der beide Seiten sich jedoch selbst um den Kontakt bemühen müssen. **(dia)**

Init

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pfalz-Metropole bewährt hat. Bildungsstätte wird die ehemalige Holtzendorff-Kaserne an der Autobahn A 6 sein, heute Technologie- und Freizeitpark (PRE-

Teilnehmer“, sagt **Barbara Wix**, Leiterin der Software-Akademie. In Frage kommen arbeitslose Akademiker, Techniker und eventuell Studienabbrecher. ■

Klaus Theato, Arbeitsberater

Barbara Wix, ... Software-Akademie

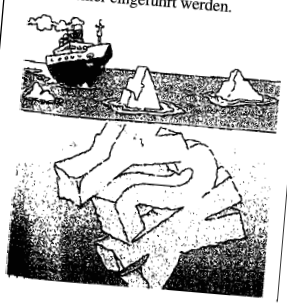
technik forum, February, 2000

Nachwort zum Jahr-2000-Problem

Interview mit Prof. Dr. Dieter Rombach

Professor Dieter Rombach, Sie gehören zu denen, die sagen, noch keine Entwarnung nach dem 01.01.; die richtigen Probleme beginnen erst. Was macht Ihnen am meisten Sorgen?

Am meisten Sorgen macht mir, dass wir uns wahrscheinlich wegen der überstandenen Probleme jetzt gegenseitig nur noch gratulieren und dabei ganz vergessen, dass ähnlich geartete Probleme in der Zukunft wieder auftreten können. Das Jahr 2000 Problem war nur deshalb so teuer, weil Softwaresysteme im überwiegenden Maß noch sehr unprofessionell konstruiert werden, d. h. es gibt keine Disziplin, keine Standards bei der Softwareentwicklung. Sie wird immer noch als kreative Tätigkeit verstanden, und die Resultate sind, dass im Allgemeinen bei der Behebung jedes Fehlers neue Fehler eingeführt werden.



Was kann man tun? Einheitliche Standards?

Erstens einheitliche Standards, was die Softwareentwicklung angeht, zweitens ingenieurmäßige Prinzipien, wie man große Softwaresysteme konstruiert. Also, mehr Konzentration auf die Entwurfsphase als auf die reine Programmierung, und drittens Ausbildung von Software-Ingenieuren. Wir brauchen nicht nur Programmierer, sondern vermehrt Software-Architekten, -Ingenieure.

Was ist Ihr Beitrag dabei?

Sie können bei uns Methoden, Vorgehensweisen bekommen, um Software in Teams zu entwickeln. Zudem beraten wir Sie, wie große Systeme architekturiert werden müssen, so dass Änderungen/Anpassungen in Zukunft leichter durchzuführen sind. Damit wir in Zukunft keine weiteren trojanischen Pferde einbauen und statt des Jahr-2000-Problems vielleicht als nächstes Mehrwertsteuerprobleme haben, wenn sich z. B. diese Randbedingungen ändern. Sie können drittens natürlich bei uns auch Weiterbildung und Ausbildung haben, um für die Firmen qualifiziertes Personal auf der Ingenieurebene bereitzustellen. ●

Karikatur von Peter de Jager, gefunden in „Spektrum der Wissenschaft“ 11/99

Der Forschungsdienst dfd, February, 2000

dfd

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28

SOFTWARE

Computer aus dem Baukasten

Wiederverwendung von Serienteilen angestrebt

Kostengünstige Lösungen erwartet

(dfd) Software - vor allem, wenn die Programmierer sie für spezielle Anwendungen „stricken“ - ist meist ein recht aufwendiges Unikat. Doch wenn es vielseitig verwendbare Bausteine gäbe, wären dann nicht die Programme billiger? Professor Ulrich Eisenecker vom Fachbereich Informatik und Mikrosystemtechnik der Fachhochschule Kaiserslautern vergleicht die heutige Softwareproduktion mit dem Bau von Kraftfahrzeugen: „Am Anfang waren Unika-te; erst später entwickelte sich die Serie. Dann musste man Abstriche machen.“ Mit dem Massenprodukt kommt der Kompromiss. Die Software hat die Serienproduktion noch vor sich.

„Die Software-Entwicklung ist vor allem auf die Entwicklung einzelner Systeme ausgerichtet; sie folgt meist nur einem Paradigma und ist dabei auf eine einzelne Programmiersprache fixiert“, erläutert Eisenecker. Wenn aber nur einzelne Systeme analysiert und modelliert werden, stellt sich die Frage, wie optimal kombinierbare und wiederverwendbare Bausteine entwickelt werden sollen. Die Einführung von Ingenieursprinzipien würde dabei erhebliche Kosten einsparen, so der Wissenschaftler. Die Amerikaner haben dies erkannt: „Das wird an der Größe der Fördermittel deutlich, die der US-Vorschlag zur Förderung innovativer Techniken für diesen Themenbereich vorsieht“, sagt Professor Dieter Rombach, Geschäftsführender Direktor des Fraunhofer-Instituts für Experimentelles Software-Engineering in Kaiserslautern.

Nach Ansicht Rombachs ist die Wiederverwendung vorgefertigter und geprüfter Bausteine der Schlüssel für die kostengünstige Erstellung qualitativ hochwertiger Softwaresysteme. Rombach erwartet, dass schon bald innerhalb einzelner Firmen beziehungsweise Firmenkonsortien sowie innerhalb bestimmter Branchen Bausteinbibliotheken entstehen werden. „Es müssen daher akzeptierte Qualitätsrichtlinien für Bausteine etabliert und deren Einhaltung garantiert werden. Die Qualitätsrichtli-

The Fraunhofer-Gesellschaft

The Research Organization

Research of practical utility lies at the heart of all activities pursued by the Fraunhofer-Gesellschaft, which undertakes contract research on behalf of industry, the service sector and the government. Working under contract to customers in industry, it provides rapid, economical and immediately applicable solutions to technical and organizational problems.

The Fraunhofer-Gesellschaft also assumes a major role in strategic research: Commissioned and funded by Federal and Länder ministries and governments, the organization undertakes future-oriented research projects which contribute to the development of innovations in key technologies and spheres of major public concern, such as energy, transport and the environment.

The global alignment of industry and research has made international collaboration imperative. Within the framework of European Union's technology programs, the Fraunhofer-Gesellschaft is actively involved in industrial consortiums which seek technical solutions to improve the competitiveness of European industry. Furthermore, affiliate Fraunhofer institutes in the USA and Asia ensure contact to the most important current and future economic markets.

The Fraunhofer-Gesellschaft is currently the leading organization of institutes for applied research in Germany and Europe. At present, the organization maintains 48 research establishments at locations throughout Germany. A staff of some 9,600, the majority of whom are qualified scientists and engineers, generate the annual research volume of around € 760 million.

Of this amount, € 650 million is derived from contract research. Research contracts on behalf of industry and publicly financed research projects generate approximately two-thirds of the Fraunhofer's contract revenue.

Fraunhofer scientists specialize in complex research tasks involving a broad spectrum of research fields. When required, several institutes pool their interdisciplinary expertise to develop system solutions. Internal collaboration is promoted through organizational structures.

The Fraunhofer-Gesellschaft was founded in 1949 and is a recognized non-profit organization. Its members include well-known companies and private patrons who contribute to the promotion of its application-oriented policy.

The man behind the name:

Joseph von Fraunhofer

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

The optical instruments he himself developed, such as the spectrometer and the diffraction grid, enabled Fraunhofer to conduct fundamental research in the fields of light and optics. He was the first scientist to measure the spectrum of sunlight and characterize the appearance of the dark absorption strips: the "Fraunhofer lines".

Through his independent, autodidactic work, Joseph von Fraunhofer won great acclaim from industry and government. This prompted the nomination of the former apprentice to a full member of the Bavarian Academy of Sciences.

Objectives of the Fraunhofer-Gesellschaft

The Fraunhofer-Gesellschaft maintains an obligation to serve industry, its partner companies, and society at large. Target groups and, thus, beneficiaries of research conducted by the Fraunhofer-Gesellschaft are:

Industry
Small, medium-sized and multinational companies in industry and in the service sector all profit from contract research. The Fraunhofer-Gesellschaft develops technical and organizational solutions that can be implemented in practice, and promotes applications for new technologies. The Fraunhofer-Gesellschaft is a vital supplier of innovative know-how to small and medium-sized companies who do not maintain their own in-house R&D departments.

Government and society
Strategic research projects are carried out under contract to national and regional government. They serve to promote the implementation of cutting-edge technology and innovations in fields of particular public interest, such as environmental protection, energy conservation, and health. The Fraunhofer-Gesellschaft, furthermore, participates in technology programs supported by the European Union.

Research Fields of the Fraunhofer-Gesellschaft

Eight fields form the core of Fraunhofer research:

- Materials Technology and Component Behavior
- Production Engineering and Manufacturing Technology
- Information and Communications Technology
- Microelectronics and Microsystems Technology
- Sensor Systems, Testing and Measurement Technologies
- Process Engineering
- Energy and Building Technology, Environment and Health Research
- Technical and Economic Studies, Information Transfer

Individual solutions are generated in close collaboration with the industrial partner. When required, several Fraunhofer Institutes work together on complex system solutions.

Advantages of Contract Research

Several thousand 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 the services 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 from 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 develop on their own the technical innovations necessary to stay competitive.

Executive Board

(as of December 31, 2000)

Prof. Hans-Jürgen Warnecke, President
Dr. Dirk-Meints Polter, Personnel and Legal
Dr. Hans-Ulrich Wiese, Finance

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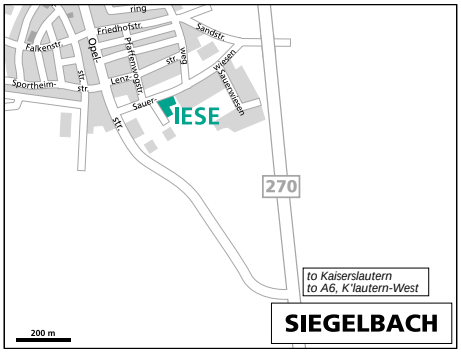
Our web server offers up-to-date information about the institute. We invite you to visit our web site at: http://www.iese.fhg.de

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 "Sauer-Wiesen". 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

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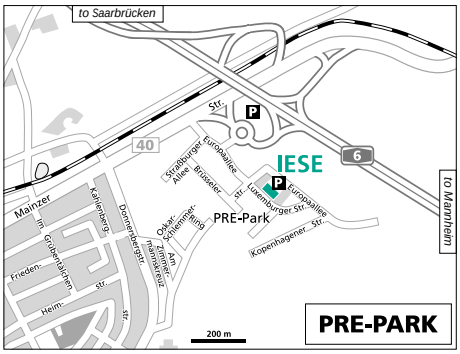
Contact Maud Schlich

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

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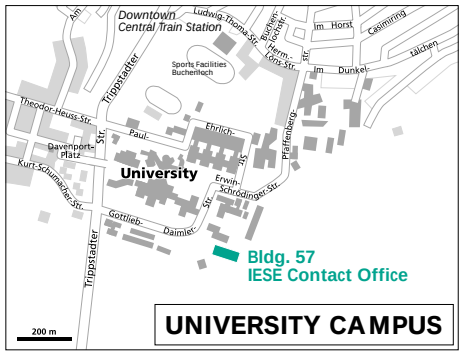
Contact Kristina Jerkku

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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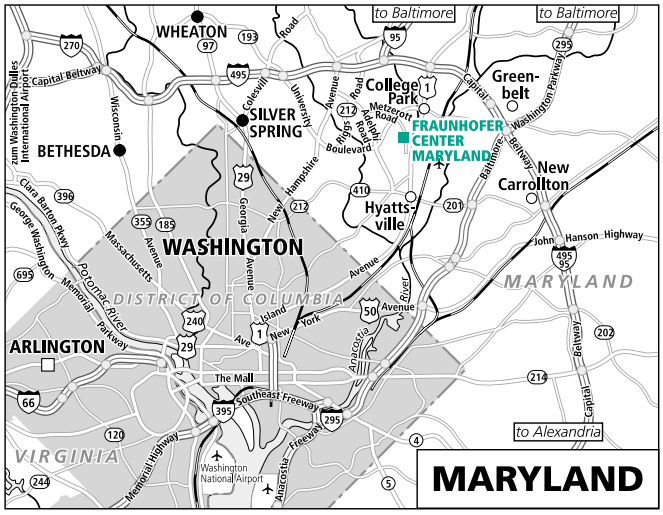


How to reach us:

By car
Directions from Points North
Follow I-95 South to the point where it merges with I-495. At this point, follow the signs for Exit #27-Richmond (I-95/495 South). Follow the Exit 27 signs staying to the left so you can take the special Rt.1/College Park exit lane. This will briefly put you back on I-95. Stay to the right and take Exit #25 onto Route 1 South (towards College Park).

For directions from this point on, see "Further directions" on this 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 onto Route 1 South (towards College Park).

For directions from this point on, see "Further directions" on this page!

By train (15 minute walk)
Exit College Park Metro station by turning right after you exit the turnstile and going through a tunnel to Calvert Rd. Take Calvert Rd. for 4-5 blocks to Rt. 1. (Calvert ends there). Cross Rt. 1 and go right a block to Hartwick Rd. Turn right (there's a Kinko's Copy sign on the corner). Our building (4321) is on the left.

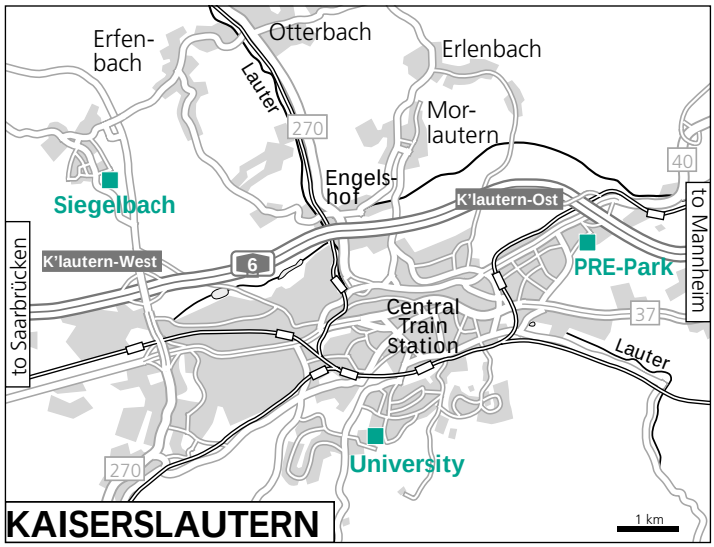
By plane
B.W.I. airport (about 45 minutes by car)
Exit the airport on I-195 (main road out of airport). In a few miles, take I-95 South towards Washington. From this point, follow directions from Points North.

National Airport (about 90 minutes by car; also a stop on the Yellow Metro line)
Exit the airport towards I-395 North towards 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 six miles. Stay on BWI Parkway to the exit for Maryland Rt. 193. This is Greenbelt Road/Rt. 193. Take Rt. 193 East to Rt. 1 South.

For directions from this point on, see "Further directions" below!

Further directions:
Stay on Rt.1 South, going past the University of Maryland. After passing the University, there will be 2 stop lights - the 2nd one being Knox Rd. Take the next right after Knox onto Hartwick Rd (there's a Kinko's Copy sign on the corner). Our building (4321) is on the left - turn left past the building into the parking lot and park anywhere.

We're on the 5th floor - directly opposite the elevator.



Global View of Kaiserslautern

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Further Information

- ❒ Annual Report 2000 of Fraunhofer IESE
- ❒ Fraunhofer IESE Seminars, Workshops and other Events
- ❒ Overview of Fraunhofer IESE
- ❒ The Fraunhofer-Gesellschaft from A-Z
- ❒ The Research Institutes of the Fraunhofer-Gesellschaft
- ❒ Annual Report of the Fraunhofer-Gesellschaft
- ❒ STI Software Technology Initiative
- ❒ Please add my address to your Annual Report mailing list

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Company

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Zip Code / City

Telephone

Fax

E-mail

Date and Signature