

Annual Report of the
Fraunhofer Institute
for Experimental Software
Engineering IESE
2002

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Imprint

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Fraunhofer Institute
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Software
Engineering

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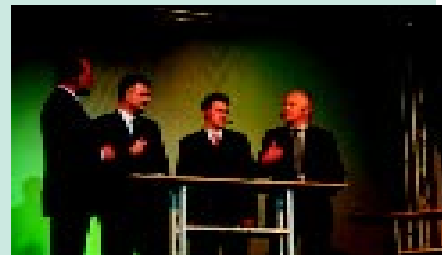
Foreword



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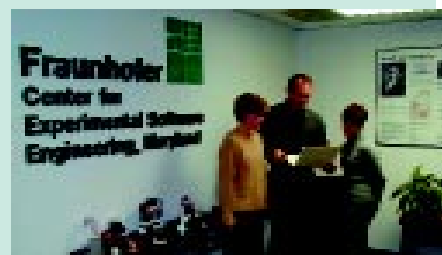
Kurt Beck, Governor of the State of Rhineland-Palatinate, at the 5-year anniversary celebration of Fraunhofer IESE.



Presenting the project on Software Inspection for Allianz AG:
Moderator S. Schulze-Hausmann, Holger Günther, Allianz AG, IESE project leaders Dr. O. Laitenberger and Dr. G. Ruhe (from left to right).



Participants of the scientific colloquium: Prof. V. Basili, Prof. M. Broy, Prof. D. Rombach, Manfred Roux, Prof. W. Mellis, Prof. P. Freeman (from left to right).



Discussing Software Engineering solutions at Fraunhofer Center Maryland: Kathleen Dangle, Dr. Mikael Lindvall, and Tricia Larsen (from left to right).




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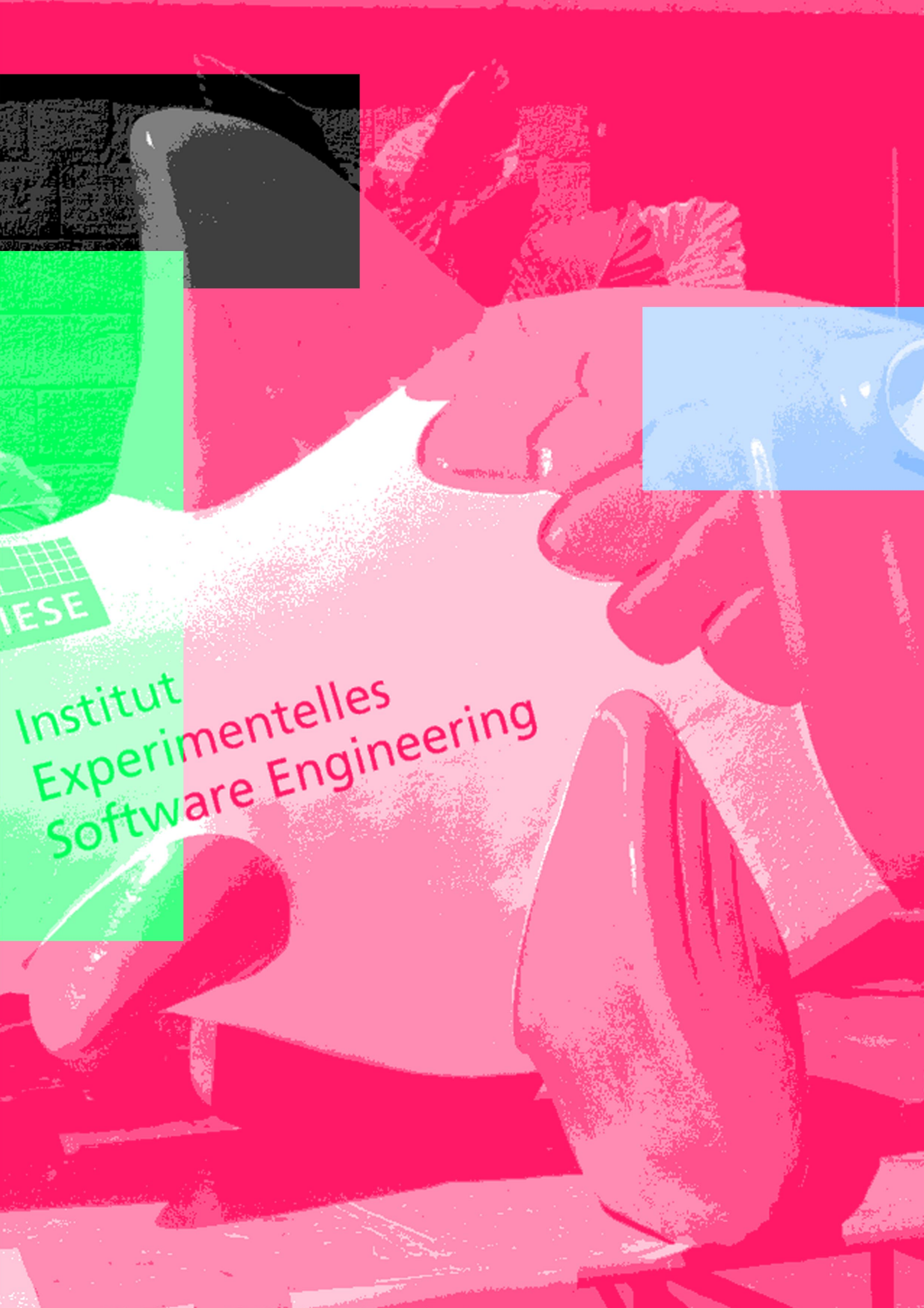
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IESE

Institut
Experimentelles
Software Engineering





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Vision and Mission



The Fraunhofer IESE staff

Highlights 2002

IESE and its Network Partners



Collaborations

Fraunhofer IESE cooperates with technology providers, technology-transfer customers, and strategic partners in national and international collaborations with the purpose of furthering the development of software engineering technology and transferring it into industrial practice.

International Research Networks

Fraunhofer IESE is a member in several international research networks. The International Software Engineering Research Network (ISERN) with about 34 scientific and industrial members plays a significant part 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. Leading research institutions within ISERN include: the University of New South Wales, Australia; FC-MD, Maryland, USA; Lund University, Sweden; Tor Vergata University, Rome; the University of Bari, Italy; the University of Strathclyde, Scotland; the University of Hawaii; the University of Maryland; the Nara Institute of Science and Technology, Japan; and VTT in Oulu, Finland. Fraunhofer IESE coordinates the ISERN network. In addition, IESE is affiliated with the Center for Empirically Based Software Engineering (CeBASE), a project of the National Science Foundation (NSF), USA. Other CeBASE members include FC-MD, the University of Maryland, the University of Southern California, Mississippi State University, and the University of Nebraska-Lincoln.

Bilateral research and exchange programs for students and scientists exist with renowned institutions, such as the University of Maryland's Experimental Software Engineering Group, the Uni-

versity of Southern California's Center for Software Engineering, the Software Engineering Institute (SEI) at Carnegie Mellon University, Pittsburgh, Carleton University in Toronto, the University of Calgary, Canada, the Center for Empirical Software Engineering Research (CESER) at the University of New South Wales, Sydney, and the Software Quality Institute at Griffith University in Australia.

Publicly-funded Collaborations

Fraunhofer IESE coordinates the national Virtual Software Engineering Competence Center (VISEK), a project funded by the German Federal Ministry of Education and Research. VISEK Partners are

- Brandenburgische Technische Universität Cottbus, Forschungsgruppe
- Fraunhofer Institut für Rechnerarchitektur und Softwaretechnik FIRST, Berlin
- Fraunhofer Institut für angewandte Informationstechnik FIT, St. Augustin
- Fraunhofer Institut für Experimentelles Software Engineering IESE, Kaiserslautern
- Fraunhofer Institut für Informations- und Datenverarbeitung IITB, Karlsruhe
- Fraunhofer Institut für Software und Systemtechnik ISST, Berlin
- Oldenburger Forschungs- und Entwicklungsinstitut für Informatik-Werkzeuge und -Systeme OFFIS, Oldenburg
- Institut für Informatik IV, TU München, München

The mission of ViSEK is to provide German software developing companies with fast and simple access to the latest and most appropriate methods for developing software according to engineering principles. Its primary goals are to build up a community of software engineering experts and professional users as well as to create an Internet portal through which the expert knowledge of ViSEK partners will be made accessible to the more than 20,000 software developing companies in Germany. The portal or virtual competence center therefore represents a basis for successful knowledge transfer between research and industry and vice versa.

On the European level, Fraunhofer IESE coordinates the Experimental Software Engineering Research Network (ESERNET). The main objective of ESERNET is to establish and maintain a European leadership in experimental software engineering as an essential catalyst for fast and sustained improvement of European software competencies. It is funded by the European Commission in the context of the 5th Framework of the IST program.

In addition, collaborations within several other publicly-funded consortia exist. These aim either at software engineering technology advancement or dissemination of best practices and technology transfer. Bilateral industrially-funded collaboration often result from 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 industrial cooperation partners of Fraunhofer IESE range from large global players to small regional 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 implement technology changes under very tight budget and schedule constraints.
- Small companies that need ready-to-use, proven technology that yields short-term return on investment.

In addition to bilateral collaborations, Fraunhofer IESE and FC-MD organize a multinational 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 field as well as in other application domains.

The Fraunhofer-Gesellschaft

The Research Organization

The Fraunhofer-Gesellschaft is the leading organization for institutes of applied research in Europe, undertaking contract research on behalf of industry, the service sector and the government. Commissioned by customers in industry, it provides rapid, economical and immediately applicable solutions to technical and organizational problems. Within the framework of the European Union's technology programs, the Fraunhofer-Gesellschaft is actively involved in industrial consortiums that seek technical solutions to improve the competitiveness of European industry.

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 spheres of major public concern and in key technologies. Typical research fields include communications, energy, microelectronics, manufacturing, transport and the environment.

The global alignment of industry and research has made international collaboration imperative. Furthermore, affiliate Fraunhofer institutes in Europe, in the USA and in Asia ensure contact to the most important current and future economic markets.

At present, the organization maintains 56 research establishments at locations throughout Germany. A staff of some 11,000 – the majority of whom are qualified scientists and engineers – generate the annual research volume of more than 900 million e. Of this amount, over 800 million e is derived from contract research. Research contracts on behalf of industry and publicly financed research projects generate

approximately two thirds of the Fraunhofer-Gesellschaft's contract revenue. The Federal and *Länder* governments contribute one third, as a means of enabling the institutes to work on solutions to problems that are expected to attain economic and social relevance in the next five to ten years.

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.

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.

takes its name from Joseph von Fraunhofer (1787-1826), the successful Munich researcher, inventor and entrepreneur.

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.



The man behind the name:

Joseph von Fraunhofer

The Fraunhofer-Gesellschaft owes its name to Joseph von Fraunhofer (1787-1826), the successful Munich researcher, inventor and entrepreneur. Born of a family of modest means, the glass-grinding apprentice Joseph

von Fraunhofer joined the institute for optics headed by privy councillor Joseph von Utzschneider, who put the young researcher in charge of glass manufacturing at the early age of 22. Joseph von Fraunhofer's major developments include new methods of glass production and processing.

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

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.

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

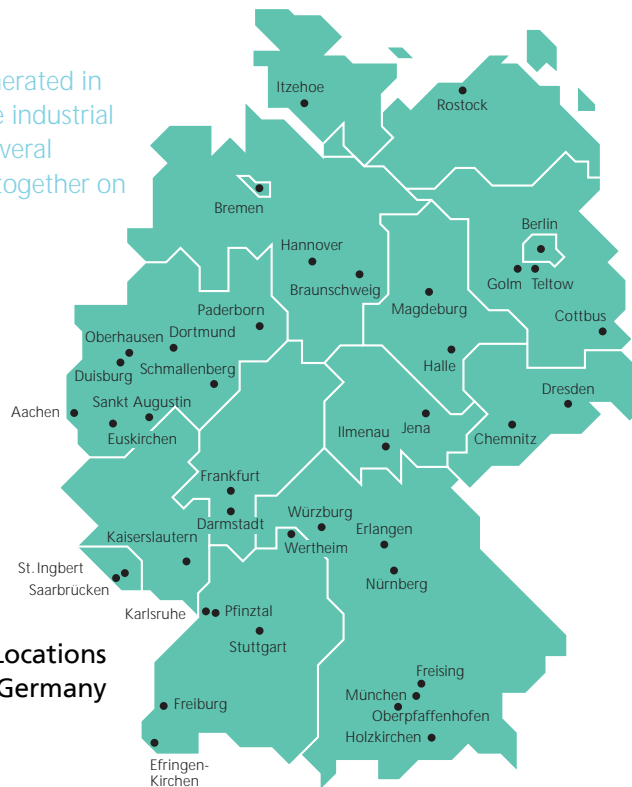
(as of December 31, 2001)

- Prof. Hans-Jürgen Warnecke, President
- Dr. Dirk Meints Polter, Human Resources, Legal Affairs and International Relations
- Prof. Dennis Tschritzis, Knowledge Management and Start-ups/Joint Ventures
- Dr. Hans-Ulrich Wiese, Finance

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Fraunhofer Locations in Germany



Fraunhofer Locations in USA:

- Boston, Massachusetts
- College Park, Maryland
- Newark, Delaware
- Pittsburgh, Pennsylvania
- Plymouth, Michigan
- Providence, Rhode Island

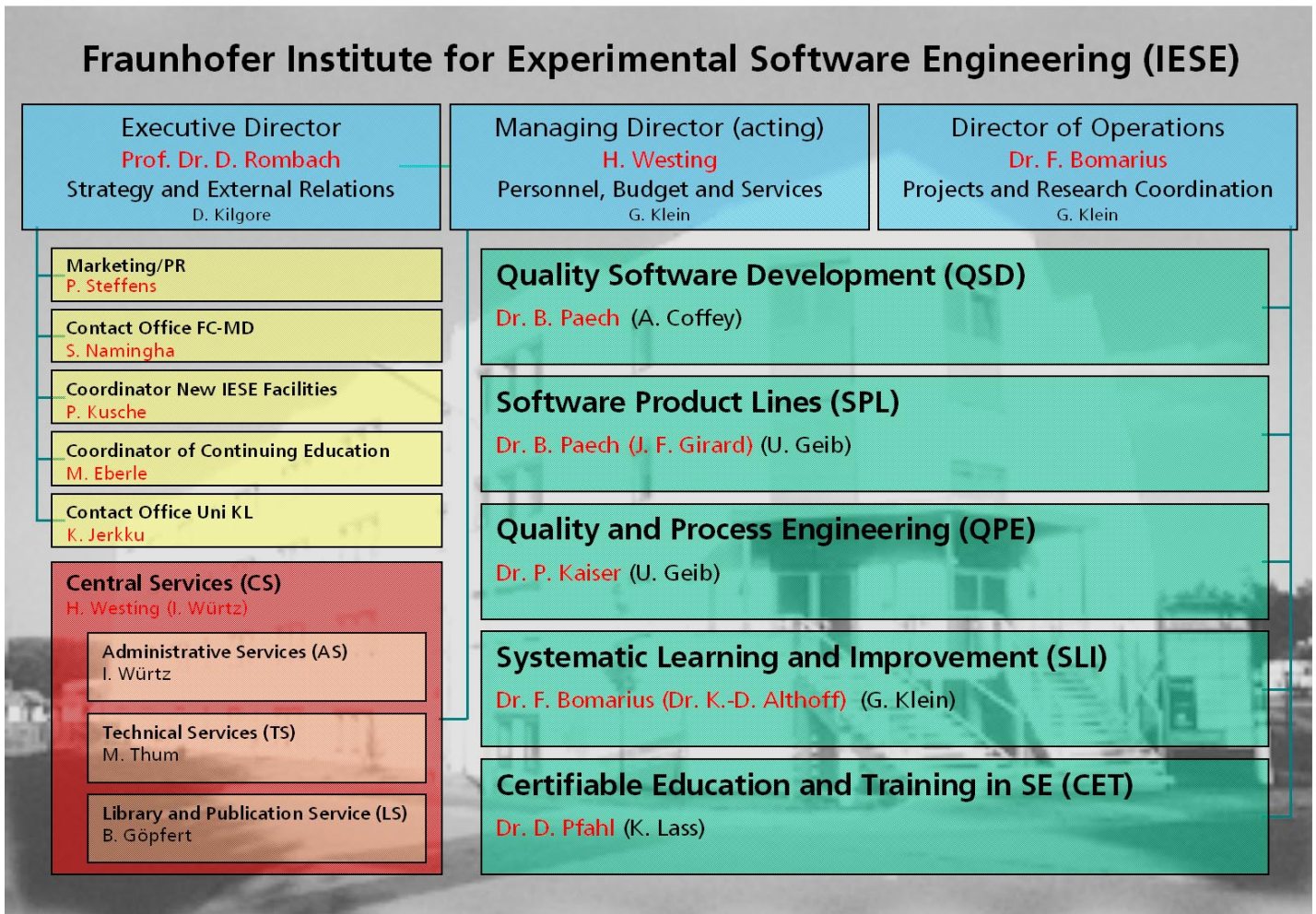
Fraunhofer Locations in Asia:

- Beijing, China
- Jakarta, Indonesia
- Singapore
- Tangerang, Indonesia
- Tokyo, Japan

Fraunhofer Locations in Europe:

- Brussels, Belgium

Structure



Organizational Charts of the FVIESE institutes: Fraunhofer IESE and FC-MD

The Fraunhofer Virtual Institute

The Fraunhofer Virtual Institute (FVIESE) is comprised of two partner institutions: the Fraunhofer Institute for Experimental Software Engineering (IESE) in Kaiserslautern, Germany and the Fraunhofer Center for Experimental Software Engineering, Maryland (FC-MD) in College Park, Maryland, USA. Both institutions are legally independent units under Fraunhofer Gesellschaft e.V., Germany and Fraunhofer USA, Inc. The institute directors, Prof. Dieter Rombach and Prof. Victor Basili, coordinate FVIESE.

Business Areas and Core Competencies

To ensure execution of daily operations, the FVIESE institutes - Fraunhofer IESE and FC-MD - are organized into several departmental units and staff groups, which constitute the institutes' line structures. The IESE line structure is complemented by a two-dimensional matrix structure.

One dimension of this matrix structure is assigned to so-called "core competencies", each of which focuses on a cluster of research themes. The other dimension is allocated to so-called

"business areas", each of which is motivated by a class of related customer problems. The core competencies are dedicated to developing innovative software engineering methods, technologies, and tools, to proving their benefit, and to packaging research results. This work is typically carried out within public or Fraunhofer base-funded projects. While the core competencies thus prepare the ground for technology transfer, the business areas are devoted to applying the technologies in industrial practice and to initiate their large-scale roll-out. Business areas are thus responsible for acquiring, setting up, and monitoring industrial projects, for continuously observing and analyzing

ing market needs, for spotting new business opportunities, and for feeding market requirements back to the core competencies. Each IESE scientist belongs to one core competency and is dynamically assigned to business area projects. Business areas are thus virtual units with no personnel resources of their own (apart from the business area manager), which draw upon the core competencies for staffing customer projects.

One member of the IESE advisory board is assigned to each core competence and each business area, in order to provide advice and guidance on strategic research or market-related issues.

Keywords CC

Experimentation Prof. Dieter Rombach

Study Type Selection

Design of Empirical Studies

Study Analysis

Result Packaging

Curator: Prof. Basili

Quality Software Development Dr. Barbara Paech

Requirements Engineering

Software Design

Inspections and Testing

Curator: Prof. Broy

Software Product Lines Dr. Dirk Muthig

Scoping and Modeling

Architecture Development and Evaluation

Architecture Recovery

Curator: Prof. Clements

Quality and Process Engineering Dr. Jürgen Münch

Goal-oriented Assessment and Measurement

Process Engineering and Technology

Cost and Quality Engineering

Curator: Prof. Basili

Systematic Learning and Improvement Dr. Klaus-Dieter Althoff

Experience Factory and Organizational Learning

Systematic Improvement

Information Technology Security

Curator: Prof. Mellis

Certifiable Education and Training in SE Dr. Dietmar Pfahl

Evaluation and Certification

Technology-enabled Learning

Reuse-based Education and Training

Curator: Prof. Shaw

IT Security Dr. Reinhard Schwarz

Vulnerability Assessments

Standards Compliance Certification

Tool Support for Security Checking

Curator: Prof. Nehmer

Keywords BA

Reliable SW for Embedded Systems Ralf Kempkens

Product Line Software Engineering

Software Engineering Process Assessments

Subcontractor Management

Data-driven Product and Project Monitoring

Secure SW for Infrastructure Facilities and Services Volker Hübsch

Requirements Engineering

IT Security Investigations

Risk Management

Flexible SW for IT-based Business Processes Petra Steffens

SW-based Products and Services Dr. Frank Bomarius

Innovation Management

Expert Reports

Software Economics

Technology Consulting

Change Management

Advisory Board

The Advisory Board consists of representatives of research, industry, and government. The board members support the Institute Directors with advice and counsel. The Advisory Board consists of:

Research

Prof. Victor Basili

Institute for Advanced Computer Science
Department of Computer Science
University of Maryland
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USA

Prof. Manfred Broy

Institute for Computer Science
Technical University of Munich
Munich

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Software Engineering Institute (SEI)
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Prof. Michael A. Cusumano

Massachusetts Institute of Technology
Sloan School of Management
Cambridge, MA
USA

Prof. Werner Mellis

Department of Information Systems,
System Development
University of Cologne
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Prof. Jürgen Nehmer

Department of Computer Science
Kaiserslautern University of Technology
Kaiserslautern

Prof. Helmut Schmidt

President
Kaiserslautern University of Technology
Kaiserslautern

Prof. Dr. Mary Shaw

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Department Head
Siemens AG ZT SE
München

Wolfgang Jung

Head of Development Center
T-Systems NOVA
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Günter Plapp

Technical Director
Robert Bosch GmbH
Stuttgart

Dr. Michael Strugala

Blaupunkt Werke GmbH
Hildesheim

Dr. Martin Verlage

Director Online Products
MARKET MAKER Software Ag
Kaiserslautern

Dr. Thomas Wagner

Robert-Bosch GmbH
Stuttgart

Government

Brigitte Klemp

Director, Department of Research and
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Ministry of Education, Science and
Continuing Education of the State of
Rhineland-Palatinate
Mainz

Dr. Ulrich Müller

Director, Department of Research,
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Ministry of Economic Affairs, Transpor-
tation, Agriculture and Viniculture of the
State of Rhineland-Palatinate
Mainz

Dr. Bernd Reuse

Director, Division on Promotion of
Information Processing
Federal Ministry of Education, Research,
Science and Technology (BMBF)
Bonn

FhG ZV

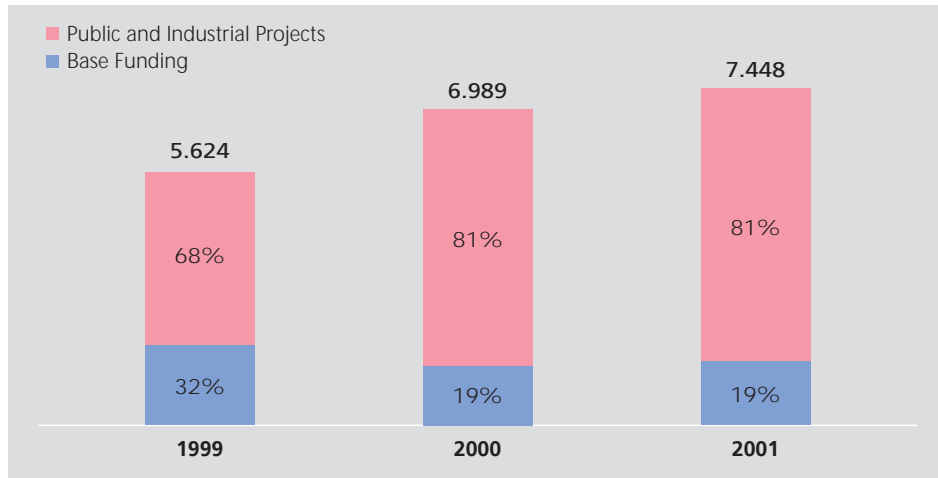
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Dr. Alfred Gossner

FhG ZV
Vorstandsmitglied
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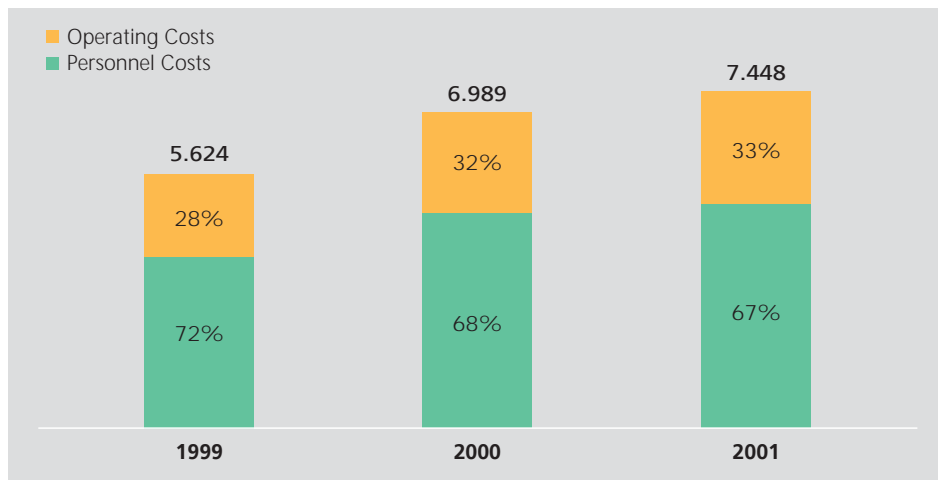
Development of Budget and Personnel



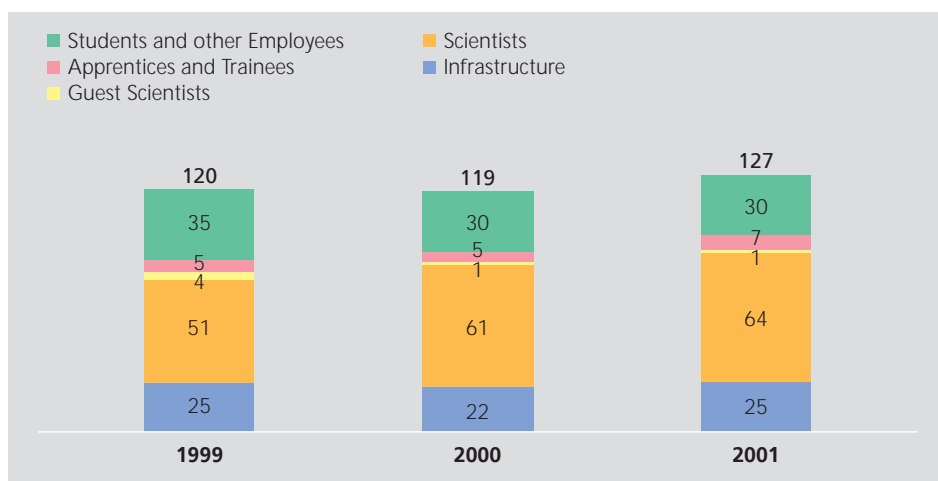
Development of Budget (in T EUR)

Development of Budget and Personnel

The growth in terms of staff was continued throughout 2001. By the end of 2001, IESE employed 89 regular employees, 1 guest scientist, 30 students, 4 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 2002.



Development of Costs (in T EUR)



Working at IESE

IESE support for SMEs

future talk

CeBIT

COMPUTER EXHIBITION
BERLIN

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Experimentation


Overview



Dr. Oliver
Laitenberger

Competence
Manager



Prof. Dieter
Rombach

Executive Director



Dr. Teade Punter



Andrea Coffey

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Overview

Software will never be error-free. Yet, software developers have to deliver products with a quality proven to be adequate for the purpose of the product. The competence area Quality Software Development (QSD) offers a portfolio of synergistic software engineering techniques that individually, or collectively, help to attain quality goals in a cost-effective way. The FINE (Fraunhofer Software Inspection) method supports early defect detection through inspection. The specification of and early planning for quality is supported by QSD's Requirements Engineering method RE-KIT (Requirements Engineering with emphasis on Knowledge Management, Interface Specification and Traceability). In the QUASAR project, these methods are currently tailored to an integrated requirements and quality assurance approach for the automotive software industry. Another important area of concern is component-based development. The Kobra method developed at IESE supports a model-driven, UML-based representation of components, and a product line approach to their application and deployment. This enables the benefits of component-based development to be realized throughout the entire software life cycle, and allows the reusability of components to be significantly enhanced. To support testing of components, QSD has developed the BIT-Composite (Built-in-Test for Component-based Development) method.

Bit-Composite

Component-based software development promises significant reductions in the overall system development effort, since large parts of an application are constructed from readily available pre-fabricated components. The problem is that when an otherwise fault-free component is integrated into an application, it may not function as expected. Reasons are that the other components to which it is connected are intended for a different purpose, have different usage profiles, or are themselves faulty. Current component technologies only assure the syntactic compatibility of interconnected components, but they do nothing to ensure that component applications are semantically correct and meaningful. Software developers are therefore forced to perform more integration and acceptance testing to attain the same level of confidence in the system's reliability, and this goes directly against the very principles of component-based development.

IESE's BIT-Composite comprises a component-based testing method and a process that is founded on building tests and test environments directly into components. Such components can instantly notify the application developer or integrator on whether a component combination is successful, and if not, automatically point out the problem of the integration. The application of BIT-Composite has essential effects on component development. Since



Dr. habil.
Barbara Paech



Dr. Christian
Burse



Dr. Victoria
Cengarle



Dr. Gerd Groß



Alexander
Hövelmeyer



Dr. Erik Kamsties



Daniel Kerkow

validation mechanisms are built in, they are considered right from the very beginning of the overall software development lifecycle. This is done as soon as the architecture of a system is devised and its components identified. In order to introduce early testing in the overall development process, BIT-Composite is integrated with and made to complement IESE's own component-based development paradigm, the Kobra method, which is based on the creation of UML models. BIT-Composite is currently being developed further within the Component+, Empress and MDTs research projects, and it has been successfully applied in five companies across Europe.

QUASAR

Modern cars are controlled by an increasing number (20-80) of electronic control units. This requires higher quality assurance and therefore higher requirements documentation standards. In addition, car series are often developed over several years in cooperation between manufacturers and suppliers, and system, software and hardware engineers must interact. These complex interactions require high changeability of the documents and adequate interfaces between the different roles. To achieve higher quality, development is usually tool-based. Thus, a smooth transition from early requirements documents in natural language to graphical models, such as statecharts, must be ensured.

Based on an industrial-scale case study provided by DaimlerChrysler AG, the Fraunhofer Institutes FIRST and IESE have developed an integrated process for requirements engineering and quality assurance for electronic control software in the BMBF-funded project QUASAR. In QUASAR, requirements are managed with requirements management tools like DOORS, and modeling tools like Rhapsody. To support the creation, access, quality assurance, and change of information for different roles, the requirements are categorized. The system requirements capture the viewpoint of the manufacturer and the user of the car, mainly in terms of use cases. The system specification captures the detailed functionality of the whole system (including software and hardware) in terms of high-level statecharts. It abstracts, however, from the details of the real sensors, actuators, and user interfaces. The software requirements derive the requirements on the software from the system specification. The software specification describes – again in terms of statecharts – the detailed functionality of the software necessary to interact with specific sensors and actuators determined in the hardware design. Specific guidelines and tool interfaces developed in QUASAR allow efficient transition between the different categories. A meta-model for electronic control software supports developers in developing their own traceability concept based on a classification of important changes. Tailored perspectives for the inspection of the different categories provide a cost-effective means for

quality assurance. QUASAR has also developed techniques for early test case generation and integrated defect management for inspections and testing.



Dr. Antje von Knethen



Kirstin Kohler



Dr. Oliver Laitenberger



Nikolas Mayer



Maud Schlich



Andrea Coffey



Susanne Märkl

Secretary

Secretary

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Overview

Product Line development is currently regarded as the most potent answer to the needs many companies face: more and more products need to be brought to the market in ever-shorter time intervals, at lower and lower costs. Product line development enables a company to make optimal use of its resources by setting up a strategic platform for software development. Such a platform addresses the characteristics common across the various products and provides means for managing product-specific characteristics systematically. Hence, product line development allows a wide variety of products to be developed and maintained very efficiently; this has been shown to work with extreme success for many companies of various sizes and in diverse application domains.

The transition from a system-by-system development to product line development requires changes to diverse aspects of the software life cycle. The solution offered by the Software Product Line competence area at Fraunhofer IESE is PuLSE™ (Product Line Software Engineering), an approach that supports all product line-related activities including support for the transition itself.

To cope with diverse organizational contexts and constraints, PuLSE has been designed to be customizable and modular in such a way that it allows product line technology to be introduced and applied only when and where useful, a flexibility that is the result of five years of experience.

PuLSE™ is a registered trademark of the Fraunhofer-Gesellschaft.

PoLiTe

With the PoLiTe (Product Line Implementation Technologies) project, Fraunhofer IESE aims at providing software developing organizations with a method for realizing an efficient way of implementing their software in a generic and reusable manner. The method is based on existing implementation techniques but integrates them into a comprehensive framework, which enables organizations to systematically select a set of techniques suited for the kind of genericity required for their products.

The PoLiTe framework consists of three primary elements:

- A reference implementation process,
- Separation of implementation concerns along three technology dimensions, and
- Characterizations of implementation techniques.

The reference process captures activities and artifacts involved in any implementation process at a level independent of implementation techniques. PoLiTe assumes that software is developed in a component-oriented and model-driven way, i.e., PoLiTe integrates product line development, component-based development, and model-driven architectures. This focus enables more concrete results, which are already applicable in many environments today and will be so even more in the future.



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In PoLiTe, variations among systems are managed within three technological dimensions; variation is mapped to configuration management concepts, component (de-) composition, and programming language mechanisms, which includes code generators. This holistic approach supports the identification of simple but efficient ways for managing variation that minimizes changes required to an existing organization. Identification is based on the characterization of existing implementation techniques, i.e., experience and case studies, which allow the effectiveness of techniques to be determined for particular application contexts.

PoLiTe is funded by Stiftung Rheinland-Pfalz für Innovation; the research team is complemented by Ulrich Eisenecker and his group at the University of Applied Sciences in Kaiserslautern.

APPLICATION2WEB

APPLICATION2WEB is a project funded by the German Federal Ministry of Economics. Its goal has been to explore efficient ways for small and medium-sized companies to offer and sell products and services on the web. APPLICATION2WEB, therefore, has analyzed and extended existing technologies to easily launch new applications with web functionality based on legacy products.

The consortium of the project consists of two research institutes, Fraunhofer IESE and FZI in Karlsruhe, and eight

industrial application partners. The application partners received support in selecting, defining, and applying the technologies suitable for their respective context.

One of the application partners was SIEDA - Systemhaus für intelligente EDV Anwendungen GmbH, a small company whose main product "Orbis Dienstplan" is a roster planning system (mainly applied in hospitals) that supports three major activities: planning of the roster, time registration, and analysis of the registered times with respect to the data originally planned in the roster. The latter generates input to an external payroll system. The overall goal of SIEDA in the APPLICATION2WEB project was the realization of Internet-based access to roster data.

The constraint was to realize this goal as efficiently as possible. The approach selected was a domain-analysis-driven approach applying component-based and reengineering techniques, which was based on PuLSE™, a Fraunhofer IESE product. This made it possible to minimize changes to the actual system, but yet changes were planned in such a way that the product was ready for future extensions, while the complexity of the product was reduced. The main sequence of activities consisted of the recovery of the actual architecture, the selection of a suitable web architecture, the transition of the system to a product line architecture, the separation and documentation of architectural concerns, and the redesign of relevant system components.



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Quality and Process Engineering (QPE)

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Overview

The Quality and Process Engineering core competence area (QPE) provides comprehensive support for customers interested in the improvement of software development processes, data-driven project management, and related products. Our main objective is to support our customers in managing their projects more accurately with respect to time, cost, and product quality.

Using goal-oriented process and product assessments we perform a "health check" for software development and identify potential areas where the organization should improve its products and processes. The ISO 15504 standard (SPICE) is used for process assessments. Product assessments are in line with the ISO 9126 and ISO 14598 standards.

We apply descriptive and dynamic process modeling techniques to support the effective implementation of improvements by introducing innovative technologies. With our simulation approach SEV we predict the impact of alternative improvement actions before implementation. By doing that, we drastically reduce the risks of process changes.

Additionally, we combine measurement with rigorous and integrated quality modeling in order to characterize, control, and predict a variety of software attributes. Our services address a wide range of issues, including identifying key performance indicators, produc-

ing industry benchmarks, and supporting measurement-based project planning and controlling.

Measurement-based Project Planning and Controlling

Software practitioners are faced with the challenging task of managing software development and maintenance processes in a predictable and controllable way. This requires particularly accurate and precise planning and quality monitoring techniques. Many software development organizations still lack the competence for determining the performance of their development processes and the quality of the produced products. Systematic support for detecting critical project states and reacting to them in order to achieve planned goals is usually missing.

We provide a comprehensive set of methods and tools to plan and control software development projects based on measurement. We give advice on how to select, tailor, and combine them, and we develop the underlying quantitative models.

On the one hand, our approach is based on the explicit definition of process models, product models, resource models, quality models, and their integration. On the other hand, collecting and using measurement data further enhances intellectual control of software processes and is seen as a prerequisite for empirical model building. The establishment of measurement and feedback mechanisms helps to



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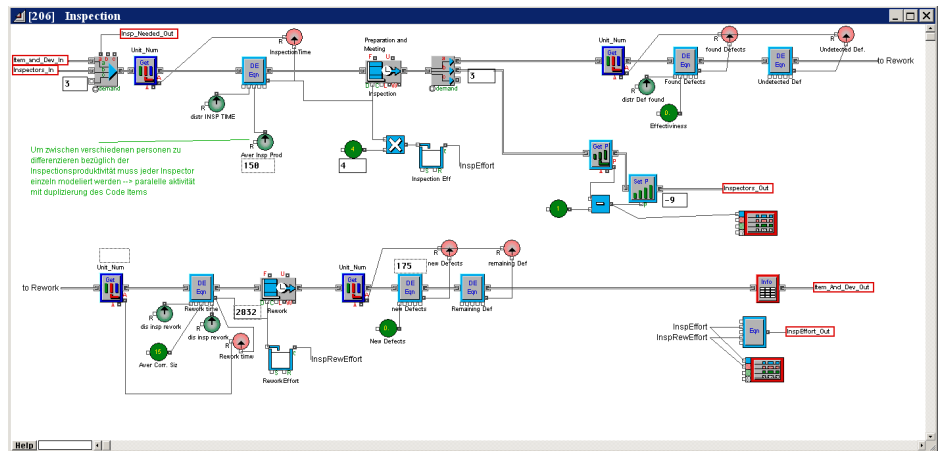
make intelligent decisions and to improve over time.

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 customer's development environment. Based on such analyses, we help build cost and risk models to improve cost estimation and cope with project risks.
- Facilitating the decision on whether to internally develop a component, subcontract one, or purchase a Commercial-Off-The-Shelf (COTS) component.
- Supporting effective project management by introducing software risk management and data-driven project monitoring.
- Guiding software development processes with our specially developed process engineering technologies, incl. the Electronic Process Guide (EPG) and the Sparmint™ process modeling tool.

Simulation-based Evaluation and Improvement of Software Development Processes (SEV)

Systematic selection of appropriate processes, methods, and tools for the development of high quality software requires knowledge about their effects under varying project conditions. Up to now, the selection has essentially relied on subjective experience, experience



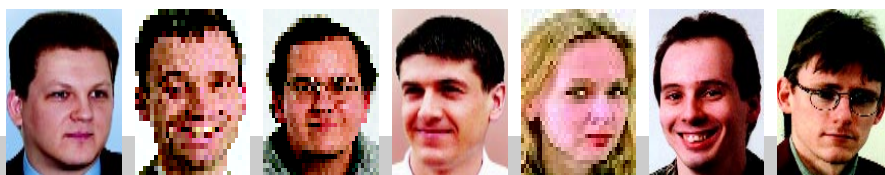
SEV diagram (simulation model)

from previous projects, or experience from expensive controlled projects. However, planning decisions are only insufficiently supported. In the SEV project, simulation is used to support decisions on process alternatives for a project. Thus, new development knowledge can be gained faster and more cost effectively. The project goals are:

- Forecasting and conducting 'what-if-games' for the selection of software development processes,
- reducing costs of empirical studies by simulation,
- supporting practice-oriented teaching and training of project managers and planners.

A simulation platform consisting of an evaluation and improvement method, an integrated tool environment, and a simulation cockpit for the effective application of the method are being developed. Using the simulation platform promises to reduce costs and

risks, to better select and focus the scope of empirical studies, and to shorten learning cycles. In addition to this, the integration of optimization algorithms promises the identification of potentials for further improvements of software development processes, which could only be identified at high costs if purely empirical methods were used. Scientific questions address the cost-effective achievement of sufficient validity of the simulation models, the identification of process improvement potentials, the adequate visualization of simulation results, and the effective combination of real and virtual (e.g., simulated) experiments. First results of the project are an initial method to develop simulation-based decision support, discrete models for selecting and tailoring defect detection processes and operational experience in applying these models in varying contexts.



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Overview

Typically, our customers want to reuse and adapt well-tried solutions. They do not want to repeat mistakes. They want to offer their products and services with constant quality, even if their experts are not available at the moment. Therefore, they seek to make more out of their knowledge based on professional experience management (EM).

That is what the core competence area SLI is about. We support customers in analyzing their knowledge management processes. We help customers not simply to gain experience but also to efficiently and sustainably use it. We support organizations in training employees on these topics. We do not offer knowledge management off-the-shelf, but EM tailored to individual organizations. The benefit for the customer is that individual experience becomes knowledge for all, that information is at hand when needed, and that the organization takes over the initiative for its own EM.

SLI develops techniques, methods, and tools for EM in the information technology field. For example, based on the experience achieved in various industrial and publicly funded research and transfer projects, we developed the DISER methodology for the build-up and operation of EM systems, including a technical infrastructure for its support.

The following two highlight projects focus on the use of EM in process introduction and improvement as well as information technology security and

eGovernment.

indiGo: Participative Process Introduction and Evolution

In organizations the quality of processes and their models is of utmost importance for the quality of the products developed. Nevertheless, many organizations neglect these processes and leave the knowledge about them in the heads of their experts.

In indiGo, a project by Fraunhofer IESE and Fraunhofer AIS, processes are introduced and continuously evolved in a global setting, with process knowledge being explicitly distributed throughout an organization. It assures that the processes are available and used in an effective and efficient manner with the participation of the process users and experts. This solution for distributed organizational process learning is based on eDiscussions, text mining, experience management, and process evolution methods.

The methodological framework consists of methods for the realization of eModeration, process evolution, and extraction of experiences via text mining. Methods for the introduction of indiGo into new organizations and the learning about processes complete indiGo's methodology. Beside this, indiGo comprises a discussion forum for distributed discussions, an experience factory for the management of process experiences, and interfaces to the process modeling tool SPEARMINT. The interaction of the developed methodology and technology supports an organi-



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Dr. Frank Bomarius



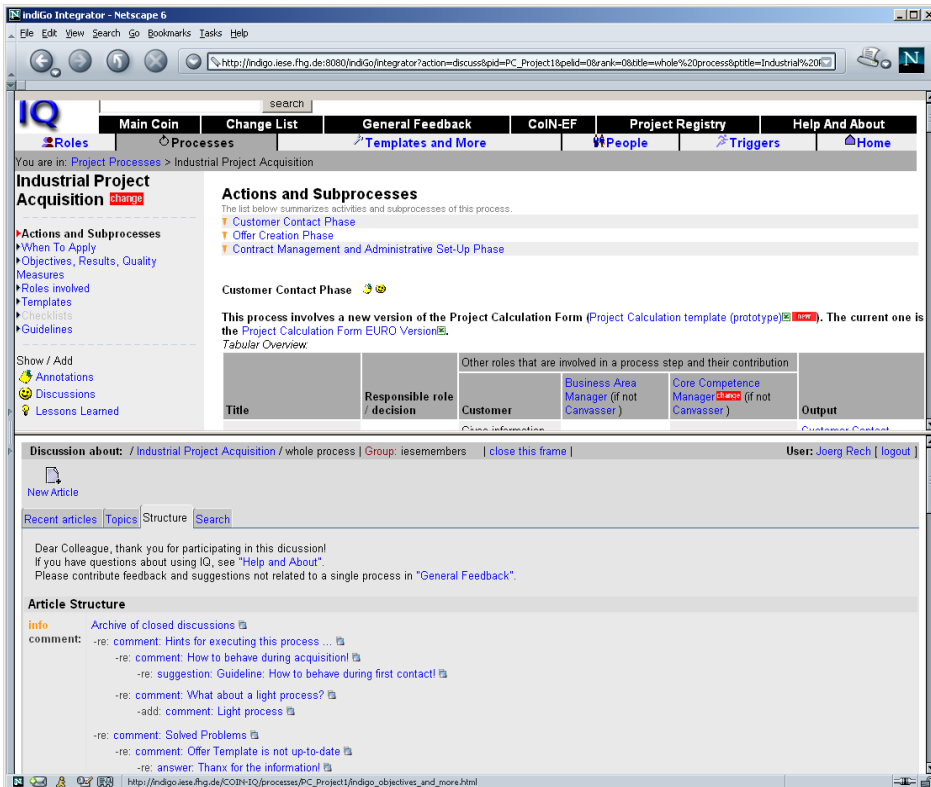
Björn Decker



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Stephan Groß



zation in learning about their processes and process modeling techniques, and enables it to record valuable experiences from process users and experts.

Results of a case study at the IESE indicate that processes introduced and modeled with process user participation result in more accepted and stable process models. Additionally, we designed and started a long-term case study for the evaluation of our methods, tools and process models.



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Certifiable Education and Training in Software Engineering (CET)

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Overview

While software is of paramount importance for market success in all high-tech and service domains, software engineering (SE) competence development does not live up to this challenge, even though the need for on-the-job and on-demand qualification of the SE workforce is intensified by ever shorter software technology innovation cycles. One possibility of dealing with this situation is to establish effective and efficient SE qualification systems that combine innovative e-learning technologies with traditional in-class training. To improve effectiveness, SE qualification systems must be tailored to business processes, software application domains, individual SE competence profiles, and to the qualification needs of a software organization. To control the efficiency of SE qualification systems, measures to evaluate the success of e-learning, quality assurance of e-learning products, and systematic reuse of training contents must be established. Moreover, the integration of e-learning processes and infrastructures with state-of-the-art knowledge management solutions is a must if sustained success is to be achieved. Backed up by its recently established e-learning laboratory, which is part of a virtual e-learning lab created by several Fraunhofer institutes all over Germany, CET conducts research in several of these crucial areas and provides related services to software development organizations, SE training service providers, and SE content providers.

CORONET: Collaborative Learning for Software Professionals

The new methods of web-based training can shorten and considerably enhance the continuing qualification of software engineers by making expertise available directly at the workplace. However, many software organizations are still reluctant to introduce web-based training because they have their doubts about the effectiveness of these forms of training.

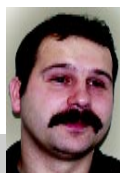
The CORONET system, result of a joint European research project coordinated by Fraunhofer IESE, addresses this issue in an innovative way.

Based on fundamental principles of continuing education, CORONET connects learners with experts and other learning resources in the most adequate way, depending on their current learning situation. The CORONET platform (WBT-Master) integrates technology-enabled learning with knowledge engineering and offers innovative concepts of creating and documenting new knowledge while learning.

The strength of CORONET is its ability to cover the whole bandwidth of possible learning settings, from long-term competence development through dedicated web-based training, tutoring and mentoring to short-term problem solving through quick information access and fast learning.



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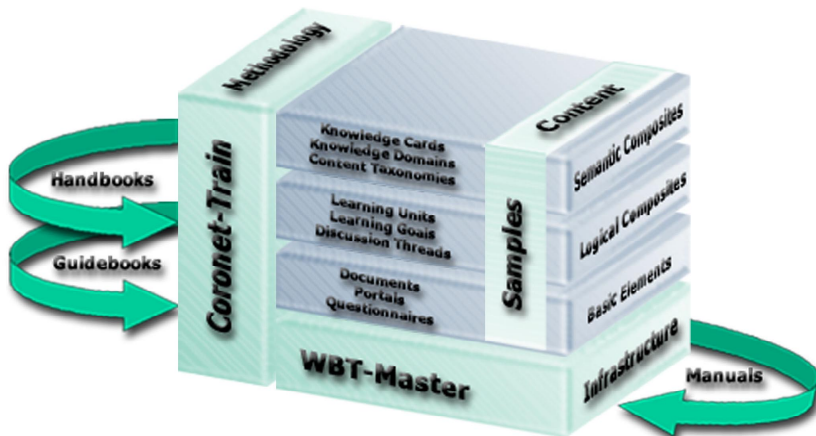
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The essence of CORONET is its focus on collaborative methods. CORONET promotes and supports the development of sustained interpersonal relationships in combination with comprehensive functionality for creating, accessing, annotating, extending, and exploiting knowledge assets, sharing knowledge for use and reuse, and learning from others and with others. In this way, CORONET helps to establish learning networks in which people of equal and different competence levels practice both individual and group learning, experience-based learning, learning with multiple activities and resources, and knowledge sharing.

Based on CORONET, Fraunhofer IESE will soon offer to regional small and medium companies special tutoring services, moderated practitioner sessions, and scheduled counseling hours with software engineering experts.

The development of CORONET was partly funded by the Information Societies Technology program of the European Union (project number: IST-1999-11634). The acronym

CORONET stands for "Corporate Software Engineering Knowledge Networks for Improved Training of the Workforce". More information on CORONET can be found at www.iese.fraunhofer.de/coronet.

IntView: Courseware Development with Integrated Viewpoints

Today, most courseware development projects face problems when it comes to meeting schedule, staying within budget, and producing quality courseware, because project teams lack detailed support and guidance in their work. Current courseware development methods proposed in literature only partly resolve these problems. They merely provide high-level descriptions of their inherent development process. This is not sufficient for project guidance and support. Furthermore, they focus only on one courseware development viewpoint and lack life-cycle encompassing quality assurance.

The IntView courseware development methodology provides courseware

developers with a process and tool that reduce development effort and increase the probability of finishing a courseware project within schedule and budget, and with high technical quality. As a comprehensive development methodology, IntView integrates the important views that must be addressed in order to achieve high quality courseware: the managerial view, the content-instructional view, and the graphical-technical views. In addition, IntView takes care of all four content dimensions, i.e., raw content, instructional strategy, content presentation style, and functionality.

IntView enhances existing courseware development approaches by integrating elements of hypermedia and software engineering approaches. Furthermore, IntView introduces a set of intermediate quality assurance activities inspired by state-of-the-art software engineering principles that verify the quality of intermediate work products in addition to already existing courseware quality assurance measures such as formative and summative evaluations.

On a high abstract level, the IntView courseware methodology can be described as a product-centered life cycle model, as shown in Figure 1.

The development of the IntView methodology was partly funded by the "e-Qualification Framework (e-QF)" project under grant 01AK908A of the German Federal Ministry of Education and Research (BMBF). More information on IntView can be found at www.iese.fraunhofer.de/IntView/



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Overview

IT security is an important requirement for enterprises that depend on information technology (IT). Fraunhofer IESE's core competence area "IT Security" assists organizations in defining their long-term security policies and strategies, in identifying and closing their security gaps, and in sustaining security of their IT operations. IESE provides methodology, tool support and technical expertise to meet customer-specific security requirements.

Securing IT is a complex and time-consuming task, and skilled security personnel are a very scarce resource. To improve the efficiency and effectiveness of security assessments, and to optimally deploy available resources, we aim at appropriate tool support.

One of the utilities developed at Fraunhofer IESE is NIXE™, a very flexible tool for performing cost-effective security checks on UNIX systems. Currently under development is IOS™ Checker, an innovative tool for hardening router configurations. IOS™ Checker has some unprecedented security assessment capabilities (see next article).

A general focus of our research is to lessen the need for the implicit knowledge and intuitive skills of few security experts, Fraunhofer IESE is working on automated decision support in key areas such as, for example, e-government security, or baseline protection measures. The goal is to apply knowledge management techniques to make security expertise more explicit.

NIXE™ (Non-intrusive UNIX Evaluation) is a registered trademark of the Fraunhofer-Gesells-

IOS Checker

Fraunhofer IESE helps its clients to secure their computer networks. Its portfolio of network security services includes tools that uncover vulnerabilities in router configurations.

Routers are integral parts of networks based on the Internet protocol (IP). In essence, a router relays (or refuses to relay) messages between given origins and destinations. In particular, it determines whether certain IP ports - i.e., network services - can be reached or not. Therefore, proper router configuration is of utmost importance for the availability, integrity, and confidentiality of a network segment. However, router configuration is a very delicate and subtle issue, even for experts. And routing experts are a rare species.

Currently, the preferred equipment for IP routing are routers that run the Internet Operating System (IOS™). To assist the user in avoiding the innumerable lurking pitfalls of IOS, Fraunhofer IESE has developed IOS Checker, a software tool that analyzes IOS configurations.

IOS Checker is a modular, extensible framework based on patterns and associated pattern handlers (Figure 1). A pattern characterizes a specific type of IOS configuration clause. A pattern handler describes, step by step, the analysis that has to be applied to configuration clauses that match the pattern. Whenever a pattern is found in an IOS configuration, the corresponding handler is triggered to assess the validity and suitability of the configuration



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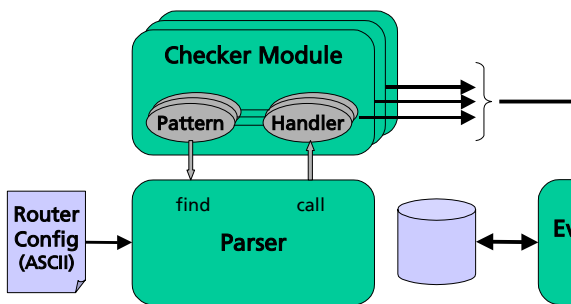
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clause. Multiple clauses may be analyzed in context. IOS Checker supports very general patterns and handlers.

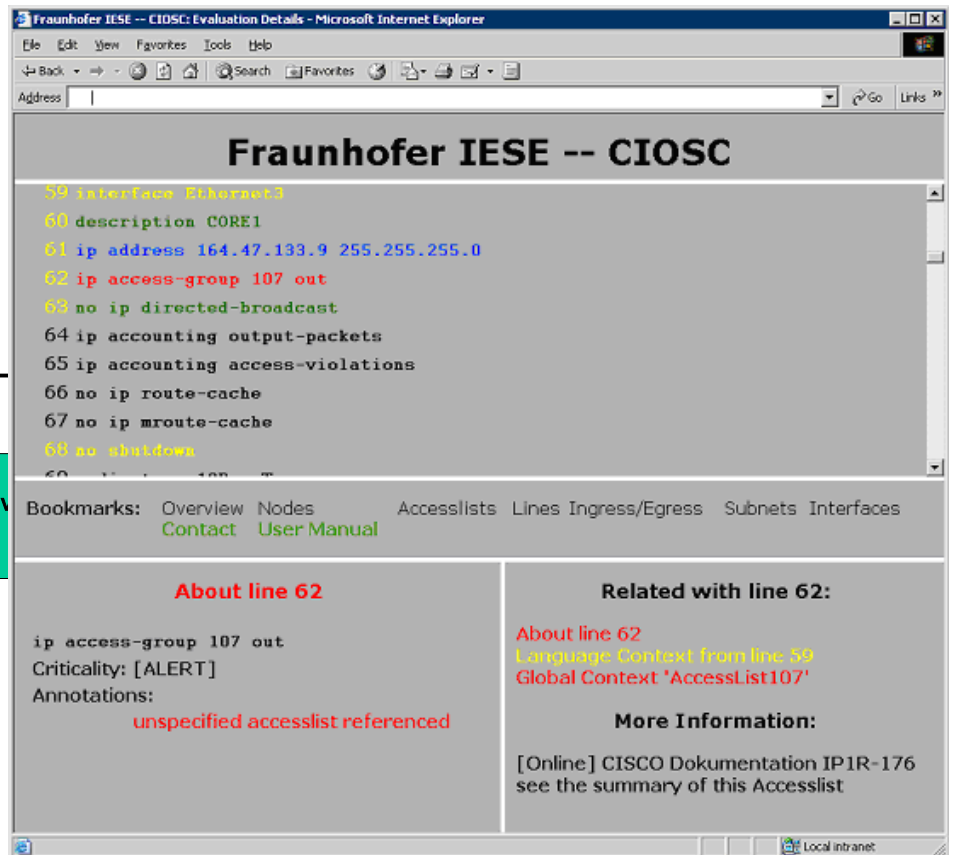
Sets of [pattern, handler] pairs that jointly perform a security analysis form a checker module. IOS Checker provides a number of predefined checker modules that cover evaluation topics such as, for example, ingress/egress filtering, SNMP settings, or authentication, authorization and accounting (AAA). In addition, there is a generic checker module with configurable evaluation criteria. These criteria can

handlers have to be specified by the programmer.

Report generating is another strength of IOS Checker. Different views on the evaluation results are shown as HTML pages (Figures 3a and 3b). The relationship between logical evaluation topics and individual configuration clauses is reflected by hyperlinks. Additional links referring to Cisco Online Manuals and other useful background information are automatically inserted.



class. Only pattern formats and the evaluation logic of their corresponding





Business Areas

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Reliable Software for Embedded Systems

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Overview

Advanced and high quality embedded software systems are one of the strengths of the German as well as of the European industry. Nowadays the use of software is a must for competitive products in many traditional engineering disciplines. New functions rely more and more on software. As production technology of the 21st century, software engineering is creating added value to almost all goods. Our business area Reliable Software for Embedded Systems addresses the specific needs of the largest application domains:

- Automotive Industry
- Railway Systems
- Mechanical Engineering
- Air and Space Industry
- Industrial and Consumer Electronics
- Chemical and Pharmaceutical Industry
- Medical Technology

These domains are characterized by a need for high quality software embedded in large heterogeneous systems. Cost-efficient methods are required to produce safe, reliable, secure, and easy-to-extend/easy-to-adapt software components.

The business area provides customer-specific solutions for the typical problems from the portfolio of IESE solutions, e.g.:

- Introduction of Product Line Software Engineering, which helps to reduce release-cycles, reduce costs by improving reuse of software components across products of a product family, and allows better synchronization of software and hardware development.

- Performing Software Engineering Process Assessments, addressing the trend towards quality certificates for an organization's capability to develop and maintain software.
- Technical support for Subcontractor Management and integration of Commercial -Off-The-Shelf-products (COTS) to allow a company to focus on its core competencies and permit time- and cost-optimized product development.
- Introduction of data-driven product and project monitoring to continuously assess processes and products with respect to quality goals.

MAN Roland

MAN Roland is the world's second largest manufacturer of printing systems and the world leader in newspaper printing systems. Web-fed presses, sheet-fed offset presses, and digital printing systems provide solutions for publications, commercial and packaging printing tasks.

Software plays a paramount role in the automation of such high performance printing machines - it must safely and securely control a delicate high speed printing process in real time.

In this project, Fraunhofer IESE collaborated with MAN Roland's development department for the sheet-fed offset presses. Zero defect and maintainability over several decades are very important criteria of MAN Roland's customers, who need to minimize down-time and who want to upgrade their printing machines over many years as new materials (paper, ink) become available. In order to meet these goals, MAN Roland wanted to learn more about the process-product dependen-

cies in their software development processes.

At the time of the start of our collaboration, MAN Roland had set out to develop a new electronics and software design. As a supporting measure, a new configuration management system had to be selected and integrated into the development process. IESE was charged with the analysis of the current software development practices, helped to evaluate and choose between candidate configuration management systems, and defined new processes in order to integrate the selected configuration management system.

The analysis of current practices at MAN Roland comprised the examination of the software product (architecture and code quality criteria), the software development process as well as staff qualification. Strengths and weaknesses in all three areas were systematically identified and reported. A corresponding action plan was devised and MAN staff has learned to use the analysis techniques that were employed.

Now MAN Roland can identify the strength and weaknesses of the current software product and software development process in relation to their business goals. Concrete steps to improve the software product and the software development process are being planned.

Testo

The highly influential U.S. Food and Drug Administration (FDA) requires detailed monitoring and recording of pharmaceutical manufacturing conditions. Traditionally, documentation has

been done on paper, with handwritten signatures. Today, the preferred format is electronic records. To regulate the conditions under which electronic format is considered acceptable, the FDA published rules relating to the use of Electronic Records and Electronic Signatures (21 CFR Part 11).

Mandatory controls defined in 21 CFR Part 11 put the pharmaceutical industry and their suppliers into a state of uncertainty because the rules leave much room for interpretation.

Due to this uneasiness, Testo, a medium-sized company producing data loggers for temperature, humidity, and fumes, felt the need to demonstrate the compliance of its products with 21 CFR Part 11. Fraunhofer IESE was the natural competence partner for an assessment, as most of the required controls refer to properties of software and software-related processes.

First, IESE made inquiries in order to establish an appropriate interpretation of FDA regulations in the context of data logging equipment. A number of FDA standards had to be taken into account to define a reasonable conformance level for the type of products and applications under consideration.

Next, Testo - supported by IESE - mapped the requirements that had been identified in phase one to security, safety, and validity properties of Testo products and processes. Where necessary, IESE suggested technological or procedural compensation for existing shortcomings.

In a final assessment, IESE confirmed Testo's compliance with 21 CFR Part 11. IESE's compliance report details the validation steps undergone by Testo and the level of compliance that was achieved in each case.

The compliance report is an important marketing instrument to convince customers of the superior quality of Testo products, and a prerequisite for FDA validations in the production environments of Testo users.

Secure Software for Infrastructure Facilities and Services

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Overview

Most organizations depend critically on their IT infrastructure, its availability and proper functioning. Information processing is vital for many business and production processes. The expanding use of telecommunication services and the growing importance of electronic commerce will further increase dependence on IT in the future. Our Business Area Secure Software for Infrastructure Facilities and Services addresses the specific needs of the following application domains:

- Telecommunications Industry
- Providers (as operators of infrastructure facilities)
- Telematic Service Providers

These domains are characterized by the need to provide a system environment that is not only highly scalable, available, and flexible, but also highly secure. The business area provides customer-specific solutions for some of the typical problems from the portfolio of IESE solutions, e.g.:

- Comprehensive support for Requirements Engineering, to cover all activities involved in eliciting, negotiating, documenting, modeling, validating, and evolving requirements for a system.
- Performing IT Security Investigations, which helps to identify actual vulnerabilities and threats, to close existing security gaps, to define adequate security objectives, and to set up the corresponding security policies.
- Introduction of Risk Management, addressing the need to assess continuously what could go wrong and to implement strategies and counter-measures to deal with it.

Highlight

Tenovis, formerly known as Bosch Telekom, decided to replace the hardware platform of the "Vermittlungs-Software I3" in order to provide faster solutions for business communications. This had important consequences for the large portion of the code written in Assembler: it had to be migrated towards C to run on the new CPU. The two main options each have their price. Rewriting in C would take away important resources from new release development. A semi-automated solution must meet the challenge of producing code that preserves performance and maintainability: most semi-automated solutions do not.

IESE was selected to help find a viable solution, due of its history of successful projects with Tenovis, its technical competence and its incremental strategy, which reduces risks.

The main benefits of IESE's involvement are that it was as an effective interface between the vendors and Tenovis, and that it could provide feedbacks on technical problems and solutions both to the vendors and Tenovis. As an independent advisor, IESE helped make the selection process explicit and systematic.

The approach taken was to evaluate external automated solutions, while supporting migration scripts incrementally developed in parallel by Tenovis. First, IESE identified migration service providers and assessed their potential. Then IESE supervised the two most promising firms in translating sample Assembler files. Together with Tenovis, IESE evaluated the results and the mode of collaboration. As a result of this evaluation, one contractor was selected to perform the migration, starting with a pilot migration on an

executable subset of the system.

In parallel, IESE's support included developing a register usage analysis tool to identify the parameters of the new functions in C. The results of this tool were a valuable input to both the Tenovis migration scripts and the contractor's migration tool. One key benefit of IESE's tool was the exposure of areas of the code that might cause failure in the migrated code. These areas will be closely monitored and tested during the final migration.

Flexible SW for IT-based Business Processes

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Overview

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Cost-Benefit Analysis and Decision Support for IT & Software Investments

In recent years, deciding on what to do to get better output from IT and software investments and costs has become more and more important for companies. Regarding decisions on investments to support processes with tools, in particular, organizations have a major interest in whether such an investment will pay off in the future. Such investment decisions may range from the strategic level all the way to the operational level, and they are a direct part of strategic improvement and project management - renowned core competencies of Fraunhofer IESE.

With Robert Bosch GmbH (Gasoline Systems - Engine Control) we recently finalized a project for developing and probing a customer-tailored method that allows for an analysis of possible IT investments in the area of methods and tools that support software development processes for engine control. The result is a method supporting the goal-oriented quantification and analysis of IT investments in a systematic, transparent, and repeatable way. During two pilot applications in the Bosch environment, the method was applied and first experience was gathered and condensed to an initial set of practical guidelines augmenting the documented method.

In one of the pilot applications, the correct cost-benefit results turned out to be contradictory to the initial hypotheses of how the results would look like. This demonstrated the beneficial application of the method: it would have

prevented our customer from an investment that would not have been beneficial.

Overall, the main customer benefits are the systematic approach to cost-benefit analysis and decision-making support, the MS Office® based set of tools and templates delivered with a method handbook, and the initial experience in applying the method.

Robert Bosch GmbH, Gasoline Systems - Engine Control, is now able to perform cost-benefit analyses of IT and software investments on demand.

QUALISEM-PEOPLE: Software Engineering Qualification Needs Analysis

Re-engineering activities typically require the implementation of new or changed software development processes. Experience shows this to only be successful if those who are to assume the various roles in the new or altered processes are adequately qualified so that they can really live these processes. One condition necessary for this is that the actual skills of the selected software engineers do match with required skill profiles.

With QUALISEM-PEOPLE, Fraunhofer IESE offers a service that supports companies in defining required skill profiles and in assessing the potential qualification needs of their software workforce.

QUALISEM-PROFILE is comprised of four steps:

Step 1: Skill profiles of each role in the new or changed development process are defined in close collaboration of the process owners in the customer organization and Fraunhofer IESE experts. This is done by adapting previously existing skill profiles, tailoring existing

standard profiles to the specific needs of the customer organization, or developing new profiles completely from scratch. Which alternative is chosen depends on the type of process changes, and on existing time and budget constraints.

Step 2: Based on questionnaires, the current skill profiles of the software engineers are analyzed. This can be done by means of a self-assessment or a management-oriented assessment performed by the decision makers in the customer organization.

Step 3: By comparing the actual current skill profiles with the required skill profiles, qualification gaps are identified and prioritized.

Step 4: For the high priority qualification needs, adequate qualification measures are proposed.

An add-on of QUALISEM-PROFILE is that it assesses role-specific qualification preferences of the workforce and, based on this information, helps establish a balance between organizational qualification needs and individual qualification preferences.

QUALISEM-PROFILE has been successfully applied in industrial projects. Due to its high flexibility, the approach is particularly suited to small and medium-sized companies.

SW-based Products and Services

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Overview

The BA SW-based Products and Services addresses the special needs of software companies who build software products or who deliver tailor-made software solutions. This includes companies who do consulting in the IT sector as well as continuing education and training service providers.

Customers in this BA are mostly SMEs with a strong need for immediate return-on-invest and who lack research staff of their own. IESE delivers the necessary innovation and research results for such companies. IESE also teams up with such companies to act as project partner towards their customers.

Typical topic areas include:

- SW process assessment and improvement
- SW product assessment and improvement
- Expert reports, certifications, tool and technology evaluations
- Approaches for software quality management, knowledge management and risk management
- Consulting services regarding e-commerce and its impact on business models, regarding IT infrastructure and operation, software development processes, and software products

FAME Workshop

The automotive industry has experienced an increase of recalls of cars due to software defects. This has prompted manufacturers to assess the software development processes of their suppliers.

Motivated by these developments, Continental AG, a manufacturer of components, modules and systems, such as brake technology, vehicle dynamics control, tires and energy management, approached Fraunhofer IESE for support in establishing sound knowledge in software process assessment technology for its various holding companies. Continental chose Fraunhofer IESE as a partner for this project because of IESE's expertise in the area of quality and process engineering. IESE has developed a software process assessment method called FAMETM (Fraunhofer Assessment Method), which is compliant to international assessment standards like ISO/IEC TR 15504. This method has been applied in many industrial sectors, and especially in the automotive industry. With FAME, IESE supports its customers in preparing and performing software process assessments. In addition, IESE has developed an in-depth training course that allows participants to register as SPICE assessor upon successful participation.

In 2002, IESE performed a one-week in-house training for Continental. Staff of various business units of Continental was trained in all aspects of process assessment in one single course. This promoted the transfer of assessment knowledge to different units in a very effective way. The individual business units now have sound knowledge of the overall processes and can prepare themselves better for software process

assessments by the automotive manufacturers, which helps them to strengthen their software development process and thus, their market position as well.



Fraunhofer Center for Experimental Software Engineering, Maryland

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Profile of Fraunhofer Center Maryland

VISION AND MISSION

In 1994, Fraunhofer-Gesellschaft e.V. (FhG) established Fraunhofer USA (FUSA), headquartered in Plymouth, Michigan, to foster collaboration between research institutions and industries in the United States. Since then, seven separate centers have opened in the United States, each center affiliated with both a local American university and one of the FhG Institutes in Germany.

The Fraunhofer Center for Experimental Software Engineering, Maryland (FC-MD), is the only FUSA center to specialize in software and related engineering fields, focusing on the use of experimental approaches to introduce innovative techniques into industry. FC-MD is an applied research and technology transfer organization and is affiliated with the University of Maryland and the Fraunhofer Institute for Experimental Software Engineering (IESE) in Kaiserslautern, Germany. Its primary focus is improving the quality of software related products and services by working directly with organizations, learning about their particular business needs, and providing tailored improvements to meet those needs.

BUSINESS AREAS AND COMPETENCIES

FC-MD emphasizes software engineering, software development practices, and software processes using application development, feedback, and learning to improve its client organizations' software development technologies. Through this proven approach, FC-MD makes its clients more competitive in critical information technology fields. Global, national, and regional organizations benefit from FC-MD services.

FC-MD supports research and development in the discipline of software engineering and its enabling technology. It facilitates collaboration between private-sector companies, government agencies, and academic institutions, in order to develop innovative, actionable approaches. The core competencies of FC-MD lie in the areas of technology transfer and process and product improvement.

CORE COMPETENCIES

Software Technology Evaluation

- Experimenting with various technologies
- Determining their suitability for use in specific environments

Customers

- National Aeronautics and Space Administration (NASA)
- Defense Advanced Research Projects Agency (DARPA)
- Department of Defense (DoD)

Project Focus

- High Dependability Computing Project (Dependability, NASA Earth Observing System Data and Information System testbed)
- National Science Foundation Center for Empirically Based Software Engineering (CeBASE) (Defect reduction, Commercial off-the-shelf-COTS-products)

Risk Management

- Using existing risk management techniques and tools on projects
- Applying risk management to the development of secure systems

Customers

- DoD
- DARPA

Project Focus

- Acquisition Risk Management (architecture, cost and schedule, technologies)
- DoD Software Intensive Systems

Experience Factory

- Developing experience bases and tools - knowledge management, building learning organizations
- Analyzing and synthesizing information

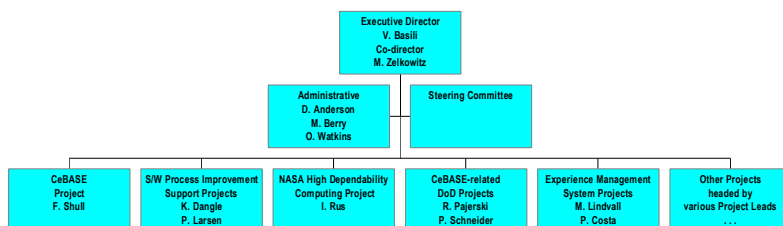
Customers

- National Science Foundation
- DoD
- DARPA
- US Army

Project Focus

- Experience Management System (Experience Base/Experience Factory tools, Visual Query Interface, Fre-

Fraunhofer Center - Maryland Organizational Chart



quently Asked Questions, eWorkshop, Lessons Learned Experience Base)

- Acquisition Risk Management (Experience Factory for risk management)
- DoD Software Intensive Systems (Experience Factory for web-enabled systems)
- CeBASE (Experience Factory for defect reduction, COTS)
- Software Process Improvement Implementation Support (Capability Maturity Model, Experience Base for small companies)

Measurement

- Decision support system for goals and metrics
- Integrating corporate goals down to software project goals
- Integrating Goal Question Metric, Balanced Scorecard, Practical Software and Systems Management, etc.

Customers

- 16 Maryland companies

Project Focus

- Software Process Improvement Implementation Support

Reading Techniques

- Defining and experimenting with various reading techniques to catch errors at early stages of development
- Determining their suitability for use in specific environments

Customers

- NASA Goddard Space Flight Center
- Jet Propulsion Laboratory
- NASA Ames Research Center

Project Focus

- Reading/Inspection Technologies
- High Dependability Computing Project (glue code and wrapper codes reading-COTS)

Agile Development

- Experimenting with various agile technologies to reduce the cost of software development
- Developing graphic user interface testing techniques compatible with agile development

Customers

- FC-MD Experience Management System

Project Focus

- Agile Methods and GUI Testing
- eWorkshop on agile methods

Software Process Improvement - Capability Maturity Model (I)

- Assisting companies in achieving their software process improvement goals
- Assisting organizations in improving the quality of their software related products and services

Customers

- Principally government contractors

Project Focus

- Software Process Implementation Support
- Software Industry Consortia

COTS

- Conducting empirical research to understand COTS-based systems and develop models
- Applying technologies for detecting defects in COTS-based systems

Customers

- NASA
- National Science Foundation

Project Focus

- High Dependability Computing Project
- CeBASE

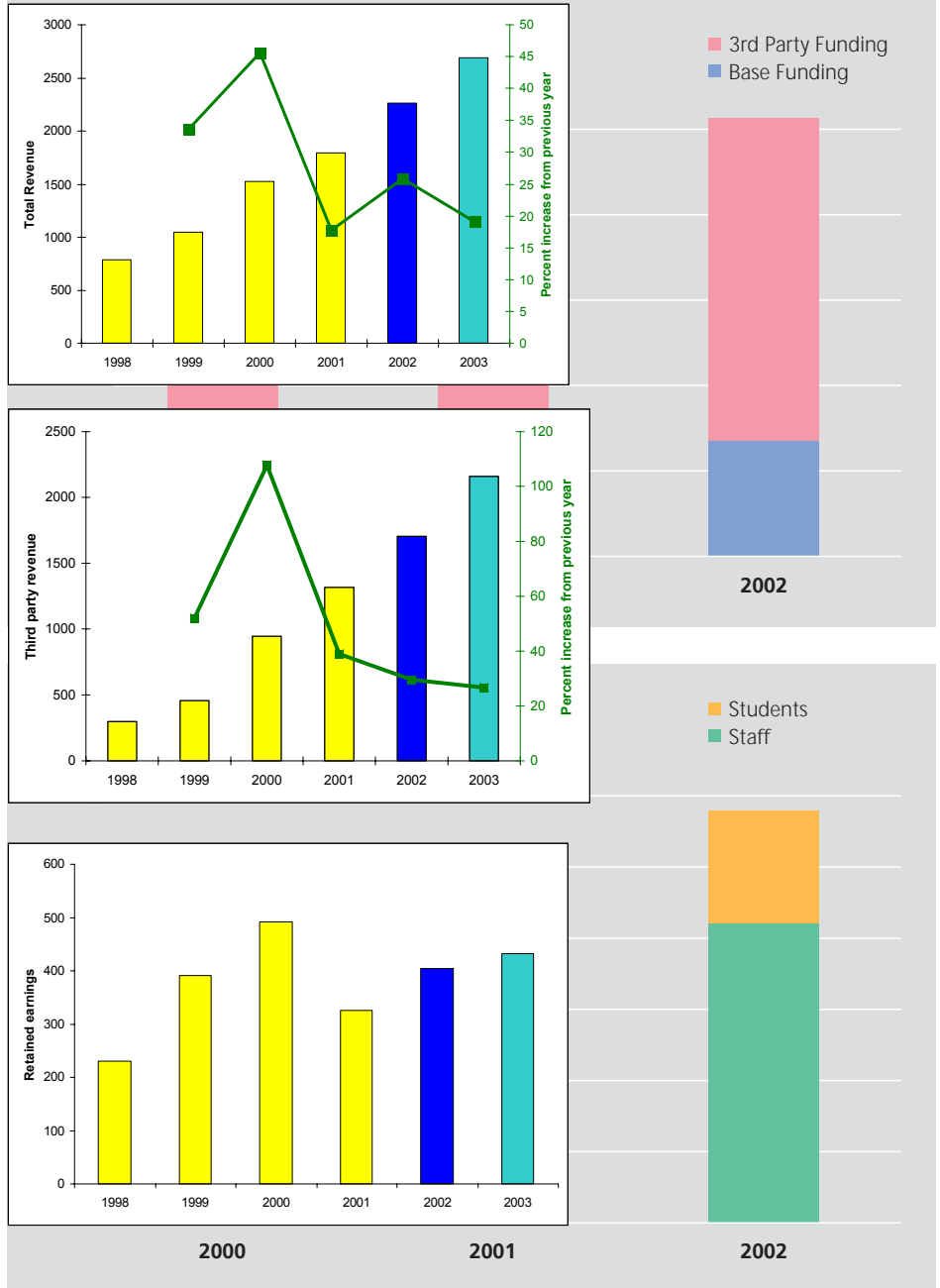
Selected Projects

FC-MD in Figures

FC-MD in Figures

The FC-MD is on track to earn a small profit both this year and in 2003 despite a small loss in 2001. Third party revenue is continuing to grow at more than 20% each year.

The line on each graph represents the annual percent increase from the previous year.



Network, Activities, Publications

Steering Committee Members

Dr. Keith Blurton
Vice President
Fraunhofer USA, Inc.

Dr. Michael C. Dyer
Corporate Fellow, Software Engineering
Lockheed Martin Corporation

Secretary David Iannucci
State of Maryland Department of Business and Economic Development

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

Mr. Tony Jordano
Vice President for System and Software Engineering
SAIC Corporation

Mr. Seymour Moskowitz
Senior Vice President
Anteon

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

Dr. Michael Plett
Vice-President
Computer Sciences Corporation

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

References

ABB, Corporate Research Ltd.
AC Technologies, Inc.
Boeing Company
CoLinx, LLC
Creative Computing Solutions, Inc.
DaimlerChrysler AG
Department of Defense
IIT Research Institute
ManTech Test Systems, Inc.
Motorola, Inc.
Nokia Corporation
QSS Group, Inc.
Systems Integration and Development

Research Partners

- Carnegie Mellon University
- CeBASE
- DoD Software Intensive Systems Office (SISO)
- Dyncorp, Inc.
- Federal University of Rio de Janeiro, Rio de Janeiro, Brazil
- Fraunhofer Gesellschaft
- Fraunhofer Institute for Experimental Software Engineering, Kaiserslautern, Germany
- Maryland Department of Business and Economic Development
- Maryland World Class Consortia, Ltd.
- Massachusetts Institute of Technology
- Mississippi State University
- NASA Goddard Space Flight Center
- NASA Independent Verification & Validation Facility, West Virginia
- Norwegian University of Science and Technology, Trondheim, Norway
- Portland State University
- Program Executive Office (PEO) Enterprise Information Systems (EIS)
- University of Kaiserslautern, Germany
- University of Nebraska-Lincoln
- University of Maryland Software

- Engineering Group
- University of Southern California
- University of Washington
- University of Wisconsin
- West Virginia University

Events

Fraunhofer USA Directors' Meeting,
January 10

3rd eWorkshop on Defect Reduction,
January 28

1st eWorkshop on COTS-based Software Development,
March 4

1st eWorkshop on Agile Methods,
April 8

Workshop on "What We Know about Fighting Defects,"
June 7 (co-located with the 2002 Metrics Symposium in Ottawa, Canada)

2nd eWorkshop on Agile Methods,
June 19

FC-MD Steering Committee Meeting,
June 20

Fraunhofer USA Directors' Meeting,
July 23

3rd eWorkshop on Agile Methods,
October 29

Fraunhofer USA Board Meeting,
November 12-13

Visitors Hosted

Sven Johann
University of Kaiserslautern
November 2001-May 2002

Yoshihiro Matsumoto and Akihiro Yamashiro
Toshiba
January 29

Laurie Williams
North Carolina State University
February 11 and October 29

Dr. Michel Cukier
University of Maryland
March 11

Dr. Dieter Rombach
Fraunhofer IESE
May 1-2

Dr. Jane Hayes
University of Kentucky
May 13

Dr. Walter Scacchi
University of California
June 12

Dr. Tim Menzies
NASA IV&V Center, West Virginia
June 14

Lori Pajerek
Lockheed Martin
July 8

Rich Turner
Office of the Under Secretary of Defense, Software Intensive Systems
Department of Defense
October 16 and October 29

Olga Jaufmann
University of Kaiserslautern
November 2002 - May 2003

Staff Professional Activities

Dr. Victor 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 Publisher
- Member, ACM Fellows Subcommittee (2002-2007)
- 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 (IESE), Kaiserslautern, Germany
- Best Paper Award, 1st International Symposium on Empirical Software Engineering (ISESE), Nara, Japan, October 2002

Dr. Mikael Lindvall

- Member, Institute of Electrical and Electronics Engineers (IEEE), Computer Society
- Guest Editor, IEEE Software (special issue on Knowledge Management)
- Guest Editor, Journal of Software Maintenance and Evolution (special issue on Process Diversity)
- Reviewer, Journal of Systems and Software
- Reviewer, IEEE Transactions on Software Engineering
- Program Committee, International Conference on Software Engineering and Knowledge Engineering (SEKE) 2002
- Program Committee, Product Focused Software Process Improvement (PROFES) 2002
- Program Committee, 4th International Workshop on Learning Software Organizations (LSO) 2002

Dr. Ioana Rus

- Reviewer, Computer Magazine
 - Member, Institute of Electrical and Electronics Engineers (IEEE), Computer Society
 - Member, Association for Computing Machinery (ACM)
 - Guest Editor, IEEE Software (special issue on Knowledge Management)
 - Guest Editor, Journal of Software Maintenance and Evolution (special issue on Process Diversity)
 - Program Committee, International Conference on Software Engineering and Knowledge Engineering (SEKE), 2002
 - Program Committee SEDEC2002
 - Program Committee, 4th International Workshop on Learning Software Organizations (LSO) 2002.
 - Program Committee, International Conference on Product-Focused Software Process Improvement (PROFES) 2002
 - Program Committee, Workshop on Decision Support Systems 2002
- Dr. Forrest Shull
- Reviewer, IEEE Transactions on Software Engineering
 - Reviewer, IEEE Software
 - Reviewer, Journal of Empirical Software Engineering
 - Editorial Board, Journal of Empirical Software Engineering, Kluwer Publishers
 - Program Committee, International Conference on Product-Focused Software Process Improvement (PROFES) 2002
 - Program Committee, ISESE'02 (International Symposium on Empirical Software Engineering)
 - Program Committee, SNPD '02 (3rd ACIS International Conference on Software Engineering, Artificial

Intelligence, Networking, and Parallel/Distributed Computing)

- Program Committee, XP/Agile Universe 2002
- Best Paper Award, 1st International Symposium on Empirical Software Engineering (ISESE), Nara, Japan, October 2002

Dr. Marvin Zelkowitz

- Series Editor, *Advances in Computers*, Academic Press
- Editorial Advisory Board, *Journal of Computer Languages*
- Editorial Board, *Journal of Empirical Software Engineering*
- Fellow, Institute of Electronic and Electrical Engineers
- Program Committee, Metrics 2002 Symposium
- Program Committee, Learning Software Organizations Workshop, Chicago, IL
- Program Committee, International Conference on Software Engineering and Knowledge Engineering (SEKE) 2002
- Program Committee, Metrics 2003 Symposium, Sydney, Australia
- Member, Association for Computing Machinery, SIGSOFT
- Member, IEEE Computer Society, Technical Council on Software Engineering.

Publications

Basili, V. R., McGarry, F., Pajerski, R., and Zelkowitz, M. V. "Lessons learned from 25 years of process improvement: The rise and fall of the NASA Software Engineering Laboratory", Orlando, Florida, In Proceedings of 24th International Conference on Software Engineering (ICSE) 2002, May 2002. Available at: <http://www.cs.umd.edu/projects/SoftEng/ESEG/papers/83.88.pdf>

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Experimentation in Software Engineering, University of Rome Tor Vergata and University of Sannio, Rome and Benevento, Italy, March 2002.

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Implementing the Experience Factory Concepts as a Set of Experience Bases, University of Sannio, Benevento, Italy, March 2002.

Implementing the CeBASE Method on the Future Combat Systems (FCS) Program (with B. Boehm), Software Technology Conference, Salt Lake City, Utah, April 2002.

"Replicating Software Engineering Experiments: Addressing the Tacit Knowledge Problem," Presentation at the 1st International Symposium on Empirical Software Engineering (ISESE), Nara, Japan. October 2002. (Winner of Best Paper award.)

Dangle, K:
Bechtold, R., Dangle, K., Larsen, P.
"CMMI Process Performance Indicators for Small Businesses," 14th Software Engineering Process Group Conference (SEPG 2002), Phoenix, AZ, USA, February 18 - 20

"Lessons Learned Implementing CMM in an ISO-Compliant Organization," International Conference on Software Process Improvement, University of Maryland, College Park, MD, USA, November 18 - 21

Rus, I.:
"Challenges in Managing Knowledge in Software Engineering; Two case studies," Presentation at IESE, Kaiserslautern, Germany, October 2002

Shull, F.:
"eWorkshops: Testing Defect Reduction Heuristics against Expert Knowledge," Invited presentation at the 17th International Forum on COCOMO and Software Cost Modeling, Los Angeles, CA, October 2002.

"Reading Techniques for Improved Software Inspections: Research and Practice," Guest lecture in course, "CSCI577a: Software Engineering I." University of Southern California, Los Angeles, CA, October 2002.

"Replicating Software Engineering Experiments: Addressing the Tacit Knowledge Problem," Presentation at the 1st International Symposium on Empirical Software Engineering (ISESE), Nara, Japan, October 2002. (Winner of Best Paper award.)

"Empirical Studies of Agile Processes," session led at meeting of the International Software Engineering Research Network, Nara, Japan. October 2002.

"Overview of Empirical Findings on Agile Development: eWorkshop Results," Presentation at meeting of the International Software Engineering Research Network, Nara, Japan, October 2002.

"Software Inspections," Training course given at the NASA Langley Research Center, Hampton, VA, USA, September 2002.

"State-of-the-Art Software Inspections at NASA," Presentation at the 2nd Annual NASA Office of Safety and Mission Assurance Software Assurance Symposium, Berkeley Springs, WV, USA, September 2002.

"An Empirical Method for Introducing Software Processes," Presentation at the Seminar on Empirical Software Engineering, at the Simula Research Lab in Oslo, Norway, August 2002.

"An Approach for Improved Software Inspections," Presentation at the Seminar on Empirical Software Engineering, at the Simula Research Lab in Oslo, Norway, August 2002.

"Dependable Software: Technology Evaluation and Transitioning at NASA," Presentation at the Seminar on Empirical Software Engineering, at the Simula Research Lab in Oslo, Norway, August 2002.

"What We Have Learned about Fighting Defects," Workshop led at 8th IEEE International Metrics Symposium, Ottawa, Canada, June 2002.

"Lessons Learned about Software Inspections at NASA Centers," Presentation at the joint JPL/GSFC Quality Mission Software Workshop, Dana Point, CA, May 2002.

"Report on the Agile Methodologies

eWorkshop," Presentation at the Software Engineering Consortium meeting in Ulm, Germany, April 2002.

"Improving Software Inspections by Using Reading Techniques," Tutorial at the University of Sao Paulo at Sao Carlos, Sao Paulo state, Brazil, January 2002.

"An Approach for Improved Software Inspections," Presentation at the University of Sao Paulo at Sao Carlos, Sao Paulo state, Brazil, January 2002.

Zelkowitz, M. V.:

"25 years of software process improvement: The NASA SEL," Portland State University, Portland OR, February, 2002

"Skepticism: The prequel," N.C.A.S. 2002 Workshop: Beyond the basics, Harpers Ferry WV, April 2002

"Non-technical issues in software process improvement," Inter-Profit Seminar on Empirical Software Engineering, Oslo, Norway, August 2002.

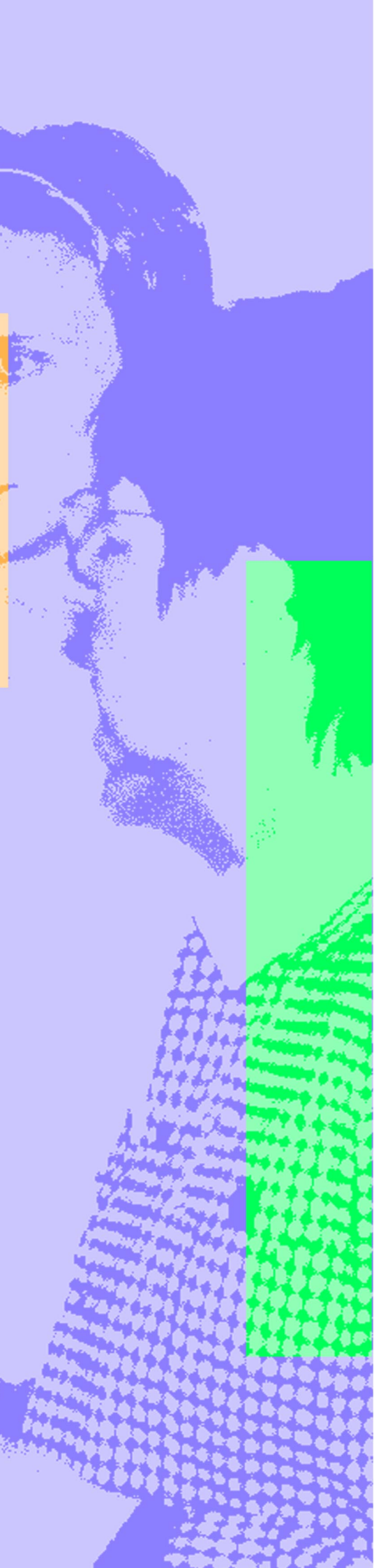


Contact



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Fraunhofer VIESE Locations

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How to reach us:

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

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

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

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

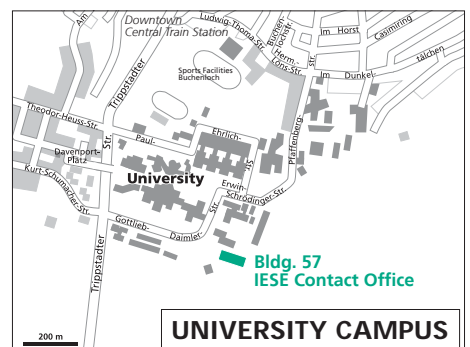
By train
 Take bus no. 2, 5, or 7 from Kaiserslautern rail-way station to *Schillerplatz* stop, change into bus no. 4, exit at PRE-Park stop. Attention: Not every bus stops at PRE-Park!
 Total time: approx. 30 minutes

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.



**Fraunhofer USA Center for
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University of Maryland
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Phone (301) 403-2705
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E-Mail info@fc-md.umd.edu

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.

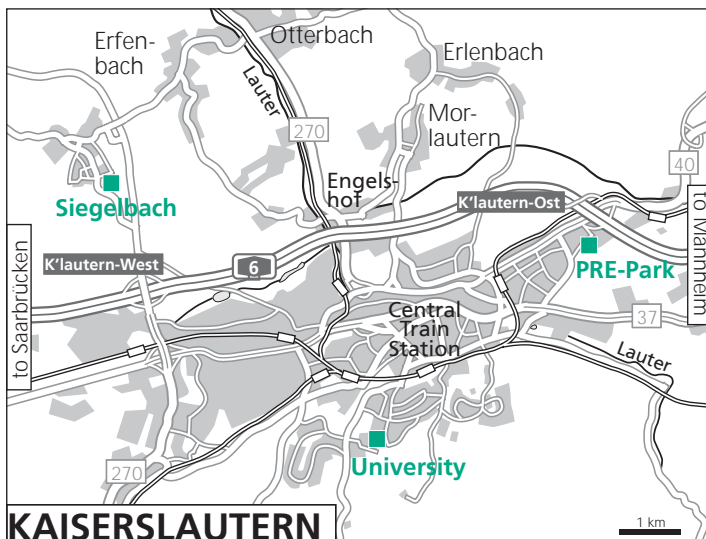
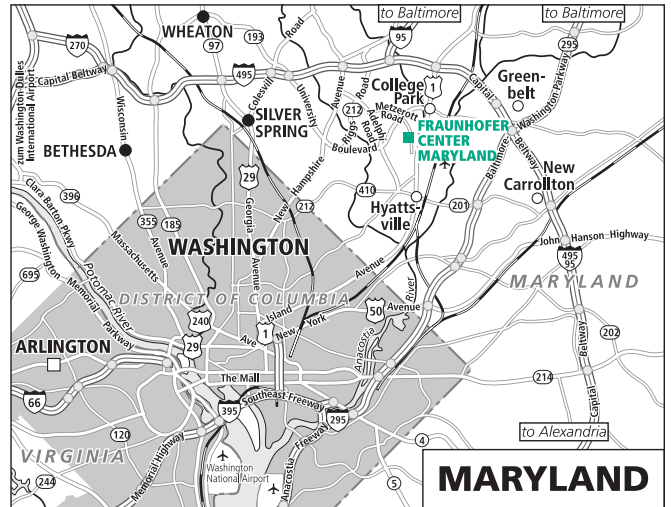
By plane
B.W.I. airport (about 45 minutes by car)
Exit the airport on I-195 (main road out of airport). In a few miles, take I-95 South towards Washington. From this point, follow directions from Points North.

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.



Fraunhofer IESE Contact Persons

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If you want to receive further
information, please send or fax us
a copy of this page.

Fax +49 (0) 6301 707 200



Further Information

- | | |
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A pdf-file of the IESE Annual Report 2002 can also be downloaded at
www.iese.fraunhofer.de

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Return Address

Title

Last Name, First Name

Company

Position

Department

Address

Zip Code / City

Telephone

Fax

E-Mail

Date and Signature