ISST

Fraunhofer Institut Software- und Systemtechnik

# Annual Report 2002

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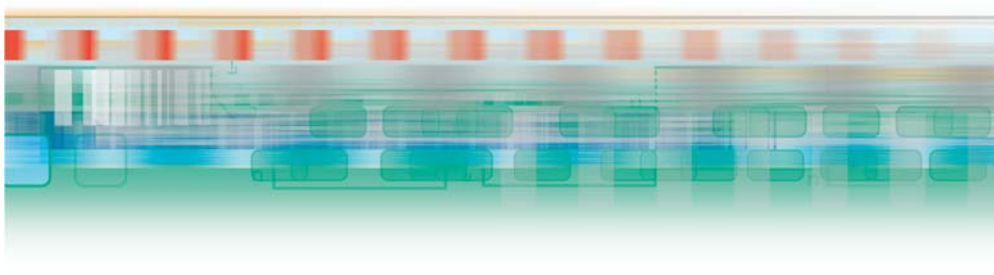


Fraunhofer Institute for
Software and Systems Engineering ISST

# IT put to the Test: Challenges for Applied Research

Ladies and Gentlemen,
Esteemed business partners and friends,

Information Technology – IT – once upon a time the crown jewel and hope for the future of every local or national business community has fallen into disrepute. This state of affairs is justified in a sense because some sectors of the IT business are, in fact, unsound. The far greater part of the industry, however, has fallen victim to backbiting and bad press. Unfortunately, the shrillness with which the IT industry has bemoaned its fate has, to a degree, provided fuel for the detractors, since – in comparison with other branches of the economy – IT's performance level has remained relatively high. Bitcom reports that for 2002, the industry expects to witness the first negative growth rate – minus 1.3 percent – in its history. Given the realignments in the market after the crash of the "New Economy", this is actually rather marginal.

Nonetheless, the economic stagnation in IT remains closely related to developments on the stock market, particularly on the German "Neuer Markt" and New York's NASDAQ. The unreliability of this barometer, however, is gradually becoming clearer, as we see rock-solid enterprises being thrown into a tailspin for no rational reason whatsoever.

The business climate, furthermore, appears frozen in the wake of the crash of the "New Economy" and the crises in the telecommunications and financial management industries. One cannot avoid the impression that Germany's business leaders are doing nothing in terms of innovation or investment to resuscitate economic activity: all appear to be waiting for an upswing in the USA to induce a resurgence in Europe.

This "pause for thought", however, cannot solely be attributed to economic hard times. Steadily ris-

ing expenditures for IT have also given rise to reflection. Many managers are now publicly questioning whether the advantages accrued via IT have been commensurate with what so far have been deemed acceptable costs, and whether IT in general has actually earned the trust and confidence placed in it. The aftermath has been a virtual halt to IT's economic expansion, a pointed re-evaluation of its capabilities, and postponement of investments in new applications and systems. To lower costs, even big firms are outsourcing their IT needs, and following mergers and acquisitions, aged IT solutions are being renovated and dead weight eliminated for greater cost effectiveness.

## The Woes of the IT Economy

With the relatively new problems in the world of information, communications and media, a much graver issue has been relegated to the back burner: though well established after thirty years, the information and communications economy has lost its vitality and is suffering from the process of emaciation. Among the symptoms:

- Many of the systems developed and put in place over the last three decades are now technologically outdated.
- The generation of founders of many small and middle-sized firms that entered the market in the seventies and eighties years has grown older and no longer has the vigor to re-energize their businesses.
- Small and middle-sized information and communications companies have been chronically undercapitalized and cannot finance the necessary updating of their products. Profits from service contracts have generally not been sufficient to permit them to reorient their business in light of new market conditions.
- Most small and middle-sized enterprises achieve an annual sales-per-employee ratio that lies below the cost-effectiveness limit of € 75.000 per employee per year. This makes almost any investment in the firm's future next to impossible.
- Despite the foregoing, the "shake out" through mergers and takeovers that might have been expected has generally not materialized. This is because the business ties many companies have managed to establish and cultivate over the years have made their continued existence possible and even indispensable from the viewpoint of their clients: stated simply, the "service firms" know their customers' systems and related requirements better than the client firms themselves.

## The Sorrows of IT Users

In many areas of business, information and communication infrastructures have undergone a process of evolution over a period of ten, twenty or even thirty years. They consist of hundreds of software systems and databases whose maintenance and development present ever-increasing interface problems and incur ever-rising costs. To right things, in many cases a comprehensive corporate IT overhaul would be required. This would mean, inter alia, the introduction of as many industry-standard architectures and interfaces as possible, reducing or eliminating redundant data, and increasing infrastructure flexibility by making provision for further change.

Where software is a component of technical products, as well as for the products themselves, product lines must be developed in which the maximum amount of custom-tailored software can be reused in future product generations.

In cases where software systems of different manufacturers are combined in information and communications infrastructures, new releases, variants and versions must be customized and configured so that they function without requiring a complete infrastructure update.

These are only a few of the scenarios that confront operators of information and communication infrastructures, whose systematic and economic development in the described scenarios can not yet be supported using proven Best Practices. For the development of information and communication infrastructures, classical procedures alone are no longer adequate.

The technologies becoming increasingly necessary for the continuous engineering of infrastructures can be characterized as systems whose further development is relatively simple and straightforward. This will enable new user requirements or operational demands to be met with minimal complication and expenditure. Furthermore, incoming systems must be compatible with those already in place so that originally standalone applications can evolve into integrated ones.

The bad news is that all this cannot be achieved without considerable investment, and this investment can only be judged as having been justified once profitability is demonstrated. As a result, IT customers have come to expect extensive, in-depth explanations regarding the logic behind proposed investments and services for their specific business activity. They expect rational and objective procedures to help them determine the "asset value" of IT, as well as for the purpose of benchmarking.

## The Test Bed

In order to meet this demand, in the year gone by, the Fraunhofer ISST placed particular emphasis on the development of appropriate assessment procedures designed to assist clients in:

- evaluating products and services offered in the market as well as the actual capabilities of the firm offering them
- establishing the creditworthiness of an enterprise prior to the granting of credit by financial institutions
- appraising an enterprise in the context of eventual capital participation or takeover;
- assessing the performance capabilities of a firm prior to partnership in a bidding consortium
- assessing the performance capabilities of a firm in the context of eventual global sourcing for software and software services

The assessment procedures comprise components that:

- appraise products with regard to their functionality, market potential, market value, technical quality, and the support for their maintenance care and development
- assess services both from the "front-end" and "back-end" perspectives, their market, market value, technical quality, and their availability
- evaluate specialist staff involved in product development and service with reference to their training, relevant experience, capabilities and skills, and job performance
- appraise the existing information and communication infrastructures with regard to the equipment, software, tools and communication concepts being considered for deployment
- evaluate managerial competence with regard to company procedures, relevant experience,

and experience in the management of projects of various sizes
- appraise corporate management, customer support, and customer service with a focus on the various service levels and quality-of-services
- scrutinize the corporate profile, market position, economic situation and overall stability

These investigations produce quantitative evidence as well as a quantified overall assessment. If practical considerations permit only a partial investigation, a commensurately partial quantified assessment is provided to the client.

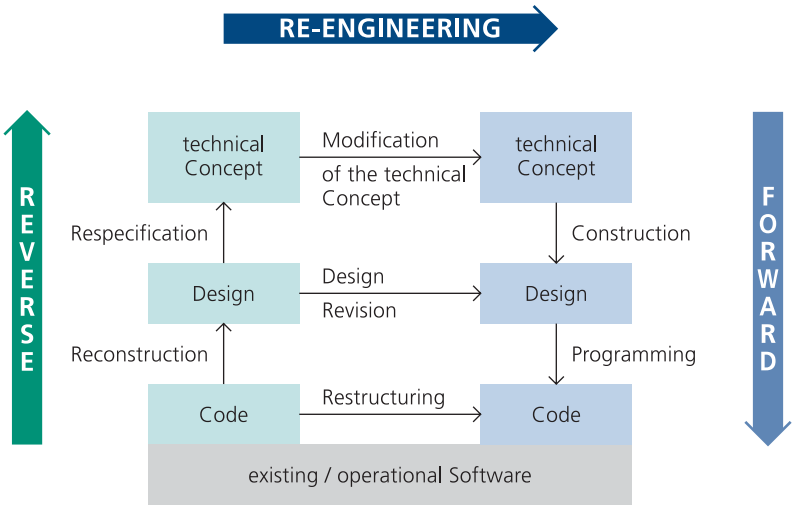
Analysis and evaluation, however, are only one of the two facets of the required reorientation. They must be accompanied by earnest efforts toward the improvement of the existing situation. Toward this end, in the last few years, the Fraunhofer ISST and partner firms in financial management and the automotive industry have demonstrated innovative approaches in the project "Continuous Software Engineering" (CSE).

## Improvement in the Future: Continuous Engineering

The major portion of IT allocations comprises expenditures for software, including development, acquisition, customization, extension, as well as support and maintenance. In Germany and Europe in particular, where secondary IT (the utilization of IT) predominates, these software outlays play a central role, yet in contrast to those for hardware and other equipment, they generally defy systematic cost monitoring. In this particular area, modern software engineering is required to address local needs and provide solutions. Software engineering is expected to provide a system for the analysis and evaluation of existing infrastructures, as well as for their further development, the goal being the optimal protection of the client's investment. Its most modern form should also make engineering procedures available with which flexible software systems can be developed whose evolution will allow continuing advancement over the course of multiple product generations. Finally, clients expect that knowledge acquired from software solutions will continue to offer them benefits over an extended period of time.

Continuous engineering is an engineering-based approach to computer science that lies at the juncture between basic and applied research. Its motivation stems from the demands of economic development and ever-more-complex information and communications infrastructures in business, both of whose concomitant problems are manifold and profound. These problems demand new fundamental considerations and the associated basic research, but they also call for practical and sometimes quick-fix solutions based on applied research or technology transfer. The Fraunhofer ISST has introduced Continuous Software Engineering as a new paradigm and has chosen it as a main focus of endeavor. The institute is currently conducting both research and ongoing projects with partners in financial management and the automotive industry.

The results of both the redesign work currently being undertaken and new developments must be of long-lasting economic value and remain fully functional and reliable in the changed and changing environment that will exist in twenty or thirty years. This calls for virtually visionary powers, both in regard to what's coming as well as to the steps that need to be taken today. Further required is an almost inconceivable extension of the planning horizon that prevails in contemporary economical and political life, similar to the




typical planning horizon – encompassing several decades – that establishes a timeframe for today's technology development. Though forgoing this type of long-range planning has been tolerable up till now, it will be absolutely unacceptable in the imminent period of change.

Classical procedures of software engineering alone are no longer adequate for the realization and further development of information and communications infrastructures. Technologies that are becoming necessary for the development and advancement of infrastructures can be characterized as follows:

1 Systems must be designed for easy enhancement to accommodate new users or meet new demands with minimal effort.
2 Existing systems must be made capable of being joined to new systems so that initially standalone solutions can be evolved into integrated ones.
3 Replacing components from existing systems with new, improved ones should be as simple as possible so that the redesign of a system can be accomplished in steps, and the migration of an old system to a new equivalent can occur in a controlled fashion.
4 The porting of a system from one standard platform to another should be as hassle-free as possible.
5 The reuse of existing systems and components for the construction of other systems should be achievable without significant expenditure.
6 The modification of some components or subsystems of a software infrastructure should have no effect on the other parts. That is, their functioning should remain unaffected with respect to the changed components.

Continuous Software Engineering can be particularly well served by putting evolutionary principles into practice. When this is done, it is possible to

establish how new components can be embedded into existing systems, how independent systems can be integrated, and how existing systems can be conjoined to create more powerful systems through design.

The ultimate goal of this endeavor is the establishment of an instructional paradigm for the design of information and communications infrastructures.

The development of fundamental principles for the evolution of information and communications infrastructures has led to continuous engineering being viewed as the most suitable approach to producing the solutions these infrastructures require (Figure left).

This approach can be broadly outlined as comprising cycles of analysis (reverse engineering), adaptation (re-engineering) and further development (forward engineering), which actually provides the definition of continuous engineering.

The Fraunhofer ISST is developing concepts, methodologies and theories in the realm of Continuous Software Engineering. Furthermore, we support our business partners – primarily in financial management and the automotive industry – in the implementation and use of our output. Among the factors that have prompted us to focus our efforts in this direction are the renewal and amalgamation of information and communications infrastructures in the context of corporate mergers and takeovers. Yet another is the increasing frequency with which firms are either outsourcing their IT activities or creating independent subsidiaries to handle them. A third stimulus has been the development of embedded information and communications infrastructures in long-term product lines for on-board-systems in cars.

Taking these to be accurate indicators of ongoing and future trends, we assume that the solutions they require will provide a fertile field for progress during the second decade of the Fraunhofer ISST's existence. We are convinced that our approach can make a positive contribution to your organization's activities and will be happy to discuss areas of mutual interest and possible cooperation.

Yours sincerely,

Prof. Dr. Herbert Weber,
Director of the Fraunhofer Institute for
Software and Systems Engineering ISST

## Software in Automobiles

Anyone interested in cars cannot fail to have noticed the virtual explosion in the proportion of electronic equipment in them over the past few years. The cost for electric and electronic components is between twenty and thirty percent in a modern, average-sized passenger vehicle, and this figure easily reaches a third or more in luxury cars. Broadly speaking, there are four main areas of application:

- Today, the drivetrain of every new vehicle worldwide, including the engine and transmission, is equipped with electronic master controllers in order to optimize fuel consumption and reduce emissions.
- The large field of passenger-comfort electronics (windows, seats, mirrors, air conditioning, etc.) comprises countless actuators in all size classes that are increasingly being produced using economical mechatronic solutions.
- Vehicle safety has improved dramatically due to passive devices such as airbags and active ones like ABS and dynamic stabilizing systems (EPS). Radar, video, and laser remote sensing units of the future are already being worked on for deployment in "smart cars" that will be able to intervene proactively to help prevent accidents.
- Infotainment electronics provide for entertainment, communication and information. In addition to radio, CD and TV, this field also encompasses navigation, telematics and, to a degree, connection to the Internet.

As a result of the overwhelming success of electronics, the development tasks of the auto industry and its suppliers have changed. The increasing demand for electronics is accompanied by a similar demand in increase for software, and this, in turn, has upped the quality requirements for software drastically. Many of the systems in question are critical for vehicle safety, and even where they aren't – for example in the infotainment area – consumers have come to expect bug-free, straightforward performance, an expectation, by the way, to which they are certainly entitled.

Thus the automotive industry has suddenly become a branch of the software industry and runs the risk of falling into a software crisis much like that confronting the computer and telecommunications businesses.

The fact that we are primarily talking here about embedded software means that its development must be supported by specialized know-how: for example, knowledge of combustion engines. Moreover, this endeavor is taking place in the context of a mechanical engineering firm, not in the sterile environment of a process-optimized software factory. This has led to the unfortunate situation that a migration gap still exists between on-campus computer science research and its application in industry, a consequence of which is that the specific needs of enterprises, many of which are long-established, tried-and-true organizational forms and process that are the essence of the organizational culture, are all too often neglected in the exploration for new technological concepts. I am pleased by the Fraunhofer ISST's dedication to making technological development conform to individual requirements. Flexible, highly adaptable technologies are selected, and the migration pipeline guarantees the constant flow of feedback

between scientific inquiry and the application of research results in ongoing projects.

Computer science research in Germany is vigorous. Measured against the dominance of American trends in the public awareness, German potential is underestimated, but success in creating the necessary symbiosis between computer science know-how and mechanical engineering in the embedded systems sector would offer Germany an unique opportunity to capture the pole position in this field of the future.

Nowadays, automobile electronics systems can no longer be seen as isolated solutions for individual tasks. What we are actually talking about is a complex networked system whose individual applications and communications software have fused over the years into a complex information and communications infrastructure. This means that new developments in the field do not start from scratch, but rather are extensions or continuations of existing work, even when substantial modification is required, and the methods used must take this into account. In view of this, the ISST relies on model-driven software development processes, which help reduce the complexity of IT infrastructures. This involves component-based system models and technologies with application-specific architectures, which guarantee the necessary flexibility. Maintenance and the systematic use of proven solutions (assets) are supported throughout the development of the product line, and it is here that the platform idea from the automotive industry is carried over into software production. Through the configuration of available components and their integration into the platform, a great number of variants can be rapidly, economically and reliably produced, and in doing so, the content of software engineering is shifted from software construction to the engineering task of developing long-lived structures with reusable components.

The training of computer scientists at German universities is primarily oriented toward disciplines and topics that regard the field from an overwhelmingly theoretical point of view. This is positive in that they acquire a firm foundation in all of the basic knowledge and skill requirements of the field, but the specialized information to which young graduates are generally exposed is rarely accompanied by knowledge of the actual requirements of industry. In this area, as an intermediary between universities and industry, the ISST has taken on the vital task of developing and implementing new education and training concepts. Project experience using new technologies in industry engenders a reorientation that can lead to a paradigm change both in applied research and what can be called "applied training". The consistent development of process-oriented learning fixes content knowledge firmly to roles that are anchored in the operating processes of Continuous Software Engineering in the sense of the development of IT infrastructures. New processes involve new tasks, responsibilities, and qualifications that are combined within the contents of specific roles. This makes it possible for the Fraunhofer ISST to create and combine modules that guarantee state-of-the-art practical training, thus addressing the needs of all: the future computer scientists, the universities, and industry.

This last point was critical in our decision to choose Berlin as the location for our newly founded subsidiary, Carmeq GmbH, which will specialize in the development of software for automobiles. The Fraunhofer ISST will surely be an important partner in this endeavor.

Dr. Karl-Thomas Neumann,
Director of Electric/Electronics Development
Volkswagen AG

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# Paradigm Change in Applied Research

# Paradigm Change in Applied Research – from General to Role-Specific Methodology

Today, it is absolutely necessary for enterprises in the secondary IT industry – IT users – to cater to the individualized demands of their clients. These include the greatest possible functionality, precise suitability and integration of products, as well as quick adaptation to technical innovation. Within the framework of its continuous engineering activities, the Fraunhofer ISST is developing methods to meet these challenges in the automotive industry, financial services sector and enterprise communications. Taking the automotive industry as an example, the following sections describe first the status quo. They then go on to introduce the steps being taken toward developing methods to meet the challenges facing manufacturers. Among them:

- The increase in vehicle functionality is burgeoning. Innovations such as onboard navigation and infotainment, initially viewed as extras, are rapidly becoming standard equipment for virtually all manufacturers. This means that having the right equipment available at the right time can increase a firm's competitive advantage significantly.
- Customers expect to be able to personalize the equipment of any new vehicle they purchase, and every model offers a myriad of variations.
- Functions that once upon a time were carried out in isolation are becoming increasingly rare. For example, many new-car buyers are no longer willing to have to punch an address from their PDA into their onboard navigation system manually; simply calling up the name in the handheld should be enough to elicit the relevant information. Similarly, the onboard computer's detecting a significant difference in the pressure of one of the tires should be enough to trigger the display of the way to the nearest service station.
- Customers are demanding quicker reaction to technological innovation: it has to be possible to install the latest telecommunications equipment in their current vehicle, since the innovation cycle of cell phones and related equipment is shorter than that of cars.

In order for expensive IT infrastructure to achieve long life in this dynamic environment, it has to be built up with an eye toward evolution. Since its inception, the Fraunhofer ISST has applied the concepts of continuous engineering in the development of methodologies that conform to engineering standards for software and systems technologies, as well as corporate organization. This approach takes the constant adaptation of the IT infrastructure into consideration, thus guaranteeing that it is evolvable.

Continuous engineering encompasses description methods for the creation of models, precise instructions for working with them, and tools that support modeling: notations, methods, and tools or NMT for short. Two essential factors in the successful introduction of new methodologies in an enterprise were frequently underestimated in the past: precise suitability of descriptive materials and exact methodic instructions. As a rule, enterprises seek systematic support for a specific task in their development process, when, for example the task can no longer be managed because it has become overly complex. The employees to whom the task is assigned usually find themselves with an increased workload and the concomitant stress. It becomes hard to convince them to implement a methodology involving new procedures today – one that is the product of modeling technology – which promises to help solve their problem in the future. In this situation, it is also usually difficult to get the benefits of the diverse uses of a description method across to them. Thus modeling instructions are sought that make it possible for the employees to utilize their creativity for the

task at hand, rather than expending time and energy dealing with the description method.

The Fraunhofer ISST, therefore, adapts continuous engineering methodologies to the specific circumstances of the firm, first analyzing the situation in detail, then mapping out a methodology, and finally testing it "on the job" before its implementation. If required, a partner firm created by the Fraunhofer ISST can provide additional consultancy services to support the implementation process. Description methods, methodologies and tools developed at universities, research institutes, or acquired from commercial providers form the foundation of the adaptation approach. Many NMTs have already proven their value in other scenarios in professional environments. The methodologies developed extend far beyond the classical terrain of software technology. Methods of analysis, specification, design, implementation, and quality assurance affect, in addition to software products, products that combine hardware and software (embedded software), systems in which several products are integrated. They also affect the organizations into which the system development and/or application is to be integrated. It should be added that the institute's goal of assisting in the transfer of innovative methodologies to the world of business is complemented by an extensive palette of electronically supported training courses and programs.

## The Role of the Fraunhofer ISST in the World of Research, Development and Consulting

There is a distinct difference between the output of the Fraunhofer ISST and that of consulting firms, universities and software companies. The methodologies developed by the institute display a strong innovative character in comparison with those of consultants, which becomes most obvious in the inventive conception of our description methods. Tools developed at universities usually have a limited range of application, and software companies generally concentrate on the development of modeling tools rather than methodologies. The Fraunhofer ISST assumes an integrator's role for its clients in dealing with the diverging offers of other providers, and in this regard the institute's work complements the providers'. For example, the institute produces development assistants that make it possible for clients to create innovative methodologies using commercial development tools not specifically designed for the client's particular purpose. One assistant of this type is a tool for the automotive industry to model networked functions. It encompasses expanded mechanisms, making it possible to cope with the broad array of equipment options alluded to previously. Also, new description methods have been developed that are mapped onto various standard description methods – such as Unified Modeling Language (UML) – in cases where the client has selected one of these as a company standard.

If a client so desires, the description method, methodologies and development assistants can become permanent features of its in-house IT environment, or, in the case of domain-specific requirements, serve as a template for new scientific concepts and developers' methods or tools in universities, consulting firms and software enterprises. In this respect, the Fraunhofer ISST not only injects innovations into client enterprises, but also escorts them from enterprises into the world of research, development, and consultancy.

## Paradigm Change in the Evolution of Methodologies

In the last few years, there has been a discernible paradigm change in the model-based development of methodologies. Whereas universal description methods, methodologies, and tools previously stood in the foreground, the trend is clearly toward increasingly distinct characteristics: domain-specific NMTs, so typical today, are being further adapted to the *roles* of the individual actors participating in the development process.

The factors behind this paradigm change can be described as follows:

### Technical Resources:

In former years, "general purpose NMTs" – whose name clearly indicates their function – were developed. Real-world practice, however, frequently revealed them as unsuitable for their designated tasks. Further evolution, aimed at increasing their precision, led to domain-specific NMTs. Another direction taken in the development of NMTs was toward improving their reusability. NMTs were created with the goal of achieving reusability based on models by means of configuration and generation. Nonetheless, a general weakness in the methodological aspect of all NMTs – resulting from the extensive range of their proposed uses – repeatedly comes to the fore: namely, this range simply is too broad to permit the description of uniform procedures in an abstract way.

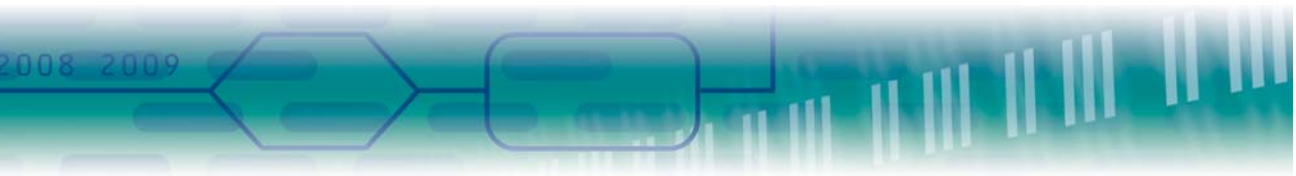
### Human Resources:

Nowadays, computer scientists and engineers are trained to use numerous NMTs, and today's graduates in the field view the combination of NMTs or their modification, e. g. the use of UML, as something taken for granted. A widespread weakness of on-campus training remains, however, the lack of knowledge of what actually happens in industry.

### The Acceptance of Modeling in the Corporate World:

To counter the trend toward complexity, individualization, and integrative capabilities, industry's acceptance of the use of model-based NMTs has increased.

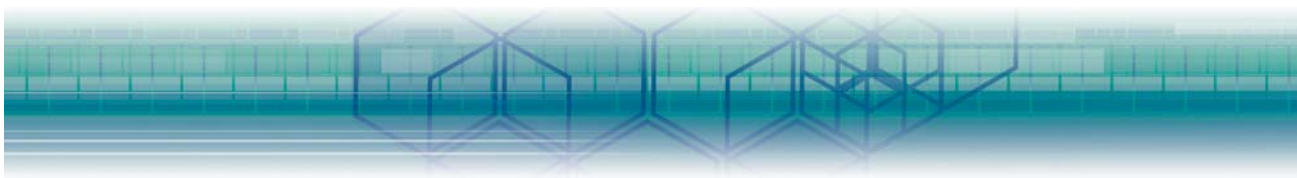
- Steadily increasing demand for functionalities has led to more complex products and systems, e. g. the monitoring of functions and their communication relationships to a master controlling mechanism is no longer possible without some form of modeling. The greater complexity of products has led to increasing difficulty in keeping an overview of the responsibilities of individual functions: forgoing methodic control leads to unclear limits of responsibility that frequently go unnoticed. Historical competences mix with responsibilities that may have been introduced ad hoc to confront the new dimension of complexity. This mixture effect is intensified in cases of restructuring or mergers.
- Customers are demanding more individualized products and systems, with the result that the development processes, the tasks and roles of the people participating in the processes, as well as the organizational structures are becoming more individualized as well. In order to safeguard the supply of investment capital as the increase of individuation progresses, resource recycling must also increase. The successful reuse of components and other development artifacts requires processing of the individual solutions on a generalized level and distinguishing between variant and invariant parts, which can only be achieved by means of modeling.



- The heightened demand for integrated products has led some firms to establish integration departments. Organizationally they oversee the interaction of the departments working on a specific product and are responsible for the interplay of the functions involved in matters of content. At the integration level, it is crucial not to get bogged down in the details of each individual function. Clear and comprehensible modeling of interfaces and an abstraction of internal details are basic requirements for the creation of this type of integration process.

At first glance, the two developments appear to be converging nicely: graduates experienced in modeling with briefcases full of model-based NMTs that include generation and configuration are heading directly toward a market with a growing appetite for modeling and reuse. The fact is, though, that model-based development processes are not being implemented to the degree that the initial situation might lead one to predict. The crossover isn't meeting expectations because:

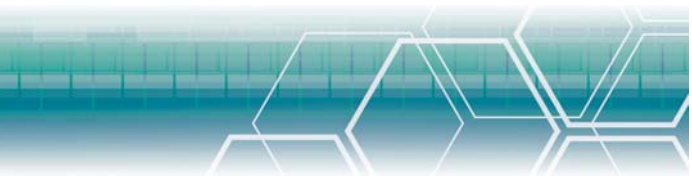
- Description methods have increasingly been developed with the goal of conceptual innovation to be able to fulfill the twin tasks of opening up new fields of research and training new generations of researchers. Because the acceptance of modeling in firms has initially been rather weak, though, a migration gap has arisen; a gap that has to be closed through the introduction of NMTs.
- Description methods usually do not adequately take into consideration the enterprise's "culture", its established rules and actual circumstances, which – despite major efforts at standardization – still have a strong influence on product development. Also, it is frequently argued that individual description methods make exchanges between enterprises impossible, but this ignores the fact that some actually formulate a mapping format for mutual exchange. More correct is the contention that a description method not adapted to the enterprise culture will render its acceptance more problematic, if not altogether impossible; stated more proactively, description methods must inevitably be adapted to the culture of the enterprise.
- Yet another obstacle to the introduction of description methods has been the lack of guidelines for their numerous uses. In fact, it is this great diversity of possible applications itself that has rendered description methods problematic for potential corporate clients, who – because of the description methods' direct integration in the manufacturing process – are clearly interested in guidelines that are as precise as possible. Thus, along with their adaptation to the client's corporate culture, detailed methodological guidelines for description methods must always be designed.
- It should be noted, however, that the diversity-of-applications problem mentioned above can be only partially remedied by means of configuration and generation, since it is virtually impossible to foresee future requirements. These, unfortunately, can pop up in an alarmingly short time span and may prove as critical to the fundamental aspects of products as their architecture. Furthermore, focusing on configuration and generation alone can require detailed adaptation or even redesign that annuls any time advantage their use might have offered. This, however, is not the case in areas where the practice is well established. A suitable strategy would therefore appear to be support for creative tasks in the development process rather than purely technical support.



- Even standard description methods have proven inadequate for the support of tools. The causes cannot be attributed to problems of the tool manufacturers alone, but rather lie within the system as a whole. Developers of NMTs have attempted to define a wide range of description methods using integrated, formal semantics, making possible their use for quality assurance, for example, by means of verification. This is an indication of how tool manufacturers specify their tools according to syntax and formal semantics. However, the demand for formal quality assurance is only a secondary reason for the acceptance of modeling. A much more attractive feature is its recognized ability to represent specific aspects of a system in a clear and unambiguous way. Thus the semantics of a description method should be more clearly defined by its application than by the demand for its integration in a variety of description methods with formal semantics. But which aspect of the system should be described? How does the role of the model in the description language relate to other models of the system? Which methodology should be used to develop the models? Which architecture should be used for the models? The description method and its semantics must be adapted to the answers to these questions. The integration of the different system components is undertaken to a large extent by the firm's employees, and support for them must come in the form of adequate and appropriate information to achieve the desired degree of integration.

The reaction of the Fraunhofer ISST to this situation has been a change in the paradigm of its development methodology. Available resources are used to bridge the gap alluded to above, and many members of the institute's staff are experienced in both the design and practical application of models. Our experts employ existing, proven NMTs as the basis for the development of enterprise-specific NMTs, and – working closely with the client – seek an approach to finding solutions that encompasses to the maximum degree possible all of the desired goals: the incorporation of innovation, recognition of the role of the client's corporate culture, the use of standard NMTs, and migration capability. Once solutions have been reached, the Fraunhofer ISST assumes the task of their migration into the client's organizational environment and all of the related descriptive, methodological, and tool-based aspects of connecting them to standard NMTs.

In this process, the reuse of well-proven artifacts and solutions is made possible for employees in creative roles through the application of concepts from domain engineering, which makes the artifacts – domain models – available. These can be abstract sections and prototypes from previous projects, such as requirements for diesel injection or the distributed function for car door locks performed by a master controller, etc. However, the connection can also be to newly conceptualized artifacts awaiting acceptance; an example might be an architecture being developed in the context of a standardization project among several firms. The artifacts and their degrees of abstraction are designed according to their specific role and then systematically linked to the development of applications within the organization. Employees involved in this process construct collections of domain models specific to their own assignments, since, for example, an individual working on an early stage of development of a function network for an automobile would have very different concerns from someone working on the partitioning of a controlling device.



In this way, the methodology maintains its role-specific features, and the argument that varying collections of domain models can lead to inconsistencies is simply invalid. On the contrary, domain models simplify application development, though in any case, the results will be subject to the firm's established approval procedures.

One result of this type of methodology development is a process description that brings together the description method, the points of view represented, and their role with respect to other description methods, architectures and systematic instructions. Yet another result is an integrated development environment using a suitable tool-based approach that links the enterprise-specific methodology to an environment of standard tools with the aid of development assistants. These development environments can have the status of research prototypes, and in this case, in conjunction with methodological descriptions, they serve as specifications for a commercial re-implementation of the development environment. The Fraunhofer ISST can also construct them as a reference implementation for use in the development process, but here the emphasis would be on functionality rather than ease of use. Upon request, a partner firm founded by the Fraunhofer ISST can provide a re-implementation or further support of the deployment of the reference implementation methodology.

One characteristic of the paradigm change under discussion is that existing NMTs are not seen as a fixed resource introduced into the enterprise, but as a variable resource custom fitted to the firm and role-specific realities in the form of projects. Another is that the methodology supports employee creativity, rather than supplanting it. The paradigm change has been made possible by the above-mentioned constellation of technical and human resources. This methodological development offers the advantage that firms do not have to look forward with anguish to development times for NMTs that last for years, but rather can expect to put NMTs in place – at least in a preliminary form – after dedicated projects of a few months' duration. The methodologies are precise, facilitating their in-situ deployment and making it easier for the enterprise to communicate its ideas for the use of models to a commercial tool manufacturer with greater precision.

The following is a more detailed look at the methodologies developed at the Fraunhofer ISST. The first section encompasses the methodological reference models, the organization of the development artifacts, and the architecture of the integrated tool environment. Following it is a description of the various directions taken by our methodologies.

## Reference Methodology

The reference methodology in fig. 1 describes the basic compatibility of the individual levels of the methodology, whose main principles include:

- Storing project and domain artifacts separately. Changes at the domain level have no direct influence on the project level and vice versa. This prevents, for example, forward-looking changes of domain artifacts from being introduced automatically into a current project, which might lead to inconsistencies.
- Having staff members select proven artifacts in a deliberate way so as to prevent degradation of the collection at the domain level through the inclusion of special or ad hoc solutions.
- Providing domain artifacts in a form and degree of abstraction that optimally supports their reuse by staff members in the preparation of new projects

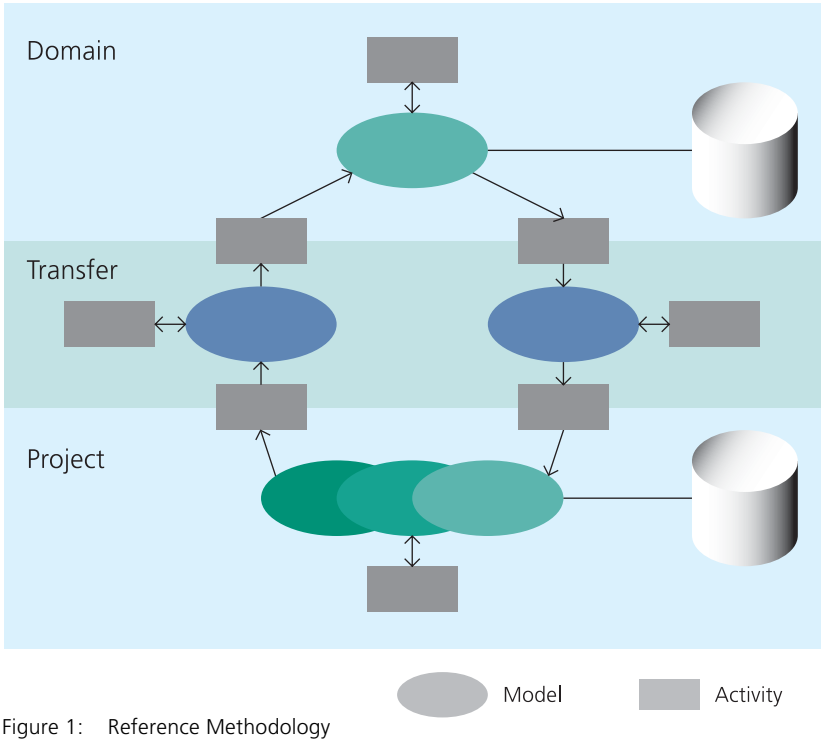



Figure 1: Reference Methodology

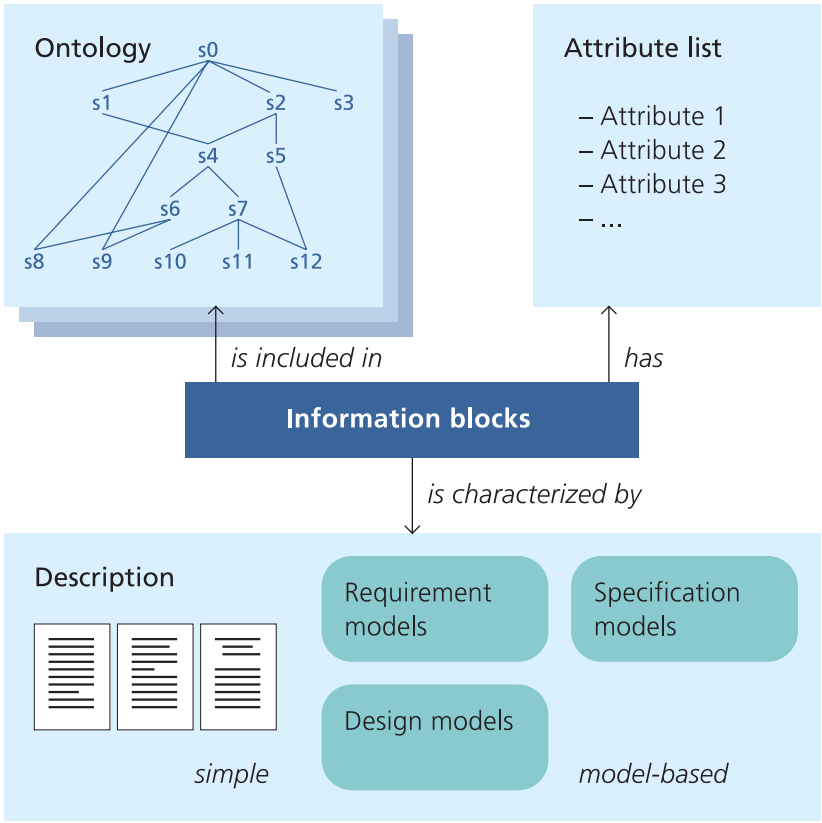



Figure 2: Reference organization for development artifacts

## Reference Organization for Development Artifacts

Figure 2 illustrates the basic organization of the storage of domain and project artifacts, termed here Information Blocks the content of the artifacts is in text form or model based, e. g. continuous text, UML diagrams, or code. The heart of the organization is the classification of the Information Blocks into ontologies. An ontology is a structured nomenclature for a specific context that structures and organizes, for example, the organizational units of an enterprise (organization ontologies), the terms of a special field (subject ontologies), or the abilities of employees (competence ontologies). An Information Block can be assigned to terms in the different ontologies when it is stored. Information Blocks are also assigned other attributes containing information not classified in ontologies, such as the creation date and version number.

Search inquiries can retrieve Information Blocks based on content information, attributes, and classification.

## Reference Architecture of the Integrated Tool Environment

Figure 3 (Page 22) shows the reference architecture of the tool environment for the methodologies developed. The methodology defines the demands on the tool environment to be developed. Commercial development tools selected by the methodology developers or provided by the enterprise are already available. Since these as a rule do not contain suitable models, the development assistants are employed to take over the mapping of the models. The tool register specifies the steps of the methodology to be connected to a particular commercial tool, as well as the development assistants to be used. The model location in repositories, which satisfies the methodology, is frequently not supported by commercial tools, and in this case the connection of the repositories is also performed using development assistants.

## The Methodologies Developed at the Fraunhofer ISST

The following briefly describes the directions taken by methodologies developed by the institute:

### Emphases

*Individual production or reuse:*
We distinguish between two types of methodology development in relation to the frequency with which artifacts are used. The methodology used in application engineering describes the procedure for constructing a product, or the procedure in a project where the requirement for individualization can encompass many product variants. The description methods employed must be in conformity with all of the processes involved in the firm's development process due to the requirement for consistency in product design. This varies from company to company. The methodology of domain engineering describes the procedure for the production of a collection of domain models and making them available for a particular role. It is matched to individuals who might potentially assume the roles, with attention paid at every step to ascertaining their most common characteristics. When possible, domain-specific methodologies

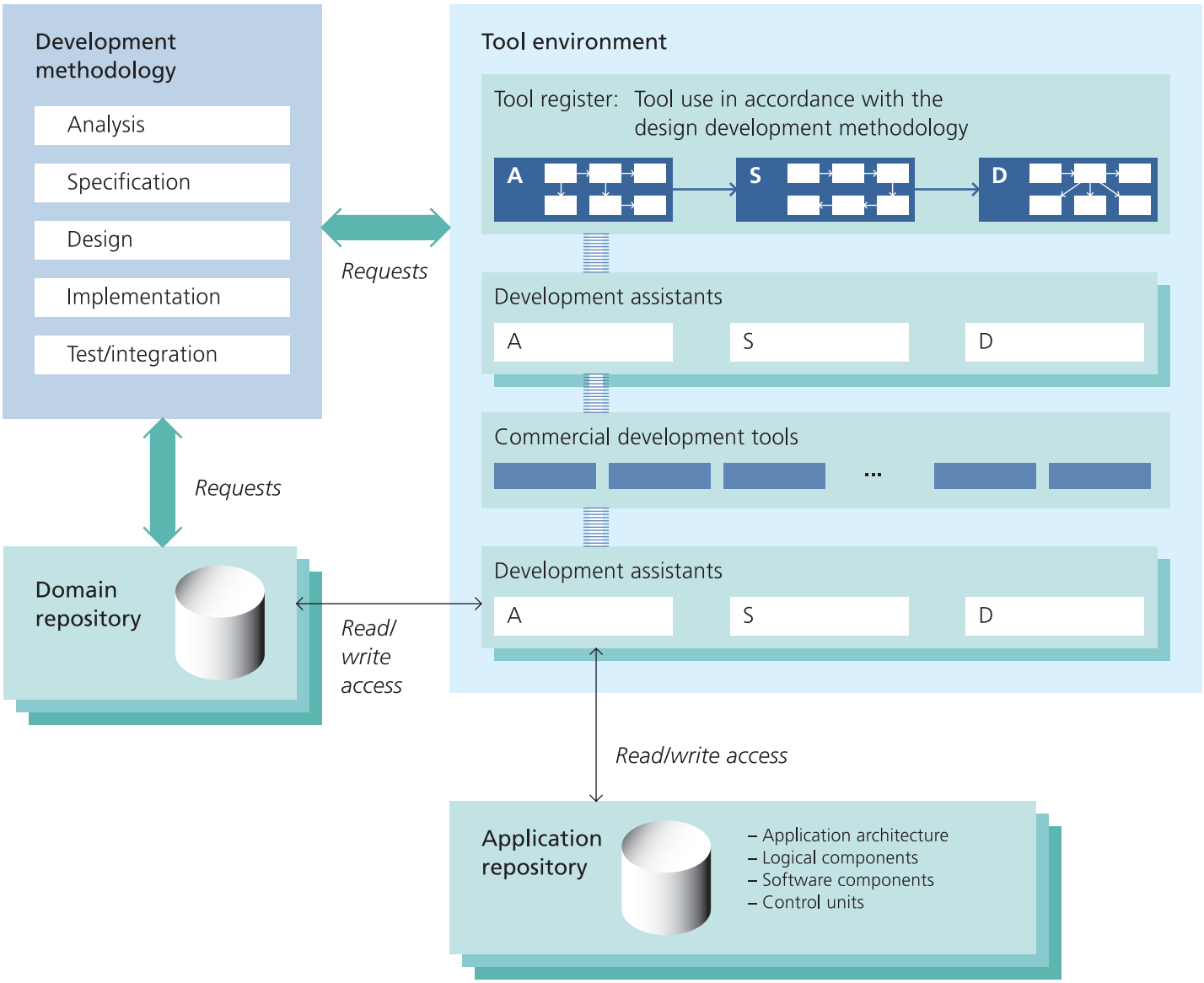



Figure 3: Reference architecture of the integrated tool environment

are employed in application engineering, whereas in domain engineering, both enterprise-specific and domain-specific methodologies are used, in which case there is usually a fusion of the two.

## Goals

*Evolution, integration and organization:*
The methodologies support three types of processes; their goals are the evolution of individual products (the classical development process), the integration of individual products in systems (the integration process), and the operation of the enterprise (the management process). These processes are intertwined, although theoretically the results of the management process provide input for the integration process, whose results, in turn, supply input for the development process. In reality, however, the processes exist in what might be imagined as a "triple helix", and interact with inevitable interdependence.

## Tasks

*Analysis, specification, design, implementation, quality assurance:*
Methodologies support the various process tasks. The central task of quality assurance is also supported in the methodologies by ensuring continuity and comprehensibility among their task-related components. By modifying the design phase, the relevant specifications orders, and implementations can be designated.

## Fields of Activity

*Automobile electronics, financial services, enterprise communication:*
The work of the Fraunhofer ISST concentrates on these three industries. The following descriptions explain the industrial sectors in which each of the departments at the institute is involved.

# The Institute

# Profile of the Institute

It is now a decade that the Fraunhofer Institute for Software and Systems Engineering ISST has been involved in the process of strengthening computer science research in the Fraunhofer-Gesellschaft's Department of Information and Communication Technology. The institute's two branches – in Berlin and Dortmund – have also participated in numerous regional initiatives in Berlin-Brandenburg and North Rhine-Westphalia respectively.

Master Projects:

- Information Logistics, whose goal is providing individuals with information appropriate to their needs
- Continuous Engineering, which deals with long-lived, evolution-capable software systems and
- eTeaching & eLearning, focusing on Workflow-Embedded Training and Teachware on Demand.

The Fraunhofer ISST provides consultant services for companies and public institutions in regard to the design, implementation, deployment and operation of long-lived IT infrastructures and specializes in eBusiness Services, Business Communication, Mobile Computing Solutions and Technical Systems Management.

The ISST scientists possess well-founded competences cultivated both at the desk and in the institute's various application laboratories: Security Management, Software Engineering, Integration Management, Coordination Management, Learning Technology, Information Management, Dependable Technical Systems, IT for Medical Facilities and Technical Due Diligence.

In this environment, they develop visions, strategies and concepts and also implement systems, as well as support the introduction and operations of solutions, all of which renders them qualified partners in any and every phase of computer-related projects.

## The Institute's Personnel

At the end of the year under review, the Fraunhofer ISST had a total of 180 employees.

The majority of our professional staff hold university degrees in Computer Science or Information Management, with others having degrees in Physics, Mathematics, Engineering, Business Administration or Commerce. All, though, have a Computer Science emphasis in their professional experience.

## The Institute's Equipment

At both ISST branches, high-performance hardware and software tools and environments are in place to promote the development of software for heterogeneous systems, information management and multimedia communication.

Many ISST projects involve intensive collaboration among team members at both facilities and a wide range of equipment, including the World Wide Web, BSCW (Basic Support Facility for Cooperative Work) and video conferencing, is used to insure their unhindered headway.

### Equipment at the Berlin Branch

The Berlin site comprises approximately 4200 square meters of office space, encompassing state-of-the-art demonstration centers, computer labs and conference rooms.

The sleek IT infrastructure consists of a heterogeneous network with a multi-tier architecture for Internet, Intranet and multimedia applications. Cost-efficient operation is assured by a centralized Intranet-based system.

Our LAN is based upon structured cabling that comprises 300-MHz-capable twisted-pair cables, as well as fiber-to-the-desk connections to every workplace. In the wiring center every connection leads to an individual switch port.

The switches for ATM and Ethernet (10/100/1000BaseT) enable the automatic allocation of each individual device to various virtual networks (emulated LANs). Individual VLANs are connected to each other through the layer 3 functionality of the switches, enabling the establishment of test networks using appropriate access control lists. The TCP/IP Internet standard serves as the network protocol.

For wide-area connections, in addition to ISDN data interfaces, there is also a 35 MBit serial Ethernet connection to UUNet and a gigabit Ethernet connection to the Berlin-based scientific network BRAIN. A connection for access to the broadband scientific network B-WIN of the Association for the Promotion of a German Research Network (DFN) is also available. Using these connections to the Internet, services such as e-mail, data transfer, and remote access to other computers and information services are provided at Internet standard. The requisite high processing speed is achieved via multiprocessor RISC-based Unix systems (UltraSPARC, PowerPC) and both Windows 2000 and Linux servers.

A high-performance data server (SUN File Server) supports Unix and Windows systems with the high degree of availability needed for the rapid retrieval of large volumes of data. Network computers, Unix workstations (SUN, IBM, HP) and a number of personal computers equipped for audio and video applications serve as the individual workstations. Mobile computing is also used. Integration into the network means that every individual workstation offers an identical working environment, providing access to all resources, multimedia information and communications systems. Various video conferencing systems for Internet or ISDN connections support collaboration between Berlin and Dortmund, as well as the coordination with external project partners.

### Equipment at the Dortmund Branch

The Dortmund site covers 2700 square meters of office space, computer pools and laboratories and numerous meeting and conference rooms.

The IT infrastructure is similar to Berlin's heterogeneous client/server network, but in addition, all workspaces are integrated into a 100 mb/sec Fast-Ethernet and 1000 mb/sec Gigabit-Ethernet LAN whose structuring involves several switches. Virtual LANs are implemented via a layer-3 module (router) in each switch; these are recognized by all switches. With this functionality, the

rapidly changing demands of departments and project groups are met. Internet access to facilitate data exchange for guests is provided by a secure 11 MBit wireless LAN situated in the Dortmund seminar facility that also uses the TCP/IP protocol.

Wide-area contacts are made possible by a permanent 2-Mbit-connection that uses a firewall to control IP traffic. This enables Internet connections like those in Berlin. Here, too, the demands for high processing speed are met via multiprocessor RISC-based Unix systems (UltraSPARC, PowerPC) on Windows 2000 and Linux servers using both Intel and AMD processors.

Various system platforms, including Solaris 2.x, AIX, Linux, Windows NT and Windows 9x, are available to employees for software development. Two high-performance central file servers that permit access from all platforms using NFS and CIFS function as data servers. They are supported by servers for central applications and backups for both Unix and Windows platforms.

## Budget and Financing

In fiscal year 2002, institute costs amounted to approximately € 12 million, an increase of 42 percent over the previous year. Personnel costs accounted for 45 percent of the total, with the rest allocated to materials and third-party subcontracts. The sharp increase in material expenditures – around 89 percent above FY 2001 – can be attributed to a significant increase in outsourcing.

Revenues from contract work for industry and public institutions amounted to € 10 million. A closer look at the figures reveals a considerable increase in income from public sector tasks and a reduction in industrial projects.

Investment volume in 2002 remained steady at about half a million euro.

Table 1: Expenses

| | 2002 in thousand € | Percentage | 2001 in thousand € | Increase |
|---|---|---|---|---|
| Personnel costs | 5445 | 45% | 4 784 | 14% |
| Non-operating costs | 1020 | 8% | 787 | 30% |
| Material costs | 5648 | 47% | 2 982 | 89% |
| **Operating expenses** | **12113** | | **8 553** | **42%** |

Table 2: Financing

| | 2002 in thousand € | Percentage | 2001 in thousand € | Increase |
|---|---|---|---|---|
| Business/Industry | 3420 | 28% | 2 420 | 41% |
| Public administration/other | 6928 | 57% | 4 556 | 52% |
| Basic financing | 1765 | 15% | 1 577 | 12% |
| **Financing** | **12113** | | **8 553** | **42%** |

# Our Locations

**The institute has branches in Berlin and Dortmund, and the distribution of the various tasks of the numerous joint R&D projects is standard operating procedure. Although the areas of operation at both sites are identical, each has its own key areas of professional activity.**

## The Berlin Branch

The Berlin branch is on Mollstraße, near the famous Alexanderplatz in the central Berlin district that bears the appropriate name Mitte (Middle). Its four divisions are Security Management, Software Engineering, Dependable Systems, and IT Qualification (the Learning Technology Department). There are two Application Labs that deal with Technical Due Diligence for IT projects and enterprises, and the major project Telematics Platform for a Medical Research Network for Health Research at the German Ministry of Education and Research (Application Lab "IT for Medical Facilities").

Research emphases in Berlin, our Master Projects, are Continuous Software Engineering (CSE) and eTeaching & eLearning. The former develops concepts and methodologies to design complex software systems that are long-lived and evolution-capable, primarily for applications in financial management and automobile electronics. The latter focuses on new curricula for further education in IT and innovative learning forms that give priority to the close integration of learning and work as well as individually adaptable instructional media.

The Berlin facility is also involved in many regional initiatives in Berlin and the neighboring federal state of Brandenburg, including the "XML initiative Berlin-Brandenburg (XIBB)" and the Competence Center for Electronic Business Communication, known as "eCOMM". In the latter, the Chamber of Commerce and Industry, the Chambers of Handicrafts of Berlin and Potsdam, the Berlin Technology Foundation, the Brandenburg "Future Agency", the Fraunhofer ISST and other organizations cooperate in offering support and consultation for SMEs wishing to exploit the Internet for eCommerce or eBusiness.

In addition, the ISST Berlin is one of the partners in the Virtual Software Engineering Competence Center (ViSEK), which draws together German expertise in methodologies and applications and makes it available to companies that develop software.


**Contact:**

Dr. Alexander Borusan
Head of Berlin Branch

Fraunhofer-Institut für
Software- und Systemtechnik ISST
Institutsteil Berlin
Mollstr. 1
10178 Berlin
Germany

Phone: +49 (0) 30/2 43 06-1 00
Fax: +49 (0) 30/2 43 06-1 99
E-mail: Alexander.Borusan@isst.fraunhofer.de
Web site: www.isst.fraunhofer.de

Dr. Volker Zurwehn
General Manager

## The Dortmund Branch

The Dortmund branch of the Fraunhofer ISST has moved into larger premises in a technology park, indicating the institute's course of growth. The technology park offers a highly innovative R&D environment that comprises universities, research centers and high-tech companies. The branch focuses on activities related to eBusiness, corporate communication and mobility management from the viewpoint of process and information management. Its output includes methodologies, concepts and solutions for workflow and document management, groupware computing, operations knowledge management, as well as eCommerce, eServices and media object management.

An essential orientation of these activities is the evolution of more personalized, needs-oriented information services, which is directly related to one of the ISST's master projects: Information Logistics. This field, in fact, is considered so important that, with support of the State government of North Rhine-Westphalia, the Dortmund branch has established an Information Logistics Competence Center in which the ISST scientists:

- undertake research and develop elements for Information Logistics systems
- provide information about potential benefits and demonstrate prototypes
- discuss business models and design innovative solutions for customers.

The Information Logistics Competence Center is, thus, a think tank dedicated to the transfer of innovative, practical solutions in cooperation with partners and users from industry.

At the same time, building bridges in technology and cooperation promotes internationalization by supporting multinational partnerships; endeavors like the "Internet 3 Development Center" and the "Sino-German Laboratory of Software Integration Technologies" have fortified the already close cooperation between the ISST and India and China respectively.

In addition to the Information Logistics Competence Center, the Fraunhofer ISST is linked to several other North Rhine-Westphalia State initiatives. Among these are the "Mobile-Media Initiative" and a project called the "Geo Data Initiative".

**Contact:**

Dr. Wolfgang Deiters
Head of Dortmund Branch

Fraunhofer-Institut für
Software- und Systemtechnik ISST
Institutsteil Dortmund
Emil-Figge-Str. 91
44227 Dortmund
Germany

Phone: +49 (0) 2 31/9 76 77-1 00
Fax: +49 (0) 2 31/9 76 77-1 99
E-mail: Deiters@do.isst.fraunhofer.de
Web site: www.isst.fraunhofer.de

Fraunhofer-Institut für
Software- und Systemtechnik ISST

Phone: +49 (0) 2 31/9 76 77-1 02
Fax: +49 (0) 2 31/9 76 77-1 99
E-mail: Zurwehn@do.isst.
fraunhofer.de

# Continuous Software Engineering
*Master Project*

## Systems in a State of Flux

"Everything flows" – this adage goes back to antiquity, but in the IT age, things are flowing lots faster. We are tempted daily with offers of enticing new hardware, operating systems and software packages, all of which seem tantalizingly tailor-made for our needs. The sixty-four-dollar question, though, is whether the new additions can be integrated into existing systems. What might be a temporary annoyance to a home user can represent an existence-threatening cost factor for a firm. Customers demand increasingly individualized products and services. Furthermore business targets, processes and technologies can fluctuate in a flash.

The need for new functionalities, however, must be weighed against their cost factor, and this is not purely financial. The information and communication infrastructure found in almost every company today incorporates a myriad of subsystems. Should even one of these go down for an extended period, the firm might be rendered unable to produce its products or offer its services. New functionalities must dovetail with the existing infrastructure, which, in turn, must be flexible enough to accommodate the alteration. The heart of a firm's IT infrastructure has to hold operations together over a long period of time, practically as long as the enterprise itself exists.

## Continuous Software Engineering (CSE)

Unfortunately, the future cannot easily be anticipated, yet new demands continue to arise that require adaptation of current systems; their evolution must remain in step with the environment. Under the motto "Designed for Change", the Fraunhofer ISST creates methodologies and concepts for the development of evolution-capable software. These, by the way, are not only relevant to the composition of new systems; architectures and procedural models that stem from CSE can be of decisive importance during the perpetual process of upgrading existing systems, the goal being their transformation into evolution-capable infrastructures.

The impetus for a restructuring frequently comes as the result of a thorough examination of the entire enterprise (Due Diligence) undertaken as part of a greater transaction, e. g. a merger or takeover. In this situation, the Fraunhofer ISST can take over the assessment and evaluation of the software products in the infrastructure (Technical Due Diligence). From a methodological viewpoint, fundamental software-specific concepts are used: model-based development involving component and middleware-technologies, domain-specific reference architectures and evolution strategies, as well as suitable management and organization techniques. In our projects with the automotive industry and the financial management sector, we put Continuous Software Engineering into

practice based on the knowledge that flexible systems help create flexible firms.

## Technical Due Diligence

The Application Lab Technical Due Diligence offers an objective and understandable technical assessment of IT products, services and even entire firms. The underlying methodology – the reference model for technology evaluation – constantly undergoes adaptation to encompass new methodological findings of CSE. For example, in 2002 the assessment procedure for structured and secure quantification of the value of software "SoftValue" was developed in cooperation with the VDI/VDE-Technologiezentrum Informationstechnik GmbH.

## The KONTENG Project

2002 saw the completion of the project Continuous Engineering for Evolutionary IT Infrastructures "KONTENG", funded by the federal ministry of education and research. In collaboration with the financial firm Bausparkasse Schwäbisch Hall AG and Berlin's Technical University, the foundations of CSE processes were scrutinized. It was determined that the description of invariants and dependences plays the decisive role in evolution: What should be preserved? What effects do changes have? Components and architectures were designed using the Component Markup Language, which was developed in the course of the project. In this particular context, evolution instead of revolution means retention of the existing high-performance host applications and their integration into a component-oriented architecture.

## CSE in the Automotive Industry

Continuous engineering is currently being employed in a completely different field of endeavor in a strategic project with the BMW Group.

Today, software systems hold great potential for innovation in automobile development, and the CSE process promises many plus points. Among these are: permitting quick reactions to market changes while maintaining the value of prior investments, controlling development costs in current operations and allowing a broad product palette while reducing development time.

The complementary concepts from domain engineering specifically target the management of multiple product line varieties, and solutions that have proven themselves in applications are reworked and maintained for systematic reuse. The successful transfer of these concepts is assured by the "migration pipeline", through which project results are introduced into the current development processes of the BMW Group and evaluated step by step.

# Information Logistics
*Master Project*

## Ways out of the Information Overload

The dizzying growth of electronically stored information has swelled the significance of Information Logistics Technologies. Alone the publicly accessible Internet comprises 550 billion documents and increases by around seven million pages daily. Data in firms, locally stored data and other sources must be considered in addition.

Mastering this mass of data creates the practical requirement for the provision of personalized information that is both requirement and context sensitive, and functions according to just-in-time criteria. Information Logistics establishes the foundation for user-centered "smart services", making it the basic technology for an "Intelligent Internet 3".

## Information Logistics in Practice

In the master project Information Logistics, the Fraunhofer ISST works toward the development and distribution of methodologies, concepts and technologies for applications that avail an appropriate, personalized information supply encompassing solutions for Content, Time and Communication Management. Technologies for determining implicit information requirements, context-controlled information supply, and the integration of services formed the emphasis in the year 2002. These converged chiefly in applications dedicated to "digital assistants" (mobile managers and emergency management).

The Fraunhofer ISST has built up an extensive network for the distribution of Information Logistics technologies, since corresponding applications are complex and thus usually developed in cooperative efforts. New business models must be discussed with partners, and ideally this discussion process with industry experts engenders new ideas.

Recognizing the importance of the topic, the institute held a series of events in 2002 that dealt with Information Logistics. Its prelude was the Information Logistics Rollout on May 14th at the Academy of Mont-Cenis in Herne, during which the entire range of uses of Information Logistics applications was presented to approximately 100 prominent personalities from politics and industry.

In the course of the year, several industry-specific Round Tables dealing with topics such as applications for crisis management, event information systems and technologies for news services were held. Through these events and several attention-grabbing reference projects, some of which will be described later, the Fraunhofer ISST has firmly anchored Information Logistics in the public awareness.

## The WIND Pilot Project

The year 2002 was yet another in which the peril from thunderstorms was proven, but since May of last year,

clients of the insurance company Bavarian Insurance Chamber (Versicherungskammer Bayern – VKB) have been able to utilize the Information Logistics system called WIND (Weather Information on Demand), developed by the Fraunhofer ISST and the firm meteomedia ag jörg kachelmann. This system – the first of its kind – offers subscribers precise, locale-specific weather and storm data via SMS, e-mail, pager or fax. The service was first made available to 5.000 of VKB's clients; general access is planned later this year. With the WIND project, the Fraunhofer ISST has demonstrated a role for Information Logistics technologies in the realm of weather information that is both significant and convenient. Insurance customers receive weather data when they need it and how they want it, giving them time to react and, hopefully, to minimize or avoid losses.

## Smart-Wear®

From the 5th to the 7th of July, 2002 the German Championships in Athletics (DLM) took place in the town of Bochum-Wattenscheid. Smart-Wear®, a digital companion developed in the form of an "intelligent vest" for sports journalists in attendance, celebrated its extremely successful world premiere at the event. About 35 reporters wearing the Smart-Wear® test equipment had access to all of the individual information they required – regardless of their location at the venue – in convenient electronic form. Up-to-the-minute highlights of the competition, including records and other news, were delivered to the wireless receiver integrated into the vest, which was a joint development of the Fraunhofer ISST and the KSI Klaus Steilmann Institute. A wireless LAN was used to deliver information to the journalists when and where they needed it.

## Joint Laboratory in Peking

On the 14th of September, 2002 the Fraunhofer ISST and the Institute of Computing Technology (ICT) of the Chinese Academy of Sciences opened the Sino-German Joint Laboratory of Software Integration Technologies (SIGSIT). The research facility has initiated its cooperative efforts with a project called "Personalized Web Services on Internet 3 for the Olympic Games 2008 in Beijing" in which Information Logistics Web services will be developed for various target groups involved with the Olympic Games.

# eTeaching & eLearning
*Master Project*

## Workflow-Embedded Training

The notion that our school systems provide the young with a knowledge base that merely needs to be built upon later is sadly outdated, even though it still represents a cornerstone of our education system. Even today, when buzzwords like "lifelong learning" have become venerable vocabulary in the discussion of the future of in-house training, many firms still find it difficult to dismantle the barriers between work and learning.

Over the past three years, the Fraunhofer ISST has developed a model based on the concept of Workflow-Embedded Training that makes it possible to link work and learning on the job. At the heart of the model are what we term "reference processes" that establish a formal framework within which learning can be synchronized with work assignments in a communicative and cooperative way.

## IT Infrastructures

IT infrastructures that support education allow the inclusion of knowledge management and electronic means of communication, which contribute considerably to the development of innovative eLearning concepts. The primary objective is placing emphasis on the social components of learning, as well as the promotion of decision-making and responsibility through prompt and practical application of what has been learned.

Knowledge acquisition does not take place in isolation; it is enhanced through contact among creative individuals. Recognizing this, the Fraunhofer ISST emphasizes the development of methods and structures for the co-production of knowledge in which both its acquisition and distribution in the enterprise play important roles.

## Fields of Competence

eTeaching & eLearning are innovative concepts for the development of personnel and organizations in firms doing business in the Information Society. In this area, we are concentrating on the following fields of competence:

- Workflow Embedded Training:
  Process-oriented curricula are being designed and implemented in further education programs. We offer an enterprise-specific adaptation of methodologies for Workflow Embedded Training.
- Continuous Skill Development:
  We assist in the implementation of Workflow Embedded Training in the organization. During the process of change, we give advice regarding the generation of information.
- Cognitive Infrastructures for eLearning:
  We are conceptualizing interfaces between the workplace and (virtual) learning environments. In addition, fragmented educational media are being automated, selected and structured. We are also developing Intranet portals that cross-link processes, areas of specialization and

experiential knowledge; the portals are based on semantic structures.

- Knowledge Dissemination:
  We are testing concepts for the integration of knowledge management and further education and the requisite tools. Infrastructures are being implemented for continuous further education and the co-production of knowledge.

## Special Focus Projects

The Fraunhofer ISST is currently undertaking three projects within the framework of the master project eTeaching & eLearning. These are: "Workflow Embedded Training in the IT Field" (which has the German acronym "APO"), "Knowledge Co-Production" for knowledge-intensive services ("WiKo") and "Teachware on Demand".

- APO:
  The German Federal Institute for Professional Training (BIBB) has defined various types of IT certification in an official "regulations procedure". For their implementation, the Fraunhofer ISST is developing and testing standards and concepts related to content, and innovative concepts in the area of Workflow Embedded Training for SMEs are currently being produced in projects with training providers in Baden-Württemberg, Brandenburg and Thüringen.
- Teachware on Demand:
  New technologies and tools are being amalgamated into a comprehensive infrastructure that facilitates the real-time creation of individually adapted instructional materials. Through the decentralized administration of documents and their automated aggregation, even large document repositories can be rendered manageable.
- WiKo:
  The objective of this project is the conception, development and evaluation of a platform for cooperative online-consultation. The WiKo project is looking into ways to enable several individuals to pool their common knowledge of a subject in real time by focusing on: the location and integration of relevant resource people; the training and coordinating of knowledge communities; the cooperative generation, use and perpetuation of information in knowledge-intensive services, especially consulting.

## Electronic Business Services

In the area of electronic trade, several requirements must be fulfilled so that the widely predicted breakthrough can actually lead to increased turnover for retailers as well as manufacturers. Such prerequisites include the secure, reliable and nevertheless efficient use of new technologies and the integration of these new communication and marketing channels into the existing course of business. The Fraunhofer ISST supports its customers in the realization of shopping systems, customer relationship management systems, electronic business transactions, mobile commerce, as well as the establishment of personalized information services. For these purposes, platform and middleware technologies, meta-information systems and call center technologies, among others, are employed.

## Business Communication

Information technology is equally significant to service companies, industry and public administration. It forms the basis for the exchange of information based on public and private networks, as well as for the support of coordination, collaboration and communication – because in the age of globally-active companies, high-performance information and communication infrastructures play a decisive role in successfully facing time constraints and pressure from the competition on the market. Workflow management, groupware, cellular Intranets and Internet technologies are only a few of the technologies that the Fraunhofer ISST utilizes in the organization of work flows, the realization of efficient access to company knowledge, the establishment of company information systems and Information Logistics services for the efficient operation of company infrastructures.

## Mobile Computing Solutions

Mobility is a trend that is increasingly reflected in information and communication technology. One piece of evidence for this tendency is not only the rapid spread of mobile phones, organizers and portable computers. Moreover, the rapid increase in wireless data communication and the interest of businesses in mobile Internet applications are also a signal for a growing demand for technology, information and solutions in this sector. The Fraunhofer ISST is taking this development into account with the corresponding services offered in the sector of "Mobile Computing Solutions". Our efforts focus on the support of mobile business processes, access to company information via mobile and stationary devices with special consideration of WAP-capable devices and mobile commerce solutions.

## Technical Systems Management

Due to their high real-time and security requirements, modern information systems in the technical realm in the form of control units, telematics systems or navigation systems have extremely complicated hardware and software. Software in particular is considered a significant cost factor – if it's expensive, it must be good. Thus, demands on quality and flexibility of software have risen. In order to be able to produce refined yet reliable software, the most modern methods, techniques and developmental tools are necessary.

**Our departments' core competencies are the basis for innovative research and development projects for industry and public administration.**

Head of Department:

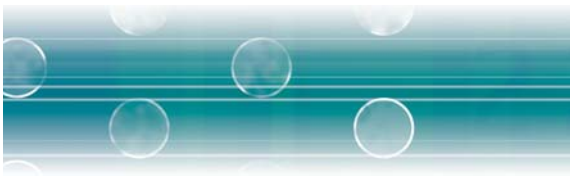
Dr. Christoph Thiel

Phone: +49 (0) 30/2 43 06-3 50
Fax: +49 (0) 30/2 43 06-5 99
E-mail: Christoph.Thiel@isst.fraunhofer.de

## Department of Security Management

Risk is an inherent ingredient in the endeavors of each and every enterprise, and the meaning of the saying "nothing ventured, nothing gained" is well known to all in business. In fact, by handling risks in a conscious, controlled manner, firms can actually reduce costs and gain an edge over the competition. An important prerequisite, however, is the firm's ability to recognize corporate risk as yet another performance measure, render it part of standard operations, and deal with it proactively.

The Department of Security Management has established the sustainable-improvement of safety and security management and risk control – particularly in the field of information processing – as its goal. The task is to put the management of client firms in the position to control their entire organization's risk situation at any moment using integrated methods and technologies. However, it is necessary for any integrated approach that views security and safety management and risk controlling as a part of standard management and controlling procedures to take technical, organizational and corporate-cultural aspects of the firm into consideration. Both practicality and suitability play an essential role in this.



## Department of Learning Technology

Further education is shifting increasingly from the seminar room to the workplace, just as technical and social competences are being increasingly viewed as the keys to coping with integrated workflow. Expert networks and corporate knowledge management are complementing or replacing more traditional forms of qualification. Intelligent infrastructures for creating and individually summarizing educational documents put eLearning theory into practice. Cooperative knowledge generation opens a new dimension of learning beyond individual qualification.

The Department of Learning Technology supports firms and training service providers in two core areas of further education's new direction:

- The creation of structures for workflow-oriented qualification in the workplace. This involves workflow-embedded curricula and, based upon them, educational infrastructures and workflows for the preparation, organization, aggregation, quality assurance and evaluation of documents.
- Initiating and promoting lifelong learning in and at work. Associated with these are the construction of expert networks and virtual communities, the scientific monitoring of qualification measures and the integration of qualification processes into business processes and organizational structures.

**Head of Department:**

Dr. Jörg Caumanns

Phone: +49 (0) 30/2 43 06-4 28
Fax: +49 (0) 30/2 43 06-5 99
E-mail: Joerg.Caumanns@isst.fraunhofer.de

Head of Department:

Dr. Frank Lindert

Phone: +49 (0) 2 31/9 76 77-4 00
Fax: +49 (0) 2 31/9 76 77-4 50
E-mail: Lindert@do.isst.fraunhofer.de

## Department of Integration Management

IT is continuously expanding into new fields, and the increasingly complex functions of the resources used daily by all of us – not to mention the linking of these resources – is creating a platform for a steadily increasing variety of services. These platforms provide a basis for the creation of applications to assist users in specific activities such as the delivery of new legal regulations that have been prioritized and filtered to specialists, or sending medical data from sensors integrated into clothing to emergency control centers.

Today, applications are complex systems whose functional scope is self-contained. At the same time, users have a great variety of information sources and services available, and because of the sheer number of these generally isolated resources, they are often faced with the problem of how to access the function they need in a specific situation. Users first have to find the functions they need and then figure out how to organize them to deal with the task at hand. For example, buying movie tickets online may require a related search for the public transportation schedule. Only when the movie fan knows which bus goes to the cinema where the film is showing, and what time it leaves and how long it takes to get there, can he go back and find out when the various shows are in order to decide which one to attend. The user is confronted with increasingly more complex – and often unsolvable – tasks.

The Department of Integration Management seeks to create methodologies and tools for the development of integrated applications. This integration considers the level of the available terminal equipment and communication technologies, the available services and compatibility at the application level.

These complexes of topics are categorized into three topic emphases. The tasks are components of the Master Project Information Logistics and expand the concepts of Information Logistics from a needs-oriented information supply to context-correct communication with intelligent application systems.

Context Computing
: This topic emphasis deals with the development of approaches to the design and implementation of digital companions who offer information and functions appropriate to the particular situation.

Service Integration
: Aimed at the integration of services, this topic emphasis focuses on the development of methodologies and platforms for the description of services, particularly at the semantic level. Also involved is the linking of services to more complex or individualized ones. The goal is a flexible, dynamic integration of services.

Personalized Context-based Portals
: The development of new approaches to portals that enable users to access services, map and administer contexts, profiles and services etc. is the task of this topic emphasis. These portals are made available to users in the form of individualized environments.

## Department of Coordination Management

Supporting business processes with software systems has been standard practice for decades and is a feature of corporate reality that is simply not going to disappear. As might be expected, a myriad of applications and information services for almost every commercial purpose is available, but nevertheless, gaps leading to delays, wrong decisions and degraded efficiency are encountered repeatedly. Ongoing analysis reveals with increasing frequency that it is not the lack of information that usually bears the blame, but rather its unavailability in specific situations, an especially acute example of which is the need for the proper combination of unstructured details in complex decision-making processes.

Under the rubric Knowledge Management, Intranets and portal systems promise some relief toward combining greatly diverging information systems. They are made available by system providers or IT departments who configure them according to the needs expressed by the users, and in many cases, their introduction more or less establishes a work environment that is a fait accompli.

This procedure, however, overlooks the reality that the needs of many users are much more dynamic than what the software solution allows. The more diverse the activities and the less repetitive the tasks required of these systems, the more diverse the requirement for information and functionality in the daily work flow.

Reacting to this situation properly requires more than personalization in the form of varying the layouts of user interfaces. The true challenge lies not in the mere modification of arrangements of preassembled elements, but in developing support systems that mediate personal, informational and functional resources based on content-related knowledge of the various information and functions, as well as on the needs of the actual users. This requires not only technical analysis, but also an overview of the entire system that considers organizational, sociological and specific company-related factors.

The creation of a networked in-house society is the principal task of process-oriented knowledge management, and achieving this is the priority of the Department of Coordination Management in both research and industrial projects. We focus on the analysis of actual requirements, existing and targeted sources and flows of information, as well as the design of technical systems and social processes that support a needs-oriented information supply. Underlying our work is a solid foundation built up over years of experience in process, document and communication management, and upon this foundation we develop innovative concepts that are professionally implemented by our interdisciplinary team.

**Head of Department:**

Dr. Thomas Kamphusmann

Phone: +49 (0) 2 31/9 76 77-4 21
Fax: +49 (0) 2 31/9 76 77-199
E-mail: Kamphusmann@do.isst.fraunhofer.de

## Department of Software Engineering

Head of Department:

Dr. Alexander Borusan
(provisional)

Phone: +49 (0) 30/2 43 06-1 00
Fax: +49 (0) 30/2 43 06-1 99
E-mail: Alexander.Borusan@isst.fraunhofer.de

With increasing frequency, what were once individual enterprise IT solutions are being merged into networked intra-company and inter-company systems that assume the character of infrastructure. Already today, many enterprises are discovering that these complex infrastructures – whose life cycle is basically unlimited – have, in fact, become indispensable elements of their business models. The result is high demands on the functionality, productivity, quality and flexibility of the software, but in many real-world scenarios, unfortunately, what is and what ought to be are miles apart.

Evolution-capable Infrastructures must be constructed so that they can be adapted over the course of their long lives to new requirements in increasingly shorter time spans and with minimal hassle. Both legacy systems and those in the process of being introduced have to be considered and made ready for eventual change, and the key to overcoming these tasks lies in component-oriented, model-based system architectures and flexible development, evolution and management processes tailored to them.

The Fraunhofer ISST's Department of Software Engineering supports both software firms and IT departments in meeting these demands. In addition to our research activities, consultancy and support contract work in company projects constitutes the emphasis of our activities. Our core competences include software technologies, architectures, methodologies, description techniques and tools for the engineering-based evolution of infrastructures. We advise and provide support for both activities aimed at the general improvement of development practices and ongoing IT projects.

## Department of Information Management

Information Logistics and intelligent Internet are keywords that indicate the future evolution of Internet use. These new directions are creating the demand for new generations of information systems that support these trends or help make them possible. In view of this, we are developing concepts, methodologies, and solutions for a needs-oriented information supply, that is, to support the transfer of the right information at the right time to the right place. From the viewpoint of information management, this means, in addition to the development of new information models and architectures, support for the access to information via various information channels.

The development of concepts and solutions for an appropriate information flow management in different application domains (business news, traffic news, ...) or service and workforce management constitute the topic emphasis. This includes the issue of location based services and the semantic description of geo services. In this area, our range of servicescomprises both the evaluation of existing solutions as well as the development of concepts for IT infrastructures supporting an information flow management. We also produce prototype solutions, from special location-based services to portal applications. The foundation of these tasks is formed by concepts for geo-data infrastructures on the open-standards basis such as those of the Open GIS Consortium and the ISO. We are actively involved in the further development of these standards in a variety of contexts.

**Head of Department:**

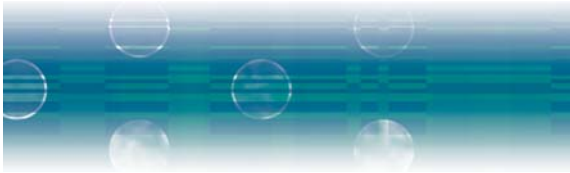
Dr. Wolfgang Deiters
(provisional)

Phone: +49 (0) 2 31/9 76 77-1 00
Fax: +49 (0) 2 31/9 76 77-1 99
E-mail: Deiters@do.isst.fraunhofer.de

## Department of Dependable Systems

Software has been a pervasive fact of life for years, and in many situations, software's being error free and failsafe are absolute prerequisites for its deployment. The Department of Dependable Systems has set as its goals the improvement of productivity in the development of complex software-intensive systems and increasing their reliability. Embedded systems in automobile electronics for both manufacturers and parts suppliers are among the main fields of application.

The principal task is providing a thoroughly methodic and tool-supported software technology for which the domain engineering approach serves as a paradigm because of its support for the management of multiple system varieties. Another important criterion is the appropriateness and practical orientation of the technologies used. Topic emphases involve using the domain engineering approach for software specification and design for software-intensive systems, as well as the improvement of software products and development processes.



**Head of Department:**

Dipl.-Inform.
Rainer Mackenthun

Phone: +49 (0) 30/2 43 06-1 30
Fax: +49 (0) 30/2 43 06-1 99
E-mail: Rainer.Mackenthun@isst.fraunhofer.de

## Application Lab: Technical Due Diligence

Strategic corporate decisions in the IT environment range from investments to budget planning, and questions such as "Is our IT modern enough?", "Is investing in new standard software worth it?", or , "How can I assess the chances and risks of my investment?", frequently land on management's desks.

Whatever the situation, decision makers need prompt, dependable information in order to protect financial commitments and software projects, which in turn requires systematic, proven procedures for the evaluation of software products, processes and manufacturers. In reality, however, few firms possess adequate in-house know-how to meet this requirement, and our experience has shown that in many cases, management has little choice but to rely on "by guess and by gosh" estimates.

The application lab Technical Due Diligence provides assistance to firms in the areas of quality assurance and evaluation of IT projects, products, services, and processes. The solid methodological underpinnings of our range of facilities form a modular system for technology evaluation, and we apply these standardized, field-tested procedures to provide our clients with an objective, understandable assessment regarding their requirements. This may include the selection of complex standard software, the preparation of technical expert opinions, or the qualitative appraisal of development processes.

**Head of Department:**

Dipl.-Ing. Eric Siegeris

Phone: +49 (0) 30/2 43 06-4 55
Fax: +49 (0) 30/2 43 06-5 99
E-mail: Eric.Siegeris@isst.fraunhofer.de

Head of Department:

Dr. Wolfgang Glitscher

Phone: +49 (0) 30/2 43 06-4 88
Fax: +49 (0) 30/2 43 06-1 55
E-mail: Wolfgang.Glitscher@isst.fraunhofer.de

## Application Lab: IT for Medical Facilities (MIT)

The application lab IT for Medical Facilities (MIT) supports facilities engaged in medical research, genome research and bioinformatics. It develops and implements IT infrastructures in medical research networks.

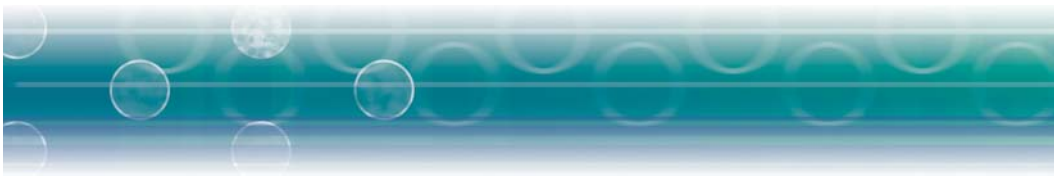
In order to stay competitive internationally, a primary task of Medical Research Networks is the rapid, specific transmission of data and information between the network members. In this connection, the application lab implements projects dealing with the construction of new research networks and health portals. Other projects are involved in the creation or further development of database and document management systems or software for clinical trials.

The business activities of the application lab are currently oriented toward a major ongoing project entitled "Telematics Platform for Medical Research Networks in Health Research (TMF) of the Federal Ministry of Education and Research", which is working on the development and deployment of high-capacity, network-spanning IT infrastructures. The ISST therefore is the project manager of this entire project, in which 35 medical research networks are currently participating.

Solutions in the following fields are being developed, deployed and tested within selected partner groups:

- data protection and data security
- IT quality management
- system components
- copyright and utilization right
- biomaterial databases

An evaluation of the installed systems will be performed, and the results made available to all participants. All of the various ISST competence areas are involved in this project.



## Basic Research: the Department Computation and Information Structures (CIS)

At the same time he was engaged to found the Fraunhofer ISST and serve as its Director, Prof. Dr. Herbert Weber became Chairman of the Department Computation and Information Structures (CIS) at Berlin's Technical University. Since then, the CIS scientific group has been responsible for the basic research component of the institute's application-oriented projects.

As a result, the Fraunhofer ISST's core terminologies, models, and master projects – the Software Bauhaus, IT infrastructures, Continuous Software Engineering, Information Logistics etc. – also have a parallel anchor at the university.

The scientific discourse and debate between institute and university have created a fertile field of cooperation: joint projects, teaching events, workshops and colloquia, the selection of diploma topics and dissertation projects, and strategic cooperation in topic emphases of research have helped assemble the institute's achievements into high-quality, manageable, networked solutions to complex problems whose dynamic development continues.

Experience gained through the Fraunhofer ISST's cooperation with companies and public sector institutions has proven extremely beneficial as case studies and examples of real-world scenarios for teaching and research. Basic research, in turn, provides ideas and methodological impulses for the institute's work.

Model-based software development forms the focus of the CIS research group's activities: modeling, model design and the related applied methodologies for large-scale heterogeneous software infrastructures. In this regard, we primarily deal with concepts for the integration of heterogeneous, data-intensive software systems into cross-platform software infrastructures. We also place particular emphasis on to Continuous Software Engineering, i. e. evolutionary software development and long-lived information infrastructures.

The concrete goal of our research is designing models, architectures, techniques, and tools for the supply of appropriate – that is, semantically oriented – information and the continuous improvement of the corresponding methodology. We apply this in our Information Logistics projects as well as in our eTeaching & eLearning endeavors.

**Head of Department:**

Dr. Ralf-Detlef Kutsche

Phone: +49 (0) 30/3 14-2 35 57
Fax: +49 (0) 30/3 14-2 16 01
E-mail: rkutsche@cs.tu-berlin.de

Phone: +49 (0) 30/2 43 06-1 20
Fax: +49 (0) 30/2 43 06-1 99
E-mail: Ralf.Kutsche@isst.fraunhofer.de

# Our Range of Research and Services Offered

## Target Group

The Fraunhofer Institute for Software and Systems Engineering ISST provides consultation to users in the business and public administration sectors who require long-term, evolution-capable information and communications infrastructures as well as customized software concepts and system concepts. For bulk users, IT manufacturers and small to mid-sized software companies, the institute generates need-specific development environments. The Fraunhofer ISST supports state and national institutions in the reorganization of administrative processes.

## Contract Research Services

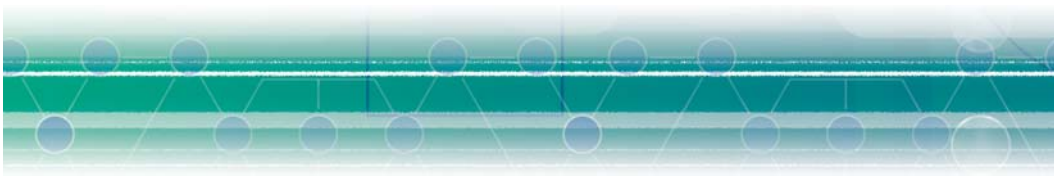
The Fraunhofer Institute for Software and Systems Engineering ISST possesses years of experience in commissioned research for industry and public administration, in joint research with industrial companies within the context of research programs, as well as in international research collaboration. Our services range from classic company consultation to the generation of expert assessments, to strategic cooperation for the purpose of prototype development.

We continually adapt the focus of our research to match the current needs and developments of the market. It is our objective to transform research results in the areas of business communication, electronic business services, mobile computing solutions and technical systems management into applicable procedures and "products" geared toward the market, that is, prototype and pilot systems as well as services, in a rapid and efficient manner.

## The Research and Services of the Fraunhofer ISST

### Security Management

- concepts and solutions for risk and safety and security management of IT infrastructures in the private and public sectors
- concepts and solutions for innovative, trustworthy and secure Internet, Intranet and Extranet applications; for example, early warning systems, eBusiness solutions, for cross media publishing, mobile computing, electronic market places, information systems etc.
- evolution of key data and target systems for IT infrastructures as well as analysis and evaluation of the information management in the private and public sectors
- support for evolutionary or revolutionary change in strengthening IT infrastructure security
- strategic consultancy in the fields of Internet, Intranet and Extranets (technologies, areas of possible application, cost/benefit, organizational aspects, security)



## Learning Technology

Workflow Embedded Teaching:
- conception of process-oriented curricula and their implementation in further education concepts
- enterprise-specific adaptation of methodologies of workflow-embedded training

Continuous Skill Development:
- monitoring of workflow-embedded training in firms
- consultation during processes of change regarding knowledge generation

Cognitive Infrastructures:
- conception of interfaces between workplace and (virtual) learning worlds
- selection, structuring and automation of fragmented educational media
- development of Intranet portals that link knowledge relating to process, area of specialization and experience, and which are based on semantic structures

Knowledge Dissemination:
- testing of concepts and requisite tools for the integration of knowledge management and further education
- conception and development of teleservice platforms for service and maintenance
- conception and development of teleservice platforms for facility-management services

## Integration Management

The service palette of the Department of Integration Management incorporates:
- consultation during the conception and development of Information Logistics, context oriented application environments
- conception and realization of complex application systems in the fields of document management, content management, portals, workflow management and archiving
- process-oriented investigation of requirements and integration in existing infrastructures
- consulting and support in product selection and adoption
- consulting for the deployment of service offers based on Web services. Conception of interfaces with regard to standards, integration in eCommerce applications, particularly in the field of geo-information services
- conception, realization and introduction of digital mobile companions, for example for museums, exhibitions etc.
- conception of Information Logistics service offers, integration into existing infrastructures
- conception, realization and introduction of context-based portals for Internet, Intranet and Extranets

## Coordination Management

The portfolio of services of the Fraunhofer ISST's Department of Coordination Management encompasses all stages of integrated knowledge management projects for both private and public-sector organizations. These include:

- analysis and evaluation of IT infrastructures in regard to knowledge management
- analysis, in particular weak-point analysis, of information sources and communication flows
- process investigation and modeling
- evaluation and client-specific assessment of current software development, in particular in the fields of ontologies, text-mining and portal systems
- conception, development and deployment of Intranet-based information portals
- strategic consultation, conception and monitoring during the implementation of integrated knowledge management solutions
- interdisciplinary contract research in all fields of needs-oriented information supply
- lead management of knowledge management projects

## Software Engineering

- development and adaptation of concepts, methodologies and techniques for planning, integration, development, and the management of IT infrastructures in enterprises
- support during the application of software-specific concepts and methodologies for the improvement of software products and their development processes
- consulting, selection and adaptation of tools to support concepts and techniques of software development

## Information Management

Strategic information management:

- consulting for information management
- information needs analysis
- consultation for conception, profitability analysis, development online Information Logistics information systems and their integration into business processes
- support during the construction of enterprise information systems (e.g. data warehouse solutions)

Geo-eBusiness:

- conception and development of geo-commerce solutions (online sale of geo-data and services)
- conception and evolution of location-based services
- integration of geo-services into applications

Service and Workforce Management:

- conception and development of teleservice platforms for service and maintenance
- conception and development of teleservice platforms for facility management services

## Dependable Systems

- development and adaptation of concepts, technologies and techniques for the construction of software-intensive systems
- development and application of concepts for the improvement of productivity in the development of complex embedded systems
- support during the implementation of concepts, technologies and techniques for increasing the reliability of software-intensive systems
- support for improvement of software products and software development processes as well as in the development of software product lines for embedded systems
- conception and development of tool assistant prototypes for the support of concepts, technologies, and methodologies

## Technical Due Diligence

- objective and understandable technical assessments of IT products, services and companies within the framework of a Technical Due Diligence
- quality assurance project analysis based on the project assurance methodology
- precise selection and assessment of standard software using practice-oriented, proven procedures
- consultation in the selection of system providers for complex IT projects by means of market analyses and company surveys
- software appraisal with SoftValue, a valuation procedure for the structured and safe assessment of software, developed in cooperation with the VDI/VDE Technology Center
- source code analysis using software metrics to support decision making and management of complex IT infrastructures
- IT assessments for strategic consultation to ascertain the potential and requirements for optimization of in-house IT systems

## IT for Medical Facilities

- conception, development and implementation of systems in the field of data security and protection in medical research, genome research and bioinformatics
- conception, selection and implementation of information systems and portal solutions for the exchange of information and data among research networks
- process management, infrastructure construction and implementation of telemedical infrastructures for research and health care
- support in the selection processes, implementation and cost-benefit analyses of systems for clinical studies

innova
BUSINESS DEVELOPMENT AND HOLDING GMBH

processware
Information Management
Knowledge Management
Business Process Management

semantik solutions

**KIS**
Kommunale
Infoservices GmbH

## Internet 3 Development Center – INNOVA Consulting Ltd

The Fraunhofer ISST Dortmund and INNOVA Consulting Ltd have joined forces in the establishment of a development and innovation center in Dortmund for the federal state North Rhine-Wesphalia: the Internet 3 Development Center. The goal of the scientific and commercial cooperation is the development of technologies, products and services for the Internet's third generation, which is characterized by an individualized, needs-oriented information supply. The concept behind the Internet 3 Development Center is to create a basis for founding new businesses and with them, initiate a new wave of IT enterprises whose technology potential will first and foremost be linked to traditional economic fields.

The Internet 3 Development Center is first and foremost a partner for high-tech SMEs. The firm itself is a medium-sized development and consulting company that opened its doors with a team of around twenty consultants. The team will begin its work in the North Rhine-Wesphalia region, but cooperation with partners from around the globe is the ultimate goal. In fact, the first foreign partner already exists in the form of a business development enterprise in Bangalore: the Karnataka Innovation Center, founded parallel to the Dortmund organization by a group in India.

**Contact:**

INNOVA Beratungsgesellschaft mbH
Emil-Figge-Straße 91
44227 Dortmund
Germany

Phone: +49 (0) 2 31/9 76 77-5 10
Fax: +49 (0) 2 31/9 76 77-5 19

## process*ware* GmbH

*Information management – knowledge management – business process management*

The process*ware* GmbH was spun off as an independent technology consultancy by the Fraunhofer Division in Dortmund in 1999. Since its opening the former ISST employees – in close cooperation with the parent organization – have introduced proven services and software solutions into the market.

The process*ware*'s approach is comprehensive, offering services from organizational to technological consulting. These include:

- overseeing the deployment of IT to optimize administrative procedures and business processes
- selection and combination of the most suitable applications and technologies in strict accordance with the client firm's IT strategy
- analysis and evaluation of the organization and service structures of the proposed IT support
- monitoring the deployment of individual components

### Range of Services

Information Management
- provision of instruments for the development and deployment of IT strategies
- appraisal of the degree and quality of IT support
- specification of IT requirements and converting them into proposals for solutions

Knowledge Management
- creating solutions for the improvement of both knowledge and organization management
- conception and deployment of Intranets, portals, knowledge management elements and electronic document administration

Business Process Management and Software Development
- analysis of organizational and administrative processes
- development of software solutions not available in the market
- support of professional communication with external developers

Software Selection
- consultation regarding procurement of standard software
- support during market research, the tender procedure and evaluation of bids

Infrastructure Change
- evaluation, conception and preparing tenders for infrastructure components
- monitoring the deployment of infrastructure improvements

eGovernment Services
- technology support oriented toward administrative processes
- integration of qualification and knowledge management into the workflow

**Contact:**

Dr. Rolf Walter
General Manager

process*ware* GmbH
Geschäftsstelle Bonn
Wilhelmstraße 22
53111 Bonn
Germany

Phone: +49 (0) 2 28/39 09-4 79
Fax: +49 (0) 2 28/39 09-4 80
E-mail: walter@processware.de

process*ware* GmbH
Geschäftsstelle Dortmund
Emil-Figge-Straße 91
44227 Dortmund
Germany

Phone: +49 (0) 2 31/9 76 77-5 20
Fax: +49 (0) 2 31/9 76 77-5 29
Web site: www.processware.de

## semantik solutions GmbH

*Intelligent matching solutions in selected business areas*

semantik solutions GmbH (ssG) is a joint venture of the Fraunhofer ISST and the Indian software house ICICI Infotech Services Limited, a spin-off of India's largest private bank. ssG was founded on 29th July, 2002 and works in the area of providing and transferring the newest procedures and systems for intelligent matching.

Matching is the core of all processes that involve the search for and retrieval of specific content. Well-known examples include portals and Internet search engines, in which syntactic methodologies are usually employed. These are extended by semantic procedures – that is, procedures based upon semantic networks – using a technology called BaSeWeP. BaSeWeP was developed by the Fraunhofer ISST and is the essence of ssG's development and marketing.

ssG's services include the provision and adaption of BaSeWeP as components of implicit search applications. These are usually business-related applications in which search processes come into play that escape users' notice. For example, by perfecting the relevant matching procedure, it is possible to enhance methodologies to assist in decision making or process optimization. Research into call center systems and enterprise resource planning (ERP) has demonstrated that the potential efficiency increase through the use of semantic matching technologies is at least 20 percent.

Depending on specific client requirements during the implementation of technologies and provision of services, ssG can also coordinate the involvement of the Fraunhofer ISST for technology, conception, and consultancy services, and ICICI Infotech for software development and IT services.

**Contact:**

Prasad Rangnekar
General Manager

semantik solutions GmbH
Geschäftsstelle Berlin
Mollstraße 1
10178 Berlin
Germany

Phone: +49 (0) 30/2 43 06-3 86
Fax: +49 (0) 30/2 43 06-5 77
E-mail: info@semantiksolutions.com

semantik solutions GmbH
Geschäftsstelle Dortmund
Emil-Figge Straße 91
44227 Dortmund
Germany

Phone: +49 (0) 2 31/9 76 77-5 10
Fax: +49 (0) 2 31/9 76 77-5 19
Web site: www.semantiksolutions.com

## KIS Kommunale Infoservices GmbH

KIS Kommunale Infoservices GmbH is the product of the Fraunhofer ISST's years of experience in business communication. Since the firm's founding in April, 2001, the institute's public sector involvement in the construction of highly efficient IT infrastructures has been the primary factor in the start-up's success. KIS was established in Teltow, in the southeast of Berlin, and in its first years, the close existing contacts to the federal states of Brandenburg and Mecklenburg-Vorpommern have been being extended.

KIS offers municipalities, counties, public administrative offices and government agencies a combination of innovative software solutions and graduated, problem-oriented consultation that focuses on providing support in the area of invoice and fee collection.

The consulting services for the creation of a collection center include support for:

- the centralization of fee and invoice collection by determining the market potential of dedicated collection centers
- the acquisition of clients
- the documentation of operating processes and the technical requirements of collection center clients
- the preparation of business plans and concepts
- the organizational and technical aspects of the collection center
- the schooling of clients
- the commencement of operations

Software provided is based on the XML and J2EE standards, both of which are scalable and evolution capable. The integration of ASP concepts is also available, in order to make use of the software possible for smaller communes.

Domain specific standards are developed for the necessary analysis of client transactions as well as for the development of interfaces for various systems. Flexible adaptability is guaranteed through the integration of workflows into the software system.

**Contact:**

KIS Kommunale Infoservices GmbH
Emil-Figge-Straße 91
44227 Dortmund
Germany

Phone: +49 (0) 2 31/9 76 77-5 10
Fax: +49 (0) 2 31/9 76 77-5 19

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## Private Sector

- AED Graphics AG
- Bausparkasse Schwäbisch Hall AG
- Bildungswerk der Thüringer Wirtschaft e. V.
- BITKOM e. V.
- BMW AG
- Brandenburg Capital GmbH
- CHUBB Insurance Company of Europe S. A.
- DaimlerChrysler AG
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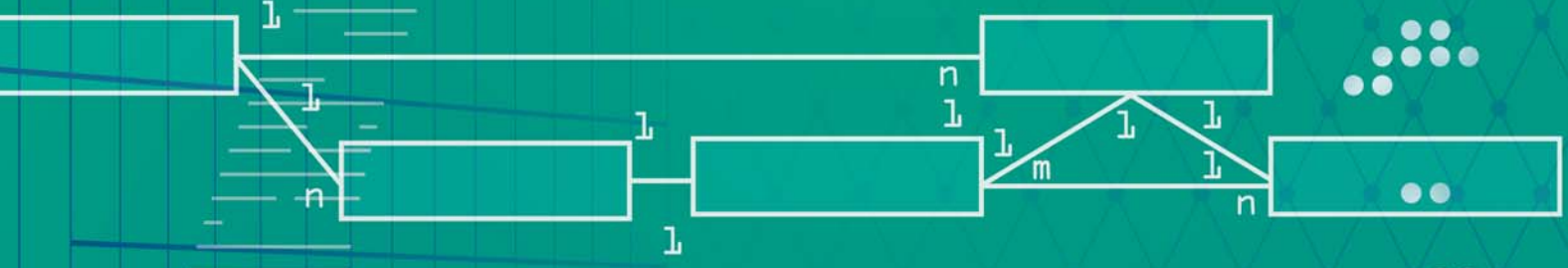
- Volkswagen AG
- VR Kreditwerk Hamburg
- Württembergische Versicherungsgruppe
- Zentrum für Telematik im Gesundheitswesen GmbH

## Public Sector

- Bundesanstalt für Post- und Telekommunikation
- Bundesministerium für Bildung und Forschung
- Fraunhofer-Gesellschaft
- Jönköping University, Schweden
- Ministerium für Wirtschaft und Mittelstand, Technologie und Verkehr des Landes Nordrhein-Westfalen
- Presse- und Informationsamt der Bundesregierung
- Staatskanzlei des Landes Nordrhein-Westfalen

# Service



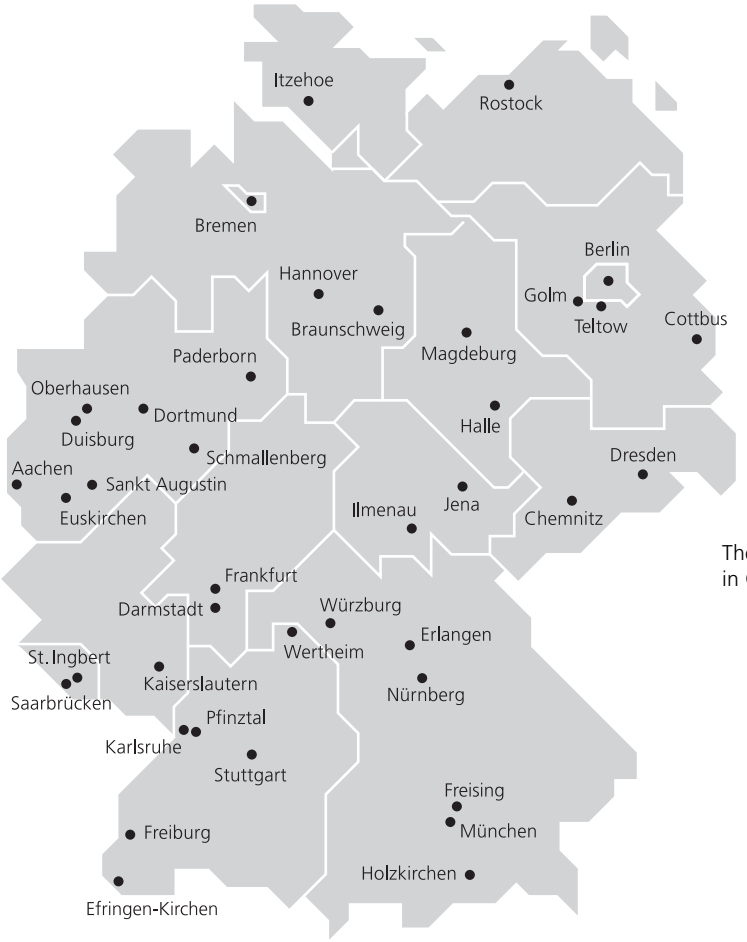
## The Fraunhofer-Gesellschaft

The Fraunhofer-Gesellschaft undertakes applied research of direct utility to private and public enterprise and of wide benefit to society. Its services are solicited by customers and contractual partners in industry, the service sector and public administration. The organization also accepts commissions and funding from German federal and Länder ministries and government departments to participate in future-oriented research projects with the aim of finding innovative solutions to issues concerning the industrial economy and demands faced by society in general.

By developing technological innovations and novel systems solutions for their customers, the Fraunhofer Institutes help to reinforce the competitive strength of the economy in their local region, and throughout Germany and Europe. Through their work, they aim to promote the economic development of industrial society, paying particular regard to social and environmental concerns.

As an employer, the Fraunhofer-Gesellschaft offers a platform that enables its staff to acquire the necessary professional and personal qualifications to assume positions of responsibility within their institute, in industry and in other scientific domains.

At present, the Fraunhofer-Gesellschaft maintains roughly 80 research units, including 57 Fraunhofer Institutes, at over 40 different locations in Germany. A staff of some 13.000, predominantly qualified scientists and engineers, work with an annual research budget of around one billion euro. Of this sum, approximately € 900 million is generated through contract research. Roughly two thirds of the Fraunhofer-Gesellschaft's contract research revenue is derived from contracts with industry and from publicly financed research projects. The remaining one third is contributed by the German federal and Länder governments, as a means of enabling the institutes to pursue more fundamental research in areas that are likely to become relevant to industry and society in five or ten years' time.




The Locations in Germany

Affiliated Research Centers and Liaison Offices in Europe, the USA and Asia provide contact with the regions of greatest importance to future scientific progress and economic development.

The Fraunhofer-Gesellschaft was founded in 1949 and is a recognized non-profit organization. Its members include well-known companies and private patrons who help to shape the Fraunhofer-Gesellschaft's research policy and strategic development.

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

## Fraunhofer ICT Group

The Fraunhofer ISST is a member of the Fraunhofer-Gesellschaft's Information and Communication Technology Group. The Fraunhofer ICT Group consists of 15 participating institutes, employs a staff of over 2.000, and operates with a yearly budget of over € 200 million. Therefore, it is the largest research alliance for information and communications technology in Europe, and one of the largest in the world. The complementing core competencies of the various member institutes cover the full value chain in the communications and IT sectors.

Contact: www.iuk.fraunhofer.de

## Address for the Berlin Division

Fraunhofer-Institut für
Software- und Systemtechnik ISST
Institutsteil Berlin
Mollstraße 1
10178 Berlin
Germany

## How to find us in Berlin

### By car

From the southwest:
Autobahn A115 (Avus) to the "Dreieck Funkturm" (radio tower) junction; highway A100 north to the Kaiserdamm exit (B2, B5), then in the direction of "Berlin-Mitte" (Berlin Center) via the roads "Straße des 17. Juni" and "Unter den Linden" to Karl-Liebknecht-Straße, corner of Mollstraße.

From the northwest:
Autobahn A111 to the "Dreieck Charlottenburg" junction; highway A100 to the Kaiserdamm exit; to continue: see "By car from the southwest".

From the northeast:
Autobahn A11 to the "Dreieck Schwanebeck" junction; A10 (Berliner Ring) Berlin-Weißensee exit, then change to the B2 in the direction of "Berlin-Mitte" (Berlin Center) Greifswalder-Straße to Mollstraße, turn right.

From the southeast:
Autobahn A13 to the "Schönefelder Kreuz" junction; A113 to the "Dreieck Treptow" junction exit, then change to federal road B96a in the direction of "Berlin-Mitte" (Berlin Center), via Adlergestell, Stralauer Allee, Mühlenstraße, then turn right into Alexanderstraße, turn right into Grunerstraße, cross Karl-Marx-Allee, then turn right into Karl-Liebknecht-Straße, and at the next fork Mollstraße.

### By train

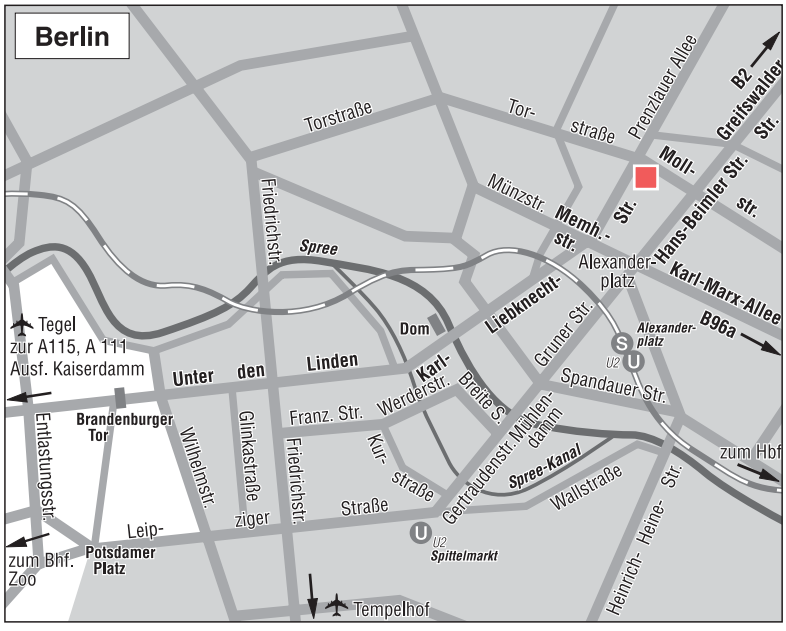
Take regional trains directly to the Alexanderplatz station. Long-distance trains to the Bahnhof Zoo or Ostbahnhof stations; then take the S-Bahn rapid transit train to the station Alexanderplatz; from Alexanderplatz it is a five-minute walk along Karl-Liebknecht-Straße to Mollstraße.

### By air

From the Berlin-Tegel airport (TXL):
Take the airport bus (109, X9) to the Bahnhof Zoo railway station; to continue: see "By train".

From the Berlin-Tempelhof airport (THF):
From the "Platz der Luftbrücke" underground railway station, take the U6 in the direction of "Alt-Tegel" to "Stadtmitte" (city center), then change to the U2 in the direction of "S+U Pankow" to Alexanderplatz; to continue: see "By train".

From the Berlin-Schönefeld airport (SXF):
Take the S9 rapid transit train in the direction of "Westkreuz" to Alexanderplatz; to continue: see "By train".



## Address for the Dortmund Division

Fraunhofer-Institut für
Software- und Systemtechnik ISST
Institutsteil Dortmund
Emil-Figge-Str. 91
44227 Dortmund
Germany

Postal address:
Postfach 52 01 30
44207 Dortmund
Germany

## How to find us in Dortmund

### By car

Via A40 motorway and B1 trunk road:
leave B1 at Dortmund-Dorstfeld; at the first traffic lights turn left into Hauert (in the direction of Technologie-Zentrum), and at the next traffic lights left into Emil-Figge-Strasse (cul-de-sac).

Approaching from the center of Dortmund:
turn right at the first traffic lights into Hauert (in the direction of Technologie-Zentrum), pass under the bridge, at the second traffic lights turn right into Emil-Figge-Strasse (cul-de-sac).

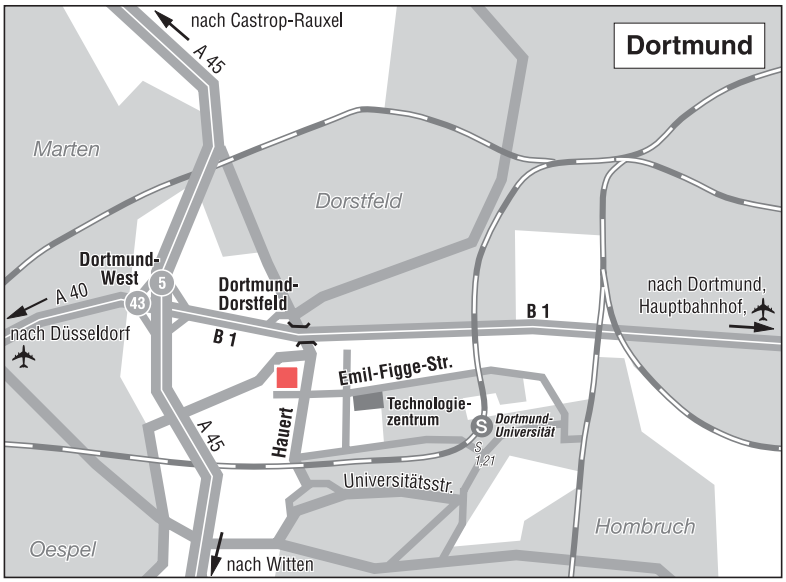
### By train

From the Dortmund main railway station, take S-Bahn rapid transit Line 1 or 21 in the direction of Düsseldorf to the "Dortmund-Universität" stop (The University of Dortmund); from there, a 15 minute walk.

### By air

From the Dortmund-Wickede airport, take the bus to the Dortmund main railway station; to continue: see "By train"; a taxi from the airport takes approximately 25 minutes.

From the Düsseldorf airport, take S-Bahn rapid transit Line 1 or 21 in the direction of Dortmund to the "Dortmund-Universität" stop (Dortmund University); a taxi from the airport takes approximately 60 minutes.



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Software- und Systemtechnik ISST
Institutsteil Berlin
Mollstraße 1
10178 Berlin
Germany

**Periodicals and Brochures**

- ☐ Institute Profile
- ☐ Annual Report 2002 of the Fraunhofer ISST
- ☐ Annual Report 2003 of the Fraunhofer ISST (available from April 2004)
- ☐ Please put me on your Annual Report mailing list.
- ☐ Please put me on your Press Release mailing list.
- ☐ Please send me your newsletter "Information Logistics News" on a regular basis.
- ☐ Information and Communication Technology (Brochure of the Fraunhofer ICT Group)

**Topic-Specific Brochures**

**Master Project: Information Logistics**

- ☐ @ptus®location: Location Information System
- ☐ @ptus®news: Right News, Right on Time
- ☐ @ptus®weather: Weather Information on Demand
- ☐ BaSeWeP: Content-Management for Web-Portals
- ☐ Emergency Management with Geo Information
- ☐ Flame 2008: Personalized Web Services for the Olympic Games 2008 in Beijing
- ☐ Information Logistics
- ☐ Information Logistics Construction Set
- ☐ Information Logistics – Enabled for Smart IT Solutions
- ☐ Internet Inside Technology
- ☐ *k***Info**: Mobile Information Construction Set
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Software- und Systemtechnik ISST
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Mollstraße 1
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## Topic-Specific Brochures

### Master Project: Continuous Software Engineering

- ☐ Continuous Software Engineering: Continuous Engineering for Information and Communication Infrastructures
- ☐ Evaluation and Selection of Standard Software
- ☐ NSI – New Security Infrastructure
- ☐ Project Assurance
- ☐ Security Maturity Model (SMM)
- ☐ SoftValue: Software Value Assessment
- ☐ TDD: Services for Financial Service Providers and Investors in the Field of Technology Assessment

### Master Project: eTeaching & eLearning

- ☐ Accompany Learning while Working
- ☐ APO: Workflow-Embedded Training in the IT Sector
- ☐ APO-Pilot: Start into the Future of Further Education
- ☐ eTeaching & eLearning
- ☐ Teachware on Demand
- ☐ WiKo: Knowledge-Co-Production for Consulting Services
- ☐ Your Decision: Learning while Working

### Topic emphases

- ☐ Telematics Platform for Medical Research Networks

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| | | | |
|---|---|---|---|
| **Direction** | Director | Prof. Dr. Herbert Weber |  |
| | Office Berlin | Ulrike Locherer<br>+49 (0) 30/2 43 06-1 00 |  |
| | Office Dortmund | Elke Schickentanz<br>+49 (0) 2 31/9 76 77-1 00 |  |
| | Office CIS/TU-Berlin | Claudia Gantzer<br>+49 (0) 30/3 14-2 35 55 |  |
| | Head of Berlin Branch | Dr. Alexander Borusan<br>+49 (0) 30/2 43 06-1 00 |  |
| | Head of Dortmund Branch | Dr. Wolfgang Deiters<br>+49 (0) 2 31/9 76 77-1 00 |  |
| | General Manager | Dr. Volker Zurwehn<br>+49 (0) 2 31/9 76 77-1 02 |  |

| | | | |
|---|---|---|---|
| **Departments** | Coordination Management | Dr. Thomas Kamphusmann<br>+49 (0) 2 31/9 76 77-4 21 |  |
| | Information Management | Dr. Wolfgang Deiters<br>(provisional)<br>+49 (0) 2 31/9 76 77-1 00 |  |
| | Integration Management | Dr. Frank Lindert<br>+49 (0) 2 31/9 76 77-4 00 |  |
| | Learning Technology | Dr. Jörg Caumanns<br>+49 (0) 30/2 43 06-4 28 |  |
| | Security Management | Dr. Christoph Thiel<br>+49 (0) 30/2 43 06-3 50 |  |
| | Software Engineering | Dr. Alexander Borusan<br>(provisional)<br>+49 (0) 30/2 43 06-1 00 |  |
| | Dependable Systems | Dipl.-Inform.<br>Rainer Mackenthun<br>+49 (0) 30/2 43 06-1 30 |  |
| **Application Labs** | IT for Medical Facilities (MIT) | Dr. Wolfgang Glitscher<br>+49 (0) 30/2 43 06-4 88 |  |
| | Technical Due Diligence | Dipl.-Ing. Eric Siegeris<br>+49 (0) 30/2 43 06-4 55 |  |
| **Basic Research** | Department Computation and Information Structures (CIS), Technical University of Berlin | Dr. Ralf-Detlef Kutsche<br>+49 (0) 30/2 43 06-1 20<br>+49 (0) 30/3 14-2 35 57 |  |

# Imprint/Contact


## Imprint

**Editor:**
Ines Jansky

**Contributors:**
Dörte Badawy
Jens-Helge Dahmen
Claudia Gabler
Rainer Mackenthun
Linda Tidwell

**Design:**
Jens-Helge Dahmen

**Digital Composings:**
Susanne Gerlach

**Translation:**
Joe Greenman

**Photos:**
Fraunhofer ISST
Inge Kundel-Saro (Page 2)

**Address of the editorial office:**
Fraunhofer-Institut für
Software- und Systemtechnik ISST
Institutsteil Berlin
Mollstraße 1
10178 Berlin
Germany





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## Contact


**Berlin Branch**

*Press and Public Relations*
Ines Jansky
Fraunhofer-Institut für
Software- und Systemtechnik ISST
Mollstraße 1
10178 Berlin
Germany

Phone: +49 (0) 30/2 43 06-2 00
Fax: +49 (0) 30/2 43 06-1 99
E-mail: pubrel@isst.fraunhofer.de

**Dortmund Branch**

*Marketing/Business Development*
Dipl.-Volkswirt Carsten Lienemann
Fraunhofer-Institut für
Software- und Systemtechnik ISST
Emil-Figge-Str. 91
44227 Dortmund
Germany

Phone: +49 (0) 2 31/9 76 77-1 61
Fax: +49 (0) 2 31/9 76 77-1 98
E-mail: lienemann@do.isst.fraunhofer.de

*Press and Public Relations*
Britta Schmitz B. A.
Fraunhofer-Institut für
Software- und Systemtechnik ISST
Emil-Figge-Str. 91
44227 Dortmund
Germany

Phone: +49 (0) 2 31/9 76 77-1 60
Fax: +49 (0) 2 31/9 76 77-1 98
E-mail: info@do.isst.fraunhofer.de