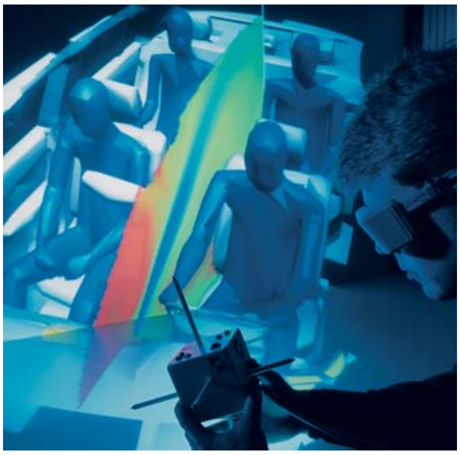
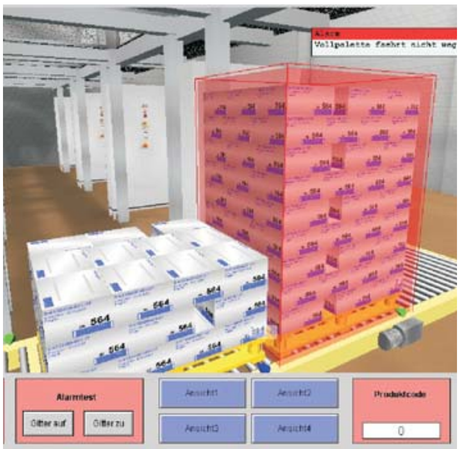
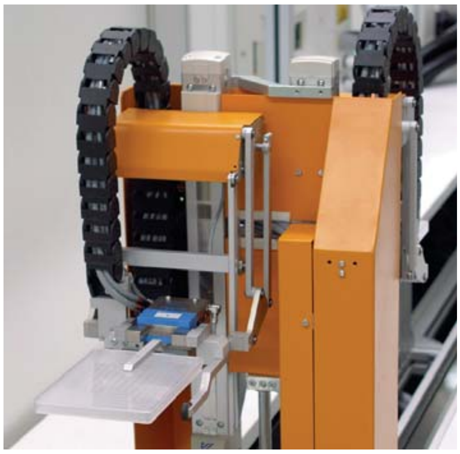
Fraunhofer

Institut
Fabrikbetrieb
und -automatisierung

Achievements and Results
Annual Report 2003







Achievements and Results
Annual Report 2003

Contents

Foreword

Esteemed Ladies and Gentlemen,
Dear Business Partners and Friends,

2003 was a very profitable year for the Fraunhofer IFF, The indicator »revenue from industry« again makes up approximately 50 % of our operating budget. The balance brought forward from the previous year will increase slightly.

On the one hand, the economic situation is the result of market acceptance of science and research services provided by the Fraunhofer IFF. On the other hand, it creates the prerequisites for further developing and establishing new fields of research.

In the last five years our institute has been able to exhibit continuous growth overall and thus create a solid basis for a further milestone in the development of the Fraunhofer IFF: The construction of the Virtual Development and Training Centre VDTC.

Planning work for the new building already began in December 2003. We expect construction to start in fall of 2004. This will open many promising prospects particularly for startups and spin-offs.

The project reports presented here are only a small selection and are intended to provide you a brief overview of our research and development projects completed in 2003.

I wish you much enjoyment reading our annual report. Perhaps it will give us inspiration for new projects!

Prof. Michael Schenk
Director

Mission

The Fraunhofer Institute for Factory Operation and Automation IFF is a decentralized scientific institution in the Fraunhofer-Gesellschaft's network.

As a regional, national and international partner its task is to use its work in application oriented research to contribute to directly benefiting the economy and benefiting society.

The institute's technological orientation revolves around conceiving, developing and realizing innovative and customized solutions to problems in the fields of

- Logistics
- Automation
- Production and Plant Management
- Information Logistics
- Virtual Development and Training

The Fraunhofer IFF works market oriented and is globally active.

To meet the demand for holistic solutions it is integrated in an international research network of partners from the scientific and business communities.

In order to employ our own creativity and external impulses to guarantee an ongoing exchange of knowledge and experience, a network of associated academics and representatives from leading industries actively supports the work of the Fraunhofer IFF.

The Fraunhofer IFF is an active member of national and international bodies in the represented sectors and as a result fundamentally shapes innovation processes in the state of Saxony-Anhalt.

As a research service provider in Saxony-Anhalt, one important concern is developing upcoming generations both for regional business and challenging positions in the scientific community. The Fraunhofer IFF thus fulfills a valuable social responsibility.

Striking the balance betweeen economy and ecology as well as implementing the rules of excellent scientific and technical practice are the basis of all our associates' work and a personal responsibility.

Our associates' combination of technical-technological expertise and soft skills typify the quality of our products and services.

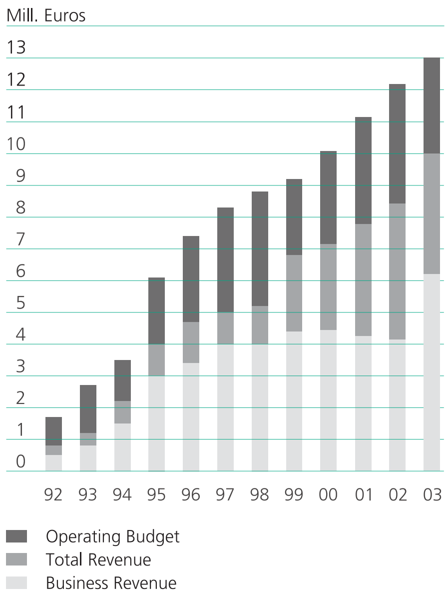
Our associates work in interdisciplinary teams and cooperate closely with our clients. Such collaboration is characterized by mutual trust, integration as partners, practical application and user orientation.

Design of the VDTC building at the Scientific Port in the state capital of Magdeburg

Board of Trustees

The boards of trustees of the individual Fraunhofer Institutes support institute management and the Fraunhofer-Gesellschaft's executive board in an advisory capacity. Members are individuals from the scientific community, the business community and public authorities.

The Institute in Numbers



Operating Budget and Earnings Trend

In 2003 operating budget expenditures amounted to € 13 million. Total revenues rose to € 10 million. Business revenues totaled € 6.2 million.

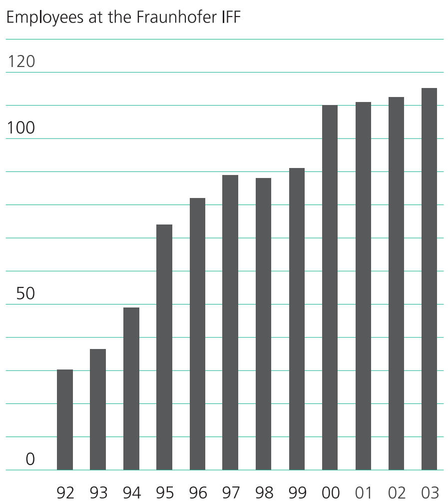
Investment Budget

Investments totaling € 0.7 million were made in 2003.

Equipment

The Fraunhofer IFF in Magdeburg has 5,000 m² office space and high-tech EDP laboratories and conference rooms. A testing facility of 1,300 m² provides technologies – virtual reality, industrial image processing, robotic, alternative energy production, rapid prototyping – for research and development.

The hardware and software encompasses tools and environments for the application of geographic information systems, for idea generation and assessment, for information and communications management, for interactive factory and system engineering, for multimedia communication and for software development.



Personnel Development

At the end of 2003, 115 employees were working at the Fraunhofer IFF. Our associates are predominantly engineers and industrial engineers. Degree holding computer scientists, mathematicians, physicists and business people ensure disciplinary work.

Training and Qualification

Over 180 student assistants and interns support the institute's work.

In 2003, sixteen Diplom theses received advising at the Fraunhofer IFF in cooperation with the Otto von Guericke University Magdeburg in particular.

We offer internships for institutions of continuing education and high schools.

Fraunhofer Institut for Factory Operation and Automation

VDT Virtual Development and Training
Dr. Eberhard Blümel

- **VS** Visual-Interactive Systems
  Dr. Axel Hintze
- **VIT** Virtual Training
  Mr. Stefan Stüring
- **VD** Virtual Development
  Dr. Steffen Strassburger
- **VP** Virtual Prototyping
  Dr. Rüdiger Mecke
- **VE** Harz Regional Competence Center
  Virtual Engineering for Products and Processes
  Mr. Marco Schumann

IFL Information Logistics
N.N.

- **PIM** Process and Information Management
  Ms. Andrea Urbansky
- **WIM** Knowledge and Innovation Management
  Mr. Hans-Georg Schnauffer
- **ITS** Information Systems
  Ms. Claudia Wilke
- **KDG** Public Private Partnership European Competence Center IT Services and Business Processes
  Dr. Ina Ehrhardt

LSN Logistics Systems and Networks
Dr. Carlos Jahn

- **LS** Logistics Strategies and Networks
  Mr. Holger Seidel
- **LP** Logistics System Planning and Operation
  Dr. Klaus Richter
- **LE** Environmental Engineering
  Mr. Peter Rauschenbach
- **MC** Mass Customization
  Mr. Ralph Seelmann-Eggebert
- **ICCL** International Competence Center Logistics
  N.N.

AUT Automation
Dr. Ulrich Schmucker

- **ISS** Intelligent Sensor Systems
  Mr. Dirk Berndt
- **RS** Robotic Systems
  Dr. Norbert Elkmann
- **LA** Laboratory Automation
  N.N.

Division

Department

Project Group

Director Prof. Michael Schenk

PAM Production and Plant Management

Dr. Gerhard Müller

PAT Process and Plant Engineering
Dr. Lutz Hoyer

PPM Product and Process Management
Ms. Susan Gronwald

SIM Security Management
N.N.

LLS O. v. G. University Chair for Logistic Systems
Prof. Michael Schenk
Dr. Rico Wojanowski

Competence Center

Competence Center Visualization Techniques
Prof.Thomas Strothotte
Dr. Stefan Schlechtweg

Competence Center Information Engineering
Prof. Claus Rautenstrauch

Competence Center Logistics Workshop-Simulation Techniques
Prof. Dietrich Ziems
Dr. Thomas Schulze

Competence Center Robotics and Machine Vision
Prof. Frank Palis
Prof. Bernd Michaelis

Management

Director
Prof. Michael Schenk

Acting Director
Dr. Gerhard Müller

Office Manager
Ms. Ines Trübe

Organization and Communications Manager
Ms. Sabine Conert

Public Relations and Marketing Manager
Ms. Susanne Rabe

Adminsitrative Services
Ms. Helga Mägdefrau

Otto von Guericke University Magdeburg

Encounter – Experience – Learn: Human and Machine in Interactive Dialog

Dr. Eberhard Blümel
Division Director VDT

VDT Virtual Development and Training
Dr. Eberhard Blümel

VS Visual Interactive Systems
Dr. Axel Hintze

VIT Virtual Training
Mr. Stefan Stüring

VD Virtual Development
Dr. Steffen Strassburger

VP Virtual Prototyping
Dr. Rüdiger Mecke

VE Harz Regional Competence Center
Virtual Engineering for Products and Processes
Mr. Marco Schumann

Project Reports

A Virtual Engineering Toolkit for the Interactive Visualization Platform VDT

Motivation

In recent years, virtual reality (VR) technologies have assumed increasing importance as planning and development resources in the early phases of the product life cycle. Their use is being advanced most notably in large scale industry such as the automotive industry or the aircraft industry. Virtual models of parts, complex products and entire plants help not only visually evaluate design variants but increasingly also test the function of products and optimize them long before they physically exist.

Small and medium-sized enterprises (SMEs), in particular suppliers for large scale industry, are under competitive pressure to keep up in this field of technology even though they do not have the VR labs, VR specialists and investment power of big companies.

The increasing use of 3-D CAD systems and the growing power of today's PC hardware, particularly graphics cards are creating favorable conditions. In this situation there is a need for a flexible software basis and related concepts of use in order to facilitate concrete application projects in the technological field of Virtual Engineering in SMEs, even from economic perspectives

The project »Development of a Virtual Engineering Toolkit for Small and Medium-sized Enterprises« took an important step in this direction. The toolkit relies on the visualization platform VDT and updates it. This report provides a brief overview of the platform and the basic modules of the toolkit.

The Interactive Visualization Platform VDT

The interactive visualization platform VDT was developed in preceding years from the aggregation and systematic provision of all usable concepts and software modules from a whole series of the Division of Virtual Development and Training's research projects on the interactive visualization of complex products and the division's know-how in the technical environment.

Main components of the platform are

- A flexible scenario concept:
  All data including reciprocal links for the concrete case of application, e.g. a printing machine the totality of which is represented by a virtual model (geometries, materials, movement options, causal relationships, functions, reactions, potential failures, machine behavior etc.)
- The scenario player:
  An executable program for using scenarios with universal functions for responding to or interacting with the concrete data (user navigation in the virtual world, grasping and manipulating objects, decisions making, etc.)
- The authoring system:
  For generating or modifying VR scenarios that enable experts in a field of application to turn their concrete know-how into consistent scenarios without having the knowledge of a computer specialist.

Tools for Process Engineering

This module provides data structures and functions to integrate simulation modules. The possibility was created to supply all scenario objects with freely definable object properties, such as processing and waiting times, temperatures, degrees of wear etc. Thus a starting application project can implement input and output interfaces to integrate external simulation systems. In this way, an interactive 3-D planning layout can change the selection and arrangement of the machines in the VR environment and - following an internally activated simulation run - even visualize the impacts, e.g. changed throughputs, in the same environment.

Post-Visualization of Simulations for Product Optimization

In product development, parts are optimized for strength, deformations as well as vibration and temperature behavior by using the finite element method (FEM) to make calculations usually made by FEM specialists as an external service. To do this, expensive FEM systems are used, which also have function to evaluate the results of calculations. Clients lack this possibility at their workplace though, precisely where flexible and interactive analysis of a preliminary version is needed when determining measures for optimization.

The post-visualization module can be used in the visualization system to visualize, animate and interactively evaluate networks and data arrays from FEM calculations.

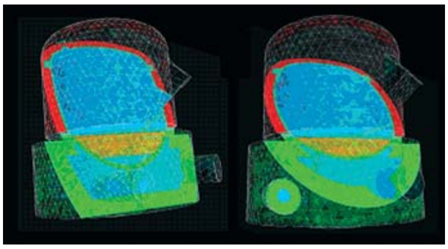


Figure 1: Interactive sectional plane in FE structure.

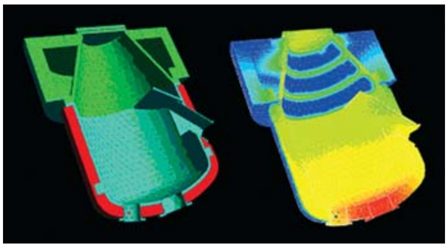


Figure 2: FE network and temperature field.

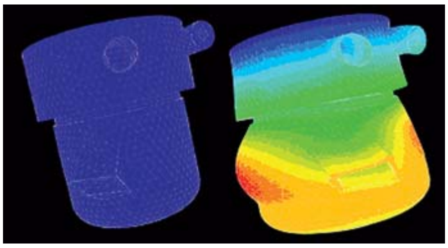


Figure 3: Exceeded deformations and related tensions.

Tools for Collision Analyses

Collision calculations play an important role in product development: On the one hand when testing preliminary designs for freedom from collision and on the other hand when testing maintainability and dismantlability. The automatic detection of object overlaps is an important planning aid in interactive 3-D layout planning too. A collision detection library was integrated as part of this module and the possibility was created to test any scenario objects incorporating all their geometric points for collision with other objects.

Import Filter for Data from CAD/CAE Systems

The most direct way to be able to realistically render real machines or equipment in virtual scenarios is to transform the respective object geometries from the design engineers' 3-D CAD systems into the facetted geometry of the VR systems. This is done by a number of converters developed and available for data from the CAD systems CATIA, ProEngineer, IDEAS and SolidWorks.

Software-aided Interaction Mechanisms

Conventional VR applications make use of special peripheral hardware (data helmet, data gloves, tracking systems, etc.) to achieve realistic interactions and the feeling of immersion. The objective for the »toolkit« was to model realistic interactions (e.g. typical engineer activities such as detaching or attaching parts with the help of tools) on cost effective standard hardware (PC with monitor, keyboard and mouse). The outcome was the implementation of an interaction concept, which is geared toward the handling of computer games, is easily understood and can be operated without additional hardware.

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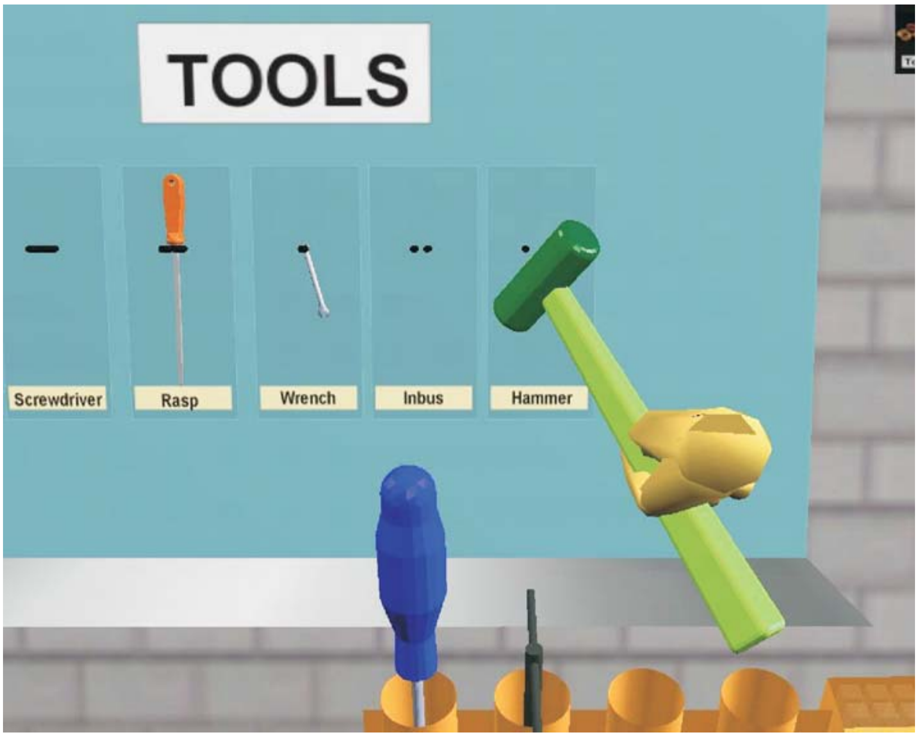
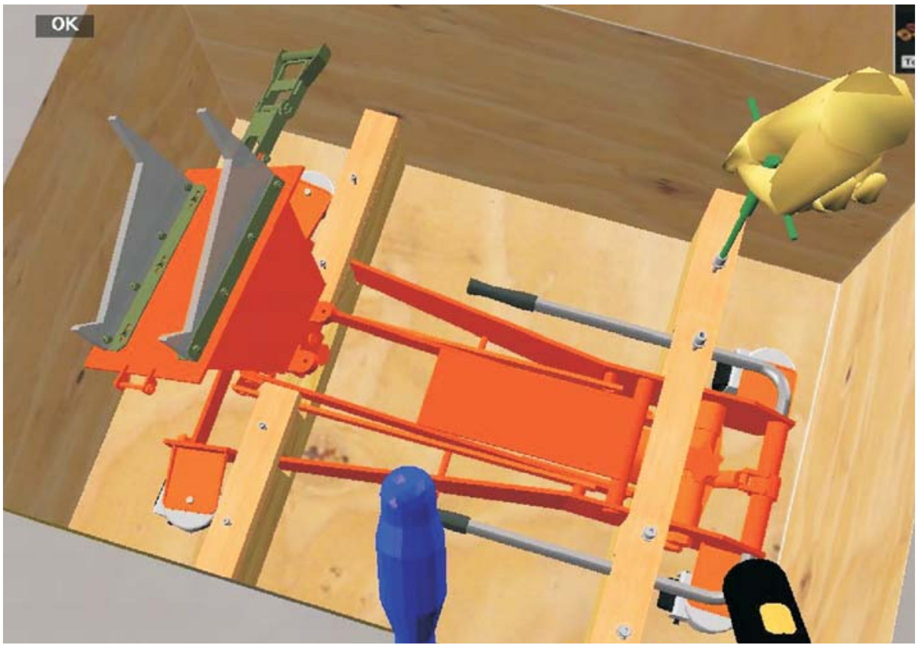


Figure 5: Tool selection and storage in tool belt.



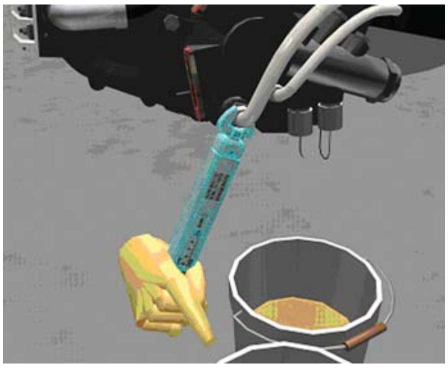


Figure 4: Virtual oil change on a generator.

Figure 6: Loosening bolts with an Allen wrench.

AITRAM: Innovative Training Methods and Technologies for Airplane Maintenance

Motivation

The objective of AITRAM (Advanced Integrated Training in Aeronautics Maintenance) is to make a contribution to improving the learning process by developing an innovative training system for aircraft maintenance based on innovative teaching concepts, new cognitive research approaches and visual-interactive simulation. It emphasizes the integration of task-oriented training with human factor training.

Improvements in the learning process are oriented toward the objectives of

- Reducing the time, costs and risks of training
- Improving functions to make complex contents more accessible for trainees
- Learning more through one's own actions; e.g. learning by doing
- Making training more attractive
- Learning from mistakes
- Providing support for better general comprehension of a technical system as well as the relationships and interactions of its components
- Prviding the means not only to acquire insight into human factor (HF) problems, but also to experience HF personally

Research Approach

The AITRAM approach is based on the following aspects of training

- Procedural analysis from HF perspectives
- Independent training/self-study and learner assessment
- HF in a task-oriented environment
- Creating maintenance technicians' awareness of HF problems and strengthening this through their own experiences in scenarios (e.g. relating to the delegation of tasks, time pressure, careless mistakes in routine jobs, communications deficits, disregarding/shortcutting a designated operation, false diagnosis, absence of checks, oversight)
- Improved job planning
- Active training of jobs in a virtual environment

AITRAM supports various employee target groups

- Technicians working off individual jobs according to a procedural description
- Technicians with responsibility for an entire operation, a procedure
- Technicians with monitoring/inspection jobs

Results

The AITRAM training system consists of three main components

- The scenario concept
- The authoring system
- The runtime system for completing training

While the runtime system is the part of the system trainees and trainers use when completing course units, the authoring system is used by an author to develop training courses and their lessons. The scenario concept constitutes the fomal basis for saving the training content produced by an author and used by the runtime system.

The AITRAM training system builds upon the results of the project TRAIMWE (cf. [6], [7]). Further development emphasized improving the modeling of causal relationships and the depiction of the behavior of objects as well as integrating a course structure with chapters and lessons. Moreover the options for testing knowledge and obtaining learner feedback were expanded.

Further development necessitated expanding the existing scenario concept and supplementing the data structures. In addition, the authoring system had to be upgraded accordingly. Another emphasis was significantly reducing the effort to create course units.

In the project, three course units from the fields of line maintenance and heavy maintenance for the Airbus A320 aircraft family were developed as prototypes.

The technical educational contents were implemented in accordance with manufacturer documentation, in particular the Aircraft Maintenance Manual AMM.

The maintenance tasks depicted include

- Installation and removal of the aileron servo control unit (ASC)
- Oil level check and oil change on the integrated drive generator (IDG) of CFM56 engines
- Installation and removal of the auxiliary power unit APU (APU)

All course units share the following structure

1. Introduction
   Preparatory information important for the job

2. Components
   General and job-specific information on the components that play a role in the job.

3. Materials/accessories/tools
   General and job-specific information on materials, accessories and tools, needed to complete the job.

4. Procedure for working off the job in three modes: Presentation, tutorial (guided mode) and test (free mode)

5. Procedure with HF in three modes: Presentation, tutorial (guided mode) and test

Figure 1: View of an airplane with ASC unit.

The procedures each consist of three sections: Preparation, installation/removal and postprocessing. The design of the procedure-based lessons can best be described with the concept of »authentic learning« (following Prof. Sven Anderson at Linköping University): Trainees do not learn and do their work in a simplified lab environment free of external influences but rather in a virtual environment modeled as realistically and tangibly as possible, i.e. not only the task itself but also influencing factors were modeled e.g. workplace layout, communications processes, realistic tools, etc.

Evaluation

All training lessons developed were evaluated by typical end users from production trainers to experienced mechanics and apprentices. Among others, criteria for evaluation were usability/ergonomics, transferability of the material learned to reality, accuracy of reproduction as well as benefits and value added for trainees and companies. The overall result was positive although the system is prototype that can definitely profit from improvements to the user interface.

Aside from using the AITRAM system in training, one important prospect for further development and application of the AITRAM system the evaluation supported is the extreme usefulness of access to the AITRAM system for technicians during their work to systematically use the system as a reference work for tasks that are not routine jobs and to complete work for which conventional documentation is difficult more efficiently.

Outlook

Fundamental elements of the technology developed for AITRAM are so well developed that they can be transferred to industrial application. Furthermore, companies can use AITRAM to manage technical knowledge. In addition, a planner can use AITRAM to support maintenance work planning by using it to relatively accurately estimate the time needed for specific maintenance work.

In terms of research, the concept of »authentic learning« needs more study. Particularly interesting is what functions of virtual training systems and what design options of VR training courses positively influence learning performance.

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Project
Financial support for the AITRAM project was provided by the European Union in its 5th Research Framework Program IST DG INFSO.

Collaboration

- Research institutions and companies from the field of civil aviation (AirEurope Volare Group, FLS Aerospace Ltd. and SR Technics)
- Research institutes focused on training and human factors in aviation (EC Joint Research Centre in Ispra and Aerospace Psychology Research Group (APRG) of Trinity College Dublin)
- Coordination and system development focusing on virtual-interactive training (Fraunhofer IFF, Division of VDT)

Literature

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[2] Caird, J.K. (1996). Persistent Issues in the Application of Virtual Environment Systems to Training. IEEE Computer Society: Human Interaction with Complex Systems, 3, 124-132.

[3] Cunningham, D. (1993). Tools for Constructivism. In Duffy, T., Lowyck, J., & Jonassen, D. (Eds.). Designing Environments for Constructive Learning. New York: Springer.

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[7] Hintze, A.; Schumann, M.; Stuering, S. (1999). Distributed Virtual Training Applications for Education of Maintenance and Service Personnel. Paper EIT-024 presented at the I/ITSEC'99, November 29 – December 2, 1999, Orlando, Florida/USA.

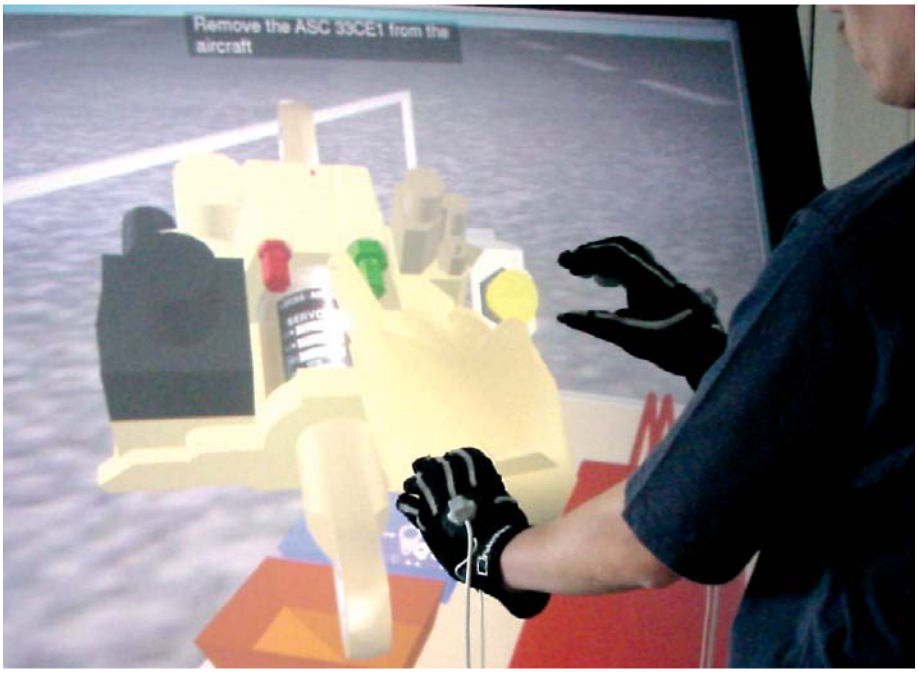

Figure 2: Advanced training for maintenance technicians in the aircraft industry.

BALTPORTS-IT: Simulation and IT Solutions for Baltic Ports

The project BALTPORTS-IT built upon the results of the already successfully concluded EU projects AMCAI, DAMAC-HP and SPHERE. The Fraunhofer IFF was also a partner in these two projects. While the past projects focused on researching potentials for optimization by means of computer simulation and developing prototype solutions, BALTPORTS-IT is implementing these results in such a way that industrial clients from the maritime sector can use them in applications.

The applications are oriented toward the management and control of harbor processes, specifically for the harbors in the Baltic region since, as new members of the European Union, they require special efforts to adapt their infrastructure to the transportation network of the other European partners. The term infrastructure relates not only to the rail and road network but especially also to the IT infrastructure.

Figure 1 shows a detail of the simulation model of the Baltic Container Terminal Riga created by partners from the Technical University in Riga. The visualization facilitates the identification of bottlenecks. Computer models can be used to analyze measures for eliminating bottlenecks for their effectiveness and compare them with alternative strategies before they are implemented.

The project BALTPORTS-IT is creating a communication platform, which will promotes the exchange of information between researchers as providers of innovative IT solutions and industrial users. In no way is the exchange of knowledge only limited to the partners involved in the project however. Rather, a stated objective of the project is to make the collected experiences available to as broad a circle of interested parties as possible.

This is being done in two different ways. On the one hand, EU funding from the project in Riga is being used to establish a Baltic Sub-Regional Competence Center in which potential users will be able to obtain information about the IT services offered. On the other hand, a series of seven workshops is being organized as part of BALTPORTS-IT, which are specifically geared toward logistics users in maritime sectors. Predominantly cities in the Baltic region such as Riga (Latvia), Klaipeda (Lithuania), Tallinn (Estonia) and Gdansk (Poland) are planned as the venues.

The outcome of the project will be the achievement of the following objectives

- Establishment of a Baltic Sub-Regional Competence Center in Riga
- Adaptation of the simulation models or information systems developed in the projects AMCAI and DAMAC-HP to the special requirements of the users
- Transfer of the research results at a total of seven workshops with some 300 participants from some 60 companies
- Setup of a WWW server with callable simulation and information systems as well as regularly updated information on IT activities in maritime sectors
- Publication of a handbook describing the experiences from the BALTPORTS-IT project

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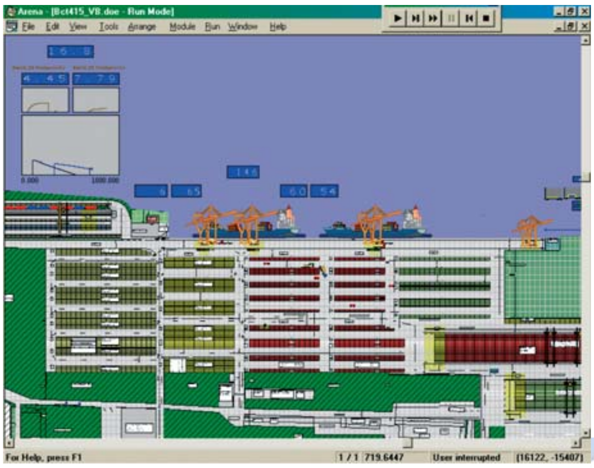

Figure 1: Simulation model of the Baltic Container Terminal in Riga.

Collaboration
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Figure 2: The BALTPORTS-IT partners: 13 institutions from 6 countries.

ProDiMA: Development of Innovative Products and Services Utilizing VR Technologies for Small and Medium-sized Mechanical and Plant Engineering Enterprises

Motivation

Mechanical and plant engineering is a structurally defining cluster in Saxony-Anhalt, which in the past was especially affected by restructuring and privatization. Today, many small and medium-sized enterprises (SME) exist in the region, the competitiveness of which is significantly determined by their success in developing high quality technical products and marketing them nationally and internationally. This generates new challenges which can be dealt with separately in individual SMEs only with difficulty. Rather, collaboration in regional innovations networks is required, which, among other things, are instrumental in protecting the state's competitiveness and ensuring its sustainability. Among other things, the outcome was new services for technical products. Today, these services can only be provided on the basis of I & C technologies, in particular VR technology.

The use of VR based services and products is already customary today, above all in large scale enterprise. Thus, for example, companies in the automotive and aviation sector are effectively using them in the development, testing and the operation of new, complex products to be able to launch these products on the market more cost effectively and more quickly. In conjunction with this, their competitiveness increases. Transferring the accumulated experiences, results and advantages to SMEs is possible only to a limited extent however. Insufficient funds and hardware and software prerequisites as well as insufficient human resources and unsuited products are currently hindering the effective introduction of appropriate services in SMEs.

In order to provide SMEs access to these technologies, special services centers are needed such as the Virtual Development and Training Centre (VDTC) being built in Magdeburg not only for regional but also national business. The model project ProDiMA is embedded in the overall strategy for developing up the VDTC and links demand-based developments of instruments and technologies with corresponding preparations in SMEs and practically relevant documentation of the successful use of these developments.

The objective is to provide services now for the digital factory, for the development and marketing of products and advanced training based on modern VR technologies.

The model project's thematic orientation was defined together with the partners around the entire range of task complexes for and in SMEs such as »VR based product documentation«, »Technologies for Training on Complex Machines«, »Visual-Interactive Product Presentation« and »Virtual Product Development«. Another object of the model project is the formulation of proposals and approaches to disseminate the results achieved in order to make these available to a wide range of potential users and studies of the suitability and use of the results achieved in the international context.

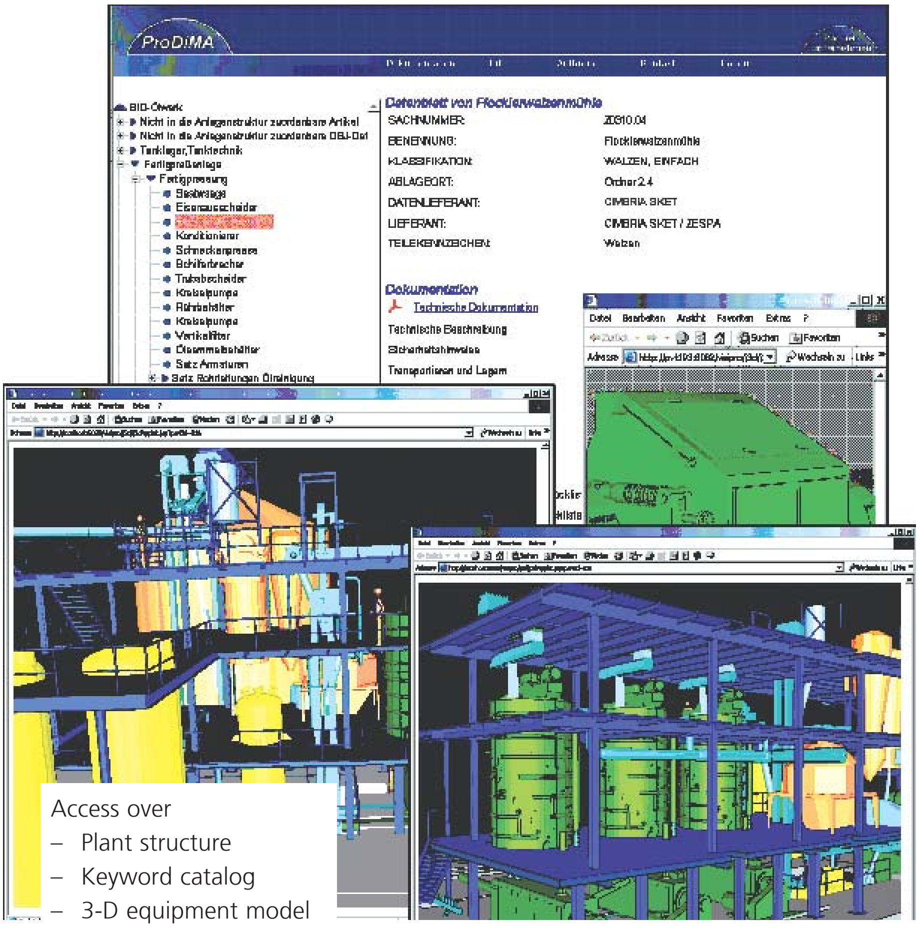


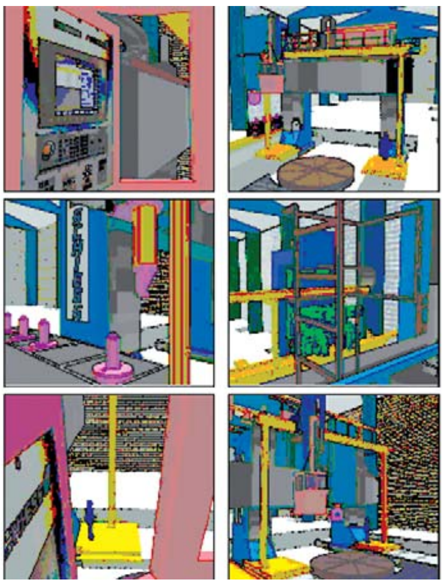
Figure 1: Demonstrator for managing and providing documentation on products.

Project Results Achieved

– Development of a prototype demonstrator for managing and providing documentation on products including the creation of a new VR model-based document access system:
Processing of all the information necessary for validating the project results taking the Bio-Ölwerk Magdeburg as an example (Figure 1)

– Development of all required technological bases and prototypical provision of a new demonstrator for training machine operators of large-scale plants:
Processing of all the information necessary for validating the project results taking a portal milling machine as an example, operator training using the virtual reproduction of the machine and virtual operator elements being made possible in the first stage (Figure 2).

Figure 2: Demonstrator for training machine



operators of large-scale plants.

– Creation of new possibilities for presenting innovative products and processes taking a ship unloading systems for bulk cargo as an example:
Provision of selected prototypical scenarios for operating the system as part of a new training demonstrator to be designed and processing of all the information necessary for validating the project results such as 3-D models, functional specifications, etc. (Figure 3).

Figure 3: Presentation of innovative products and processes taking a ship unloading system for bulk cargo as an example

– Creation of possibilities for visualizing assembly activities in different spaces taking a complex generator as an example :
Processing of all the information necessary for validating the project results such as 3-D models, different spaces, assembly operations etc. (Figure 4).

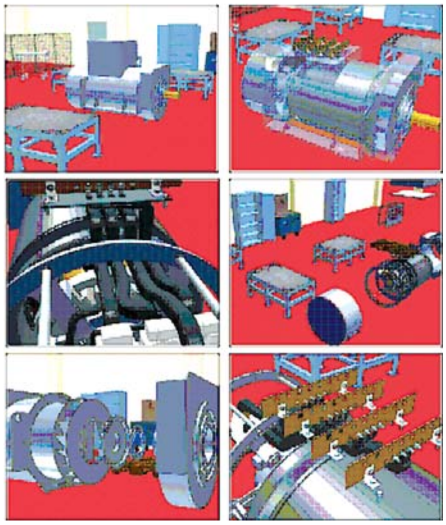


Figure 4: Visualization of assembly work in different spaces taking a complex generator as an example.

Today, these technological developments are generating foreseeable effects toward increasing competitiveness and creating competitive jobs, which will be sustained by successes in the process of innovation. Thus an effect is being produced toward sustainable regional developments, which will have a model character for the development of high quality innovation systems in Saxony-Anhalt.

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– Schiess AG, Aschersleben
– Anhaltische Elektromotorenwerke Dessau GmbH
– SIGMA Innovationsgesellschaft mbH, Magdeburg

ProDiMA: Technologies for Training on Complex Machines: Operator Training on a Virtual Portal Milling Machine

Motivation

The project is an integral part of a framework project for the development of innovative products and services utilizing VR technologies for small and medium-sized mechanical and plant engineering enterprises (ProDiMA).

The subproject »Technologies for Training on Complex Machines« represents the use of virtual reality (VR) technologies to train personnel on a heavy tool machine. Virtual reality is understood as the creation of a three-dimensional graphic model that can be used in an interactive training environment. In the process, not only the future machine operators at an end client's facilities but also the manufacturer's maintenance and service personnel, who have to be appropriately trained, had to be taken into account as target groups. While the project was being completed it became additionally apparent that the model created constituted an excellent possibility for documentation especially on the international market.

The project was completed with the objective not only of developing a one-time solution but also of demonstrating a model solution for small and medium-sized enterprises. Especially in small and medium-sized enterprises, a frequently cited argument for the reluctance to use VR technologies is the high cost. This is true whenever VR technologies are considered in isolation from other applications. However this project was able to demonstrate that the costs incurred could be reduced to a cost effective level if VR technologies were used with other development trends to let synergies develop.

CAD Data Transfer

3-D data could be accessed from the project partner the Schiess AG, a long established medium-sized enterprise in Saxony-Anhalt. In view of the market requirements, this manufacturer of heavy tool machines uses a 3-D CAD system when designing new developments. This favorable situation was taken advantage of to create an operator training model for a project currently in development.

One challenge was the great complexity and accuracy of detail of the individual assemblies used in mechanical and plant engineering as well as the size of the portal milling machine to be reproduced. The detail used in design is not needed for the training purposes aimed at here. The objective of virtual training is to give trainees the possibility to acquire knowledge in the virtual model they can transfer to real equipment.

The detail could be reduced beforehand in the CAD system. Furthermore a converter had to be developed to transfer the data to the virtual development and training platform (VDT platform) developed at the Fraunhofer IFF. In addition to the graphic data, the machine control functions had to be implemented in the virtual model. These were modeled on the basis of several on site meetings together with the project partners. The outcome was the development of a training scenario with reproduces the manual operation of the portal milling machine and the die heads along the CNC axes.

Figure 1: Vertical machining center in gantry construction (photo: Schiess AG).

Foundation for Other VR Projects

Along with the immediate project results, the conclusion that VR technologies can be advantageously used not only in large concerns but also in small and medium-sized enterprises is an important insight. The project enabled the Schiess AG to start using VR technology and the project partner is confident they will deepen their use of VR in subsequent projects. The experiences gathered in this project will accelerate the creation of VR models in future projects.

A further starting point for future collaboration is the use of VR models for purposes of documentation. This provides the Aschersleben company an important competitive advantage particularly on the international market.

When the effort needed to create and update multilingual documents is compared with the one time effort to create a virtual 3-D model, this objective appears realistic

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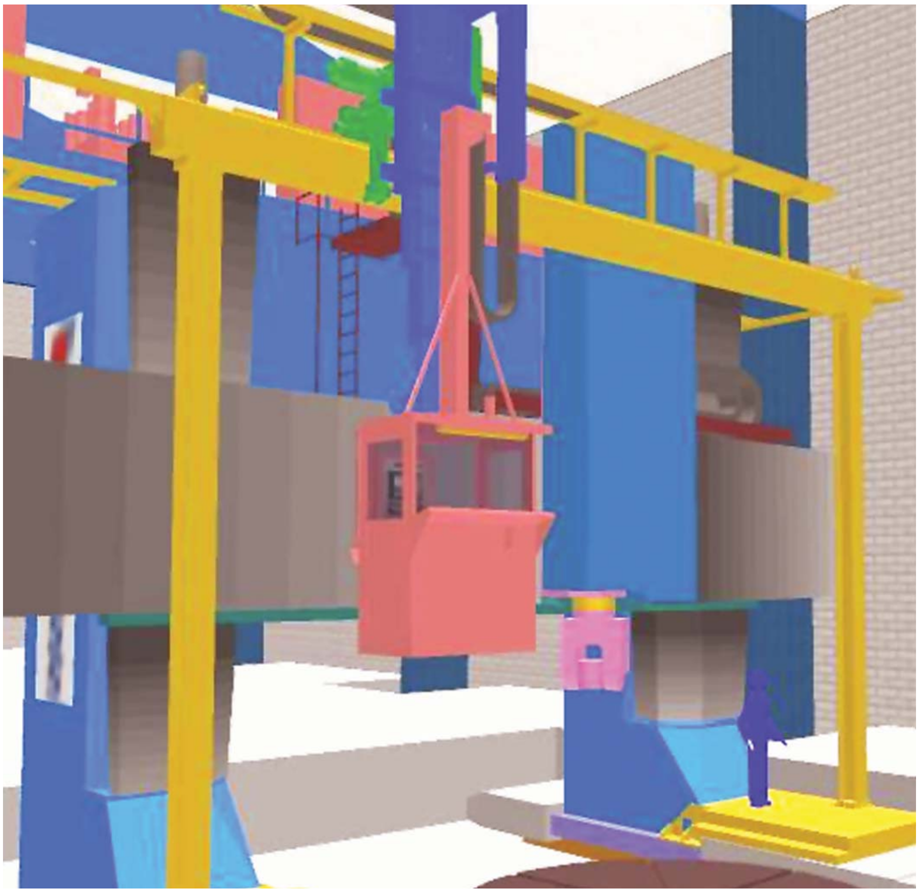

Figure 2: Virtual model of a portal milling maschine.

Visual-Interactive Training in the Production Environment

Motivation

Together with Rautenbach Guss Wernigerode GmbH, new possibilities were developed at the Fraunhofer IFF to train employees in core molding. The objective of the project was to create an instrument that makes it possible to train employees to practically handle the core shooter with little risk and safely without needing blocked times on a real machine and without incurring high costs by incorrectly operating machines. The method employed to do this used visual-interactive models of the real machine. A training scenario for the operation of a cold box machine had to be developed for core molding.

The configuration of the cold box machine scenarios had to achieve the following objectives

- Becoming acquainted with the core shooter and its basic parts
- Presenting and using the necessary assembly tools
- Presenting the core box change procedure
- Learning operation from core box change through cleaning
- Representing the impact of errors

The scenario is intended to be used to teach and train the design, assemblies, operation and setup procedures on the core shooter. The trainee first acquires background knowledge about the design of the core shooter assemblies. A further task is learning the various steps of operation. Finally the scenario must teach the importance of carefully completing setup procedures, especially cleaning. A user is given a command of the cleaning operations and is enabled to use the tools needed for this, which the user can select in the scenario.

The Virtual Training Scenario

The basis for developing such new forms of learning is a virtual reality platform created at the Fraunhofer IFF for generating and using training scenarios. Along with machine geometry, assembly hierarchy and animations, it is also able to store their behavior in the model. A user can interact with the machine and experiences the same behavior on the model as on the real machine.

The model of the cold box machine was developed jointly by the Fraunhofer IFF and Rautenbach Guss Wernigerode GmbH. Taking the manufacturer's CAD data as the starting point, geometry and hierarchy were first configured and the machine animations on which it is based were stored in the scenario.

A user can interactively navigate in scenarios, explore the machine three-dimensionally on the model and view individual assemblies and their motion sequences. A user can use an exploded view to obtain an overview of the core shooter.

Along with presenting the assemblies serving as the basis, users can also let core box change operations be demonstrated and subsequently perform them themselves. They can use animations, functionalities and procedures to train on the virtual model.

A user can enter into interaction with the machine through the machine's operator console. A functional model of the machine is stored in the scenario. The controls on the model behave just like the real controls, i.e. by activating the controls, users can control the virtual machine just as they can the real machine. Thus, for example, they can initiate a manual or automatic core box change, move the core box into the machine room or release the first shot after the core box has been prepared.
A special focus of the training is teaching users the correct cleaning sequences.

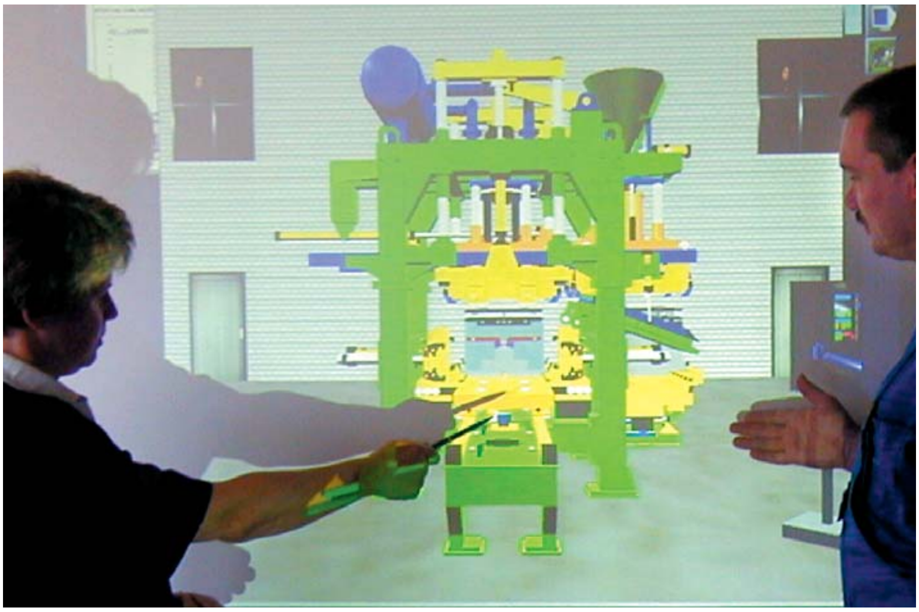

Figure 1: Virtual model of a core shooter.

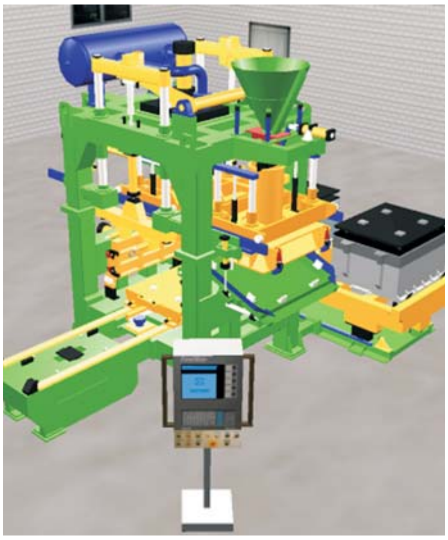

Figure 2: Core shooter with operator console.

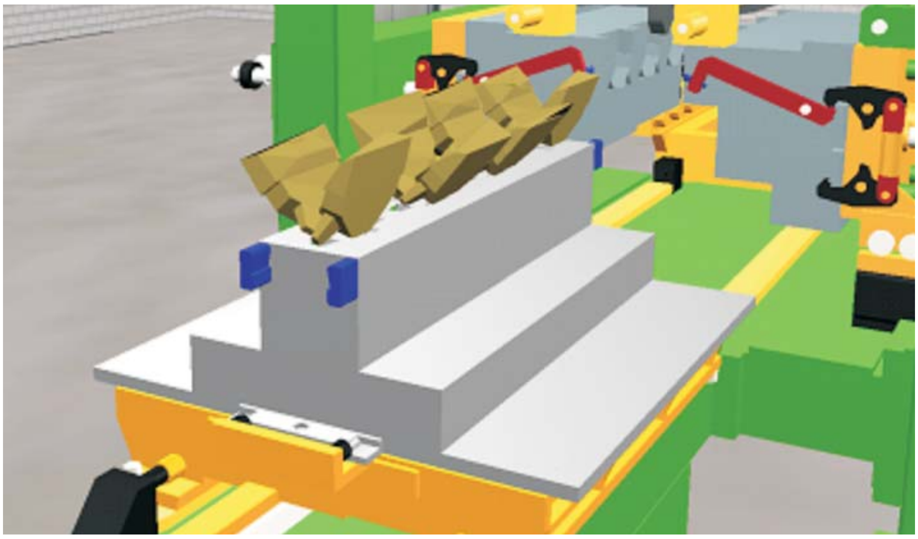

Figure 3: Defective core resulting from improper cleaning.

To do this, tools are available such as a broom, vacuum cleaner, ladder, etc., which a trainee must correctly select and use in the correct sequence on the correct part to successfully complete the required cleaning steps. Since the impacts of incorrect cleaning are stored in the model, an integral part of the training scenario is the possibility to represent errors. If the cleaning procedure is performed incorrectly, the consequences are experienced in the model. Among others, these are

- Leaky spots on the shooter head → sand shoots out of the seal on the shooter head and cores are defective
- Uneven opening of side panels → cores break
- Neglected cleaning → the uptake is blocked when lifting

Apart from the presentation, guided training and free training are also available to advanced users, each mode differing in its level of user support and guidance. A trainee is first shown which actions on the operator console can trigger which machine reactions. Trainees can then perform these actions autonomously and, if they perform them correctly, they experience the desired machine reaction.

Training on the virtual model is connected with a number of other advantages over the real model. Among others, these are:

- Operations can be learned even on hard to reach spots such as the shooting plate in its working state
- Learning is low-risk in dangerous situations (e.g. when the machine's safety door is closed)
- Training does not cause the cold box machine to break down
- Impacts of errors can be experienced without a bad core actually being produced
- Training progress can be assesed when setting up the core shooter

Use of the Training Scenario

Since January 2004, this training scenario has been being used for training in core production. The program has been being used to train cold box machine operators since then. Continuation of training for employees by the forepersons of all three shifts is envisioned. Further use of the training scenario and increasing awareness of the importance of thorough cleaning of the core shooter will contribute to increasing process reliability at Rautenbach Guss Wernigerode GmbH.

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Forms of Computer and Internet-based Training for Foundries

Motivation

As part of a research project funded by the German Federation of Industrial Cooperative Research Associations »Otto von Guericke« (Arbeitsgemeinschaft industrieller Forschungseinrichtungen »Otto von Guericke« e.V. AiF) and jointly worked on by the Fraunhofer IFF and the Institute for Foundry Technology Düsseldorf IfG, virtual interactive models were used to make new forms of employee training possible for foundries.

As the training objective, the technique of training on virtual models provides the possibility to obtain knowledge about

- Assemblies and their design
- A machine's parts and assembly hierarchy
- The training object's mechanisms and functionalities
- Handling machine parts and controls
- Operating, servicing and maintenance procedures
- Impacts of errors

Visual-interactive 3-D models can help realistically acquire knowledge about typical foundry machines and their functioning independent of real, cost-intensive equipment.
The provision of such models over the Internet facilitates quick access wherever desired.

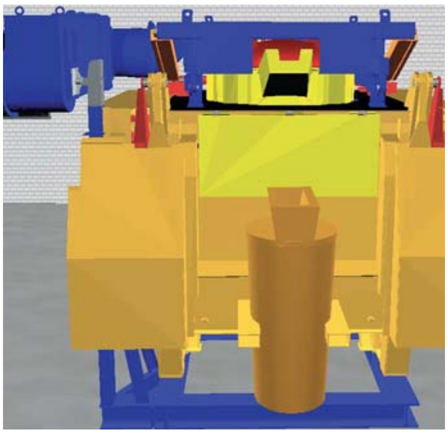

Figure 1: View of the crucible induction furnace.

Figure 2: Exploded view of the crucible induction furnace.

Creation of the Data Bases

The Fraunhofer IFF's VR platform was used to generate a training scenario. A crucible induction furnace was selected as the model example (Figure 1).

The objective of the scenario was to represent the operations in the core process of smelting in a foundry. To this end, procedures were configured for different materials on which the operations for smelting could be learned.

First, taking the manufacturer's CAD data as the starting point, the furnace geometry and hierarchy were virtually configured. As a result, a user can interactively navigate in the scenario. A users can use an exploded view to obtain an overview of the furnace and view individual assemblies as well as their correlations (Figure 2).

Furthermore, a user can use animations, functionalities and procedures on the virtual model to train the basic operations on the crucible induction furnace.

- Making up charge of the raw materials
- Heating up
- Deslagging
- Monitoring temperature kontrolle
- Taking and analyzing a casting sample
- Coireecting the analysis
- Adding additives
- Pouring of the finished melt (Bild 3)

In the scenario, a user can select between different levels of user support, presentation mode, guided training or free training. Users themselves can use the controls on the operator console to initiate the furnace's actions themselves.

The actions include

– Opening and closing the hood for deslagging
– Opening and closing the hood for making up the charge
– Opening and closing the hood for pouring
– Tipping the furnace for deslagging
– Tipping the furnace for pouring

In the free mode a user receives feedback at the end of training about the correctness of the training steps completed.

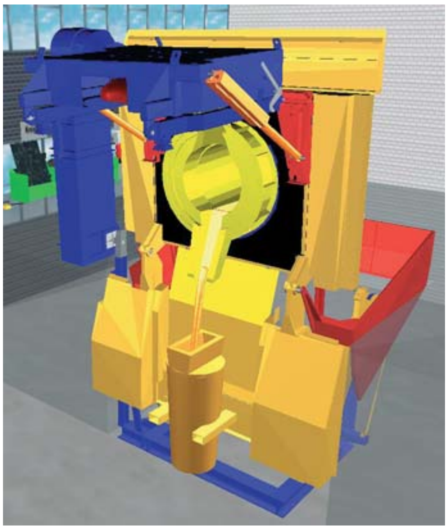

Figure 3: Casting the finished melt.

Transferring the Scenario to the Internet

One emphasis of the project was also processing scenario use for the Internet and providing examples. As a result, educational contents can be transmitted to users quickly and on demand. The interlinking of conventional hypertext documents with virtual training scenarios provides completely new possibilities for learning. To this end, it was also necessary to make, training scenarios available over the Internet.

The training scenarios described constitute the starting point for creating Internet-compatible, interactive, virtual 3-D models. The modeling language VRML was selected as the basis for being able to present training scenario information in the Internet. A converter converts it into an Internet-compatible form. What is more, the training scenarios were adapted for the Internet. Specifically, the quantities of data to be transmitted were too large and had to be edited by polygon reduction

The Cosmoplayer plugin freely available on the Internet serves as the runtime system for scenario visualization.
The Cosmoplayer can use such VRML files as visual-interactive scenarios.

Currently, scenarios allow

– Navigating in the scene (exploring the machines on the 3-D model)
– Learning the construction, e.g. through exploded views and highlighting of parts
– Displaying part information by selecting parts with the mouse
– Incrementally learning operator procedures with respective user information

Naturally, scenarios can also be used locally outside the Internet directly on a PC.

The scenario can be used as a locally available VR model with the Fraunhofer IFF's runtime system and was made available for the Internet in simplified form.

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Virtual Stadtplanung Using Interactive Visualization of Urban Structures and Objects

Motivation

Transformations in the wake of the reunification of Germany and social and political changes in Central and Eastern Europe have led to a large number of apartments being vacant. This trend is particularly strong in the so-called »Plattenbaugebieten«, areas with concrete slab apartment houses. In this context, eastern German cities and communities represent a particular economic and political challenge. Sustainable solutions must be developed to restructure affected urban areas.

Not even the capital of Saxony-Anhalt has been able to elude these developments. In order to find an appropriate response to recent urban exigencies, the city of Magdeburg gave the necessary urban development measures an appropriate framework in the form of a meticulously worked out urban development concept.

Since hitherto customary methods of recording and analyzing designs could not sufficiently do justice to urban development measures of this magnitude, a decision was made to use interactive visualization techniques.

In contrast to previous virtual models and computer animations, this virtual model will not only record and depict existing urban structures and designs but also edit them, present them and make it possible to discuss them using indicator analysis in the model's background.

Development of an Interactive City Model

As part of the »Virtual City« project an interactive city model was developed at the Fraunhofer IFF, which satisfied the aforementioned demands by implementing a complex data model or providing a virtual work and development platform.

Recording the historic Altstadt and recording the concrete slab apartment complex of Neu-Olvenstedt placed the focus of modeling on two important core urban areas. The historically evolved structures of the Altstadt on the one hand and the clear features of industrial prefabrication on the other hand necessitated individual objectives and differentiated methodologies during work on the project.

Along with aerial photographs of the city of Magdeburg, digital city maps and excerpts from land registers as well as various digitized urban inventories could be used as the basis for modeling Building upon this data, the actual structures in the Altstadt were generated in an intensive process of photogrammetric surveying and modeling. CAD data and preliminary work from the responsible planners were used to implement planned urban restructuring measures. »Virtual model modules« can be used to easily visualize these designs in the virtual city any time without having to interrupt the modeling. Structures can be altered and modified by users, relocated and analyzed at the same time.

Automatic generation techniques could also record secondary urban elements from existing digital registers such as tree stands and streetlighting, which considerably influence a city's appearance, and also position them in the model.

While the individual character of development around the Altstadt still stood in the way of automatically generating models of the structures, these methods could be applied to the Neu-Olvenstedt neighborhood. An inventory cataloged according to type of structure, facade and color as well as digital survey plans and registers were they basis for this method of working. Not only these existing architectural structures were integrated but also the urban planners' designs and visions. A menu system makes these optionally available to a visitor of the virtual model.

Diverse hardware options up through realistic perception with spatial image replication augment the concept of interactive visualization. In conjunction with using textures to photorealistically visualize facades, they lead to a more intensive experience of space. The deeper, multidisciplinary comprehension of the model and design achieved, ultimately also increase the quality of the model considerably.

The Virtual City Model

Today, the virtual model of the city of Magdeburg enjoys the approval of professional planners and residents of the city alike. Use of this development is not only reserved for professional planners and architects. The visualization concept has proven its worth at public meetings of citizens too. The city model's particular quality of communication and information facilitates early, democratic involvement of affected residents and thus contributes considerably to the quality of an urban development concept.

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Project Reports

Development of a Service Connector for Cooperative Bid Management

Motivation

Small and medium-sized enterprises (SME) in the plant engineering industry are increasingly facing short-term and complex requests, which cannot be managed by the company receiving the request alone and necessitate the involvement of other partially unknown companies. Since their range of services is typically often specialized, SMEs have difficulty surviving against large competitors in this context. A way out for SMEs is the opportunity to form virtual and temporary cooperations. The approach of collaborative commerce (c-commerce) supports this strategy.

The objective of the c-commerce approach is to reveal potential solutions to companies in order for them to be better able to manage both long-term and short-term contractual relationships and in particular cooperative relationships and to create ways to make local information available globally. Thus for SMEs in particular it becomes possible to form virtual ad hoc cooperations to be able to act as a general contractor or full service provider, since they are able to offer not only their own services but also the services of cooperation partners. It follows that the data in the service directories, which clients or suppliers have, has to be current.

Reasons for the very great effort needed coordination among the members of a virtual network of companies have crystalized from the projects FASA I and FASA II. In particular these include

– Service directories in companies have no standard structure and are incompatible.
– Media breaks occur at company boundaries because a multitude of various costing tools are used which lack any common interface to exchange costing data.

Approaches

Initial approaches to improving customer-supplier relationships can be found in supply chain management (SCM). The SCM approach provides the possibility to effectively organize a limited number of participating companies, which find themselves in long-term contractual relationships. The limits of this approach are reached whenever short-term, complex requests cannot be managed by the company receiving the request alone and necessitate the involvement of other partially unknown companies.

Since their range of services is typically often specialized, SMEs have difficulty surviving against large competitors in this context. By contrast, large-scale enterprises usually have a broad range of services or can expand as necessary by purchasing companies more easily than

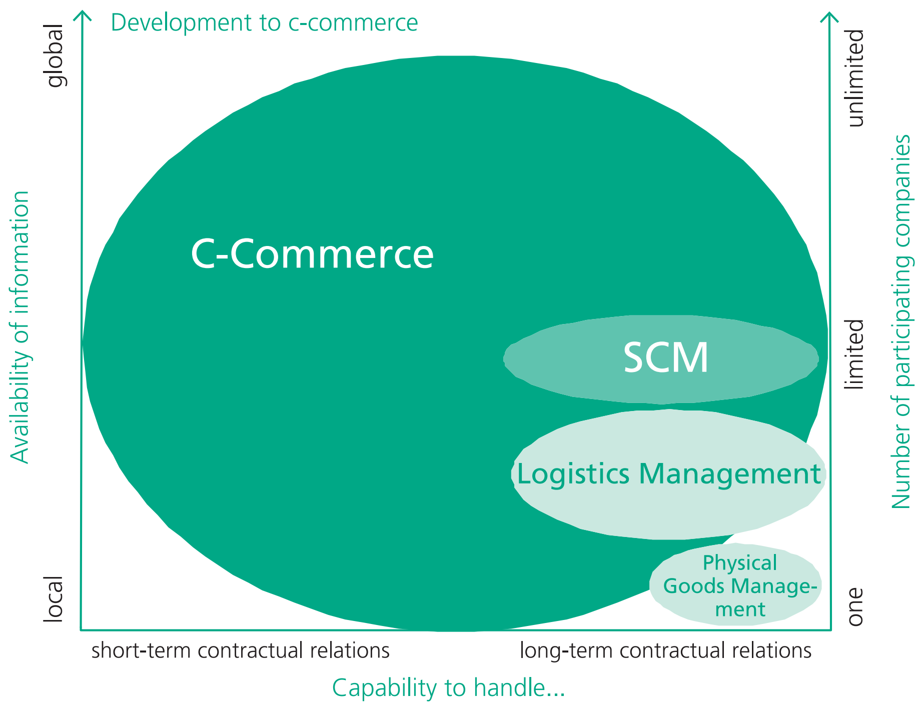

Figure 1: Development of company collaboration.

SMEs, which additionally normally lack the necessary financial buffer. This especially applies to the SMEs in Saxony-Anhalt.

A way out for SMEs is the opportunity to form virtual and temporary cooperations. The approach of collaborative commerce (c-commerce) supports this strategy. Figure 1 delimits the individual flows of development and shows which cooperative relationships can be supported by which approach.

Previous approaches such as logistics management and SCM aim exclusively at improving contractual relationships structured long-term with a very limited number of companies. This approach's considerations about the development of partnership models most notably target the handling of existing partnerships.

C-commerce is an expansion of this and aims at revealing potential solutions for companies in order for them to be better able to manage both long-term and short-term contractual relationships and in particular cooperative relationships and to create ways to make local information available globally. Thus it becomes possible for SMEs in particular to form virtual ad hoc cooperations to be able to act as a general contractor or full service provider. Therefore the objective of the project is to use appropriate research and implementation measures to create the organizational and technical resources, which enable plant engineering SMEs in Saxony-Anhalt to efficiently and flexibly join together in virtual company networks and as a result to enhance their competitiveness in in an environment characterized by concentration.

Figure 2: Signing the cooperation agreement.

For quotation costing, all relevant network member services must be brought together in a standard calculation. However this is not automatically possible in light of the aforementioned problems. Rather, a large amount of manual adjustment is required. In particular, having to recalculate a bid in the course of bid negotiations represents a serious problem, which needed to be resolved in this project.

Successive Approach

To achieve the aforementioned objectives of this joint project, the following sub-objectives have to be achieved

- Formulation of a cooperation concept for the c-commerce approach,
- Development of a standardized technical representation of plant engineering service directories,
- Creation of a service connector for a cooperation platform for the pilot field of bid costing.

Companies in the Joint Project

The project started on May 2, 2003 and has a runtime of 22 months (project end 2/2005).
Since August 2003, the following companies have been working together on this joint project

- BEA Elektrotechnik und Automation Technische Dienste Lausitz GmbH
- Lindner AG JUCH Industrie-Isolierung GmbH
- SKL Engineering & Contracting GmbH
- TÜV Nord MPA Ges. f. Materialprüfung und Anlagensicherheit mbH & Co.KG
- Weber Rohrleitungsbau GmbH & Co.KG
- Eudemonia Solutions AG

The joint project is being funded by the Saxony-Anhalt Ministry of Economics.
The official kick-off was held in Magdeburg on September 18, 2003.

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Web-Services for Small and Medium-sized Enterprises

Motivation

Fast, flexible, cooperative, specialized, open - these are all properties that determine the competitiveness of straightforward small and medium-sized enterprises in the face of the current economic situation. In particular, the ability to respond flexibly to current demands as well as quick adaptability and networking capability are indispensable today for small and medium-sized enterprises. Against this background, the openness for new markets also becomes a crucial success factor in competition.

Small and medium-sized enterprises are currently not sufficiently able to organize themselves with partners in networks in real time and flexibly in order, for example, to be able to offer hybrid products (high quality goods and associated services) or combined services (full services). Small and medium-sized enterprises must be put in a position to meet these demands by specializing and focusing on their core services.

Today it is neither indisputable that the properties cited presupposed particular high performance in the IT field for smooth communication with clients and partners and to handle company processes nor that modern information and communications technologies have the potential to support the required openness and flexibility.

Virtually counter to the growing importance of IT is the observation that, as all companies' make efforts to cut costs and be cost effective, discussions about IT expenditures are particularly controversial. Thus individuals responsible for IT in small and medium-sized companies are repeatedly confronted with budget cuts. Such decisions are frequently based on statements such as too expensive, insufficient support for the processes in the technical departments, too little utility for the (core) business, media breaks and insufficient flexibility to changed customers and business demands. Usually these are not to be brushed off and document situations, which have resulted from the rapid development of the IT sector.

While on the one hand IT system support of companies' business processes has increased constantly, on the other hand the continuity of IT development has let extremely heterogeneous system landscapes develop. Hence, process modifications and optimizations now almost always also necessitate considerable adaptation of the IT since most operations are already supported by I & C technologies. Precisely in these cases however the room to maneuver is limited, among other things, because of the heterogeneous hardware and software that have evolved, diverse interfaces between the IT systems used and increasing demands on data maintenance, management and security.

Use of New IT Technologies

New information technologies such as web service technology, which, based on concepts of software reusability through »encapsulating« of functions, standardization and platform independence, promise a way out of the existing dilemma of insufficient flexibility in the IT field, constitute approaches to research and development activities with which the Fraunhofer IFF relates specific demands to the design of process-supporting IT applications and infrastructures.

Above all efforts are being focused on companies, which, for reasons of their size alone, are unable to enhance the opportunities and potentials of newest information technologies and simultaneously strongly increase their benefit for their core business. The Fraunhofer IFF's work concentrates on current and future problems, generated in the environment of utilization and application in a company and also concern precisely the communication of a common understanding of the performance requirements on IT from the perspective of the business processes and the range of services of the new technologies to support business processes. The emphases grow out of set from the insight that the problems to be solved in the environment of small and medium-sized companies are often on a higher semantic level than those well known IT companies (IBM, Microsoft, Sun, etc.) are focusing their efforts on to improve web service technology in and of itself.

Figure 1: (l. to .r.)Roland Abele, Aston Business Solutions (Germany) GmbH, Karl-Heinz Bondick, T-Systems CDS GmbH, Dr. Horst Rehberger, Saxony-Anhalt Minister of Economics, Wolfgang Branoner, Microsoft Deutschland GmbH, and Prof. Michael Schenk, Fraunhofer IFF.

One project with the objective of utilizing new IT technologies, specifically .net technology for SME users is entitled »Dynamic IT Infrastructures for Organizations in Transformation (DITO)«.

The objective of this research project is to identify concepts for integrative management of internal and external business processes and their IT. This is a matter of preparing organizations, in which processes and operations change, for the use of new technologies as well as providing SMEs appropriate tools to introduce and implement these technologies. Hence specific problems at the interfaces of process design, IT infrastructure management and service offering pertaining to the handling of web service technology in small and medium-sized enterprises are being researched.

The project is being worked on in an approach integrating the various foci of research in order to be able to collect and incorporate existing correlations and dependencies between the thematic areas. In the process, the field of research is first being scientifically worked up and the logistics concepts formulated and in a second, downstream step the concepts are being practically implemented and their practicability is being demonstrated.

The project »Dynamic IT Infrastructures for Organizations in Transformation« is part of the efforts around establishing the European Competence Center for Innovative IT Services for Improving Business Processes in Small and Medium-sized Enterprises and Administration in Saxony-Anhalt.

With the signing of a partnership agreement to establish the competence center on November 27, 2003, the consortium consisting of the corporate partners Microsoft Deutschland GmbH, T-Systems International and Aston Business Solution as well as the Saxony-Anhalt Ministry of Economics and Labor and the Fraunhofer IFF set itself the goal, among others, of contributing to increasing companies' competitiveness and establishing sustainable I & C solutions in small and medium-sized enterprises.

The cooperation partners will jointly work up the results of the research project and showcase them to make the results demonstrable and experienceable for potential users.

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Planning – Controlling – Optimizing: Logistics Solutions for the Networked World

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LP Logistics System Planning and Operation
Dr. Klaus Richter

LE Environmental Engineering
Mr. Peter Rauschenbach

MC Mass Customization
Mr. Ralph Seelmann-Eggebert

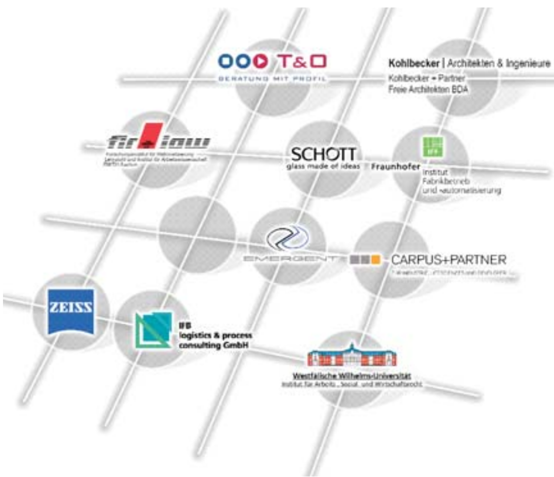
ICCL International Competence Center Logistics
N.N.

Project reports

Service Products for Planning Teams for Factory Planning Tertiarization (ProTT)

Motivation

If in the past the view was widespread that value added can be generated solely by industrial production, although most people are working in the service sector and this sector generates the largest proportion of the gross domestic product, then today a sectoral transformation of the national economy is being talked about. This rethinking of so-called industrial nations up through a service society is given expression in the German Federal Ministry of Education and Research's support program »Services for the 21st Century«. This initiative resulted in services being identified as the driving force behind growth and employment. The prerequisite for this is internationally competitive services and strategies for successful development of international service markets.



The export of industrial goods and German companies' construction or relocation of entire production facilities to markets developing abroad is inducing an impulse of demand for services. In particular the relocation of production abroad is producing new competitive opportunities for German service companies from the industry planning sector. For research, requirements are generated with respect to developing interdisciplinary, innovative and competitive services.

Together with partners from industry, researchers from German research institutions have taken up this challenge as part of work on a joint research project. The starting point was the identification of factory planning as representative for an internationally competitive industrial service.

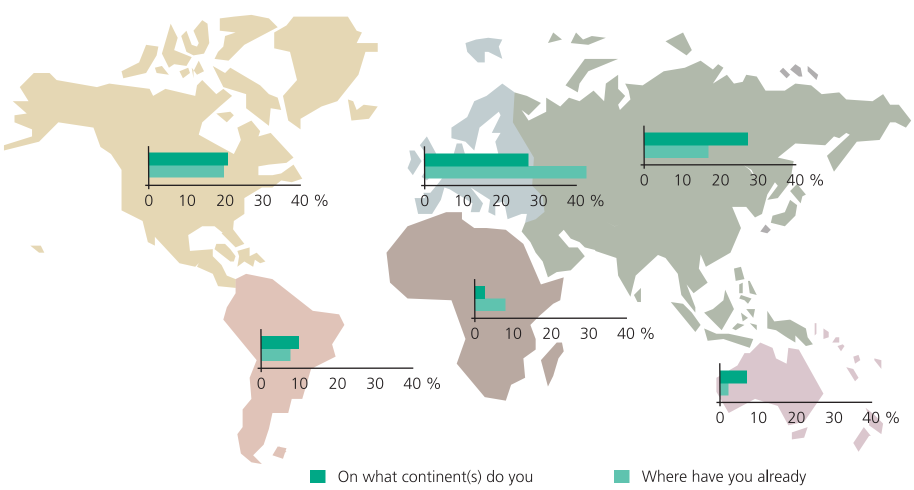
In the project, forms of cooperation and organization in the industrial planning business were developed and internationally competitive services were tested as pilots in the context of factory planning. The project thus contributed to developing and establishing cooperation networks in which planning service providers jointly expand their range of services and develop special service-supplier relationships tailored exactly to the demands of internationally active production networks.

Foci of the project work were the thematic areas

- Service internationalization
- Service management
- Service modularization
- Work organization in service teams
- Basic legal conditions of international factory planning

Service Internationalization

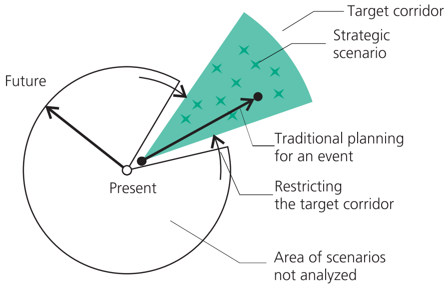
In recent years, service markets have developed considerably faster than goods markets. Nevertheless, German companies export some six times more goods than services. Now as before, only a few German service providers offer their services internationally. New opportunities for service providers are resulting from German companies' construction or relocation of entire production facilities in developing markets abroad. This development is inducing an impulse of demand for services and is providing German industrial planning companies potential for growth in international service competition. According to estimates from the Federal Ministry of Economics, precisely engineering services could be an interesting export article in the future.



The project ProTT studied types of competition in the service sector, analyzed alternative forms of service provider development of international markets and discussed these specifically from the perspective of a German industrial planning company aspiring to go abroad.

Service Management

The research focus of service management mirrors current methodological developments in the field of factory planning.



Using the factory typologies developed in the course of the project, implications resulting from the typologies were derived for strategic target planning in factory planning. The second focus of this field of research was business aspects of factory planning. Under the concept of holistic cost management, requirements and instruments for expanded feasibility studies in factory planning projects were studied. In addition to this, project work analyzed orientation variables in factory planning. With the help of these orientation variables, on the basis of their product idea, the targeted production program and the technology to be used, investors obtain in simple sub-stages information on relevant production indicators and required investment volumes in early planning phases. Prequalification in factory planning marked another thematic complex in this field of research. A methodology was developed for establishing educational material approved by service providers for employee training on factory planning methods and tools.

Service Modularization

Interfaces play a decisive role when designing the depth of technical services. If the organizational structure is not coordinated with the functional structures of the services concerned, significant losses of efficiency can occur. The methodology developed in the research field of service modularization enables providers of technical services to structure their individual services in functional modular service bundles. With this methodology, both internal and external service providers can gear the structure of the organizational units toward the modular structure and in this way take advantage of the potential for efficiency in their form of internal organization. Thus, when subcontracting partial services, the danger is minimized that losses of efficiency will occur at interfaces located unfavorably between services and organizational units.

Work Organization in Service Teams

This focus of research took up the reference model for services, which takes its starting point from the service dimensions of potential, process and result. In order to be able to define the design field of work organization in service companies in detail, this model was expanded on the one hand by the dimension of potential development. On the other hand the individual dimensions (potential development, potential, process and result) are subsequently specified.

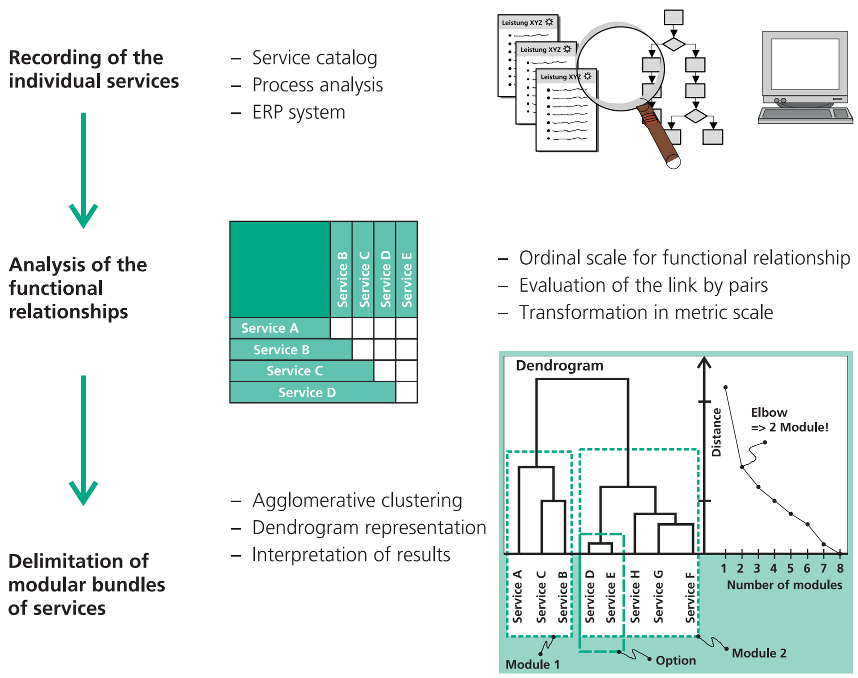
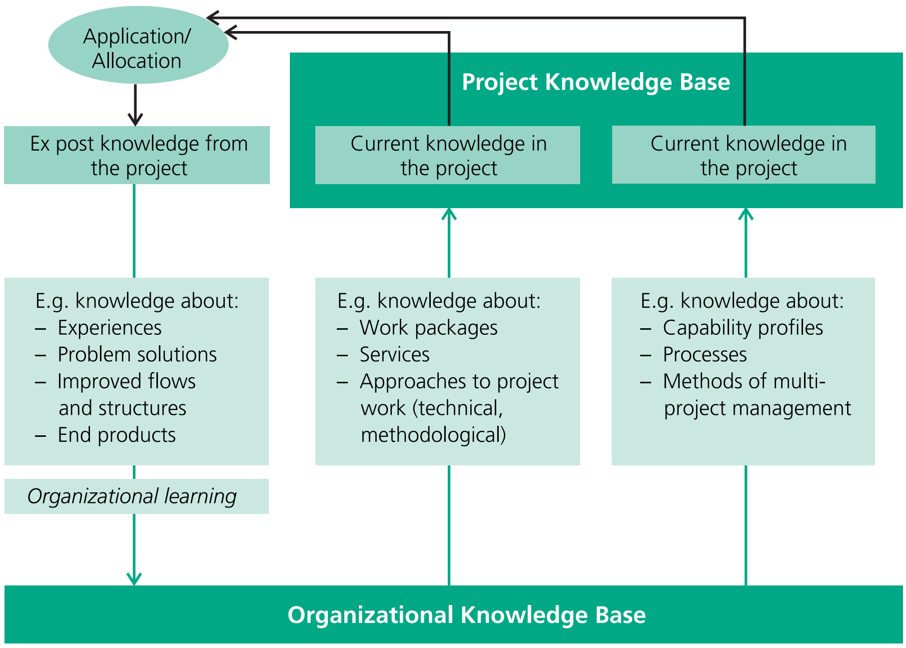


Figure: Approach to service modularization



Factory planning tasks are predominantly worked on within teams. Hence the analysis of planning teams assumes particular importance. Since planning teams are integrated in organizations on the one hand and consist of individuals on the other hand, their effectiveness and efficiency also crucially depend on the interaction with the organizational and the individual level. That is why a special emphasis on the design of the organizational knowledge base of planning agencies was addressed and the development of employee expertise in distributed service teams was singled out as a central theme.

Basic Legal Conditions of International Factory Panning

The complexity in terms of content and the international relationships of a transnational factory planning process make particularly great demands on the legal protection of German factory planners intending to do business abroad.

Factory Planning Contract

As part of ProTT, an annotated factory planning contract was drafted, the detailed provisions of which should protect German factory planners from the numerous pitfalls of foreign law that could possibly be applied. The annotations explicate the proposed contractual terms and include examples of alternative formulations.

International Industrial Law

As a rule, transnational activity entails posting German personnel abroad. In this respect, the stipulations of labor law are significant for the employment contracts between a German factory planning company and its personnel posted abroad were analyzed.

Planning Networks

In order to be able to compete internationally, a planning company will frequently have to join together with other planning companies to fulfill a big contract. To this end, annotated articles of association, which also present potential different forms of cooperation, were proposed as part of ProTT.

Detailed documentation of the research results has been collected in the »ProTT Series«.

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Automated Dimensionig and Simulation of Supply Chains

Motivation

Against the background of increasing competitive and cost pressure, every company is compelled today to constantly identify and take advantage of potentials for optimization in its process flows. The constantly increasing networking of value adding processes in conjunction with the required flexibility and variability are forcing a holistic, company-wide view of the supply processes. That is why, supply chain management views value added as a related process, which begins at the supplier of raw materials and ends at the customer. The goal is to totally optimize the material, goods, information and value flow along the entire value added chain. Therefore the planning and control of the networking of companies is today an ongoing challenge to those responsible for the processes and operations to be coordinated.

The deficits of MRP II based ERP systems for managing problems specific to a supply chain were virtually eliminated by the development of advanced planning systems (APS). Presently, advanced planning systems mostly function as upgrade packages for ERP software and thus facilitate effective support of the control and decision processes in supply chain management.

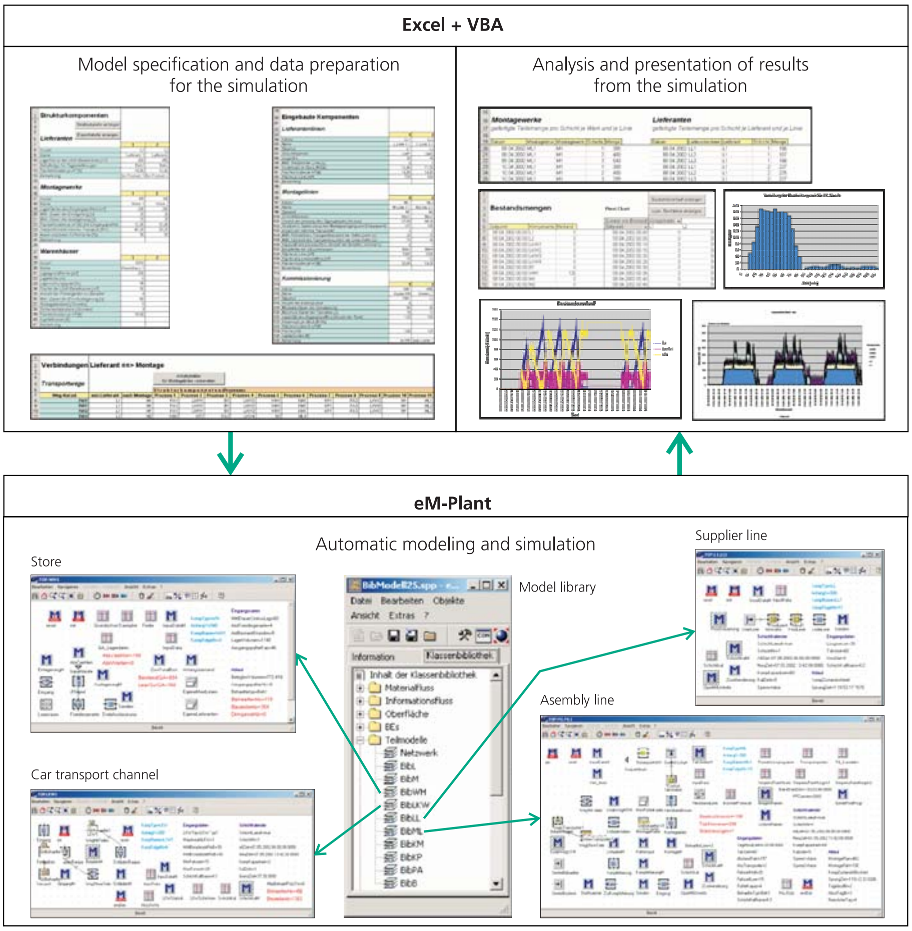
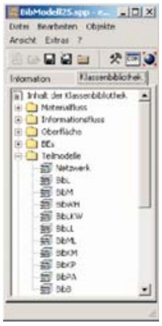


Figure 1: SC Simulation tools for modeling and simulating supplier networks.

Tools, which effectively support logisticians in modeling, dimensioning and designing the supply chains to be engineered, are still lacking in the early phase of planning. Since static analyses based on spreadsheets are no longer expedient when processes are complexly networked, the use of simulation systems suggests itself for incorporating company-wide concerns. Compared with a static simulation, the dynamic view allows a realistic depiction of events and influences such as failures, timetables, fluctuating demand or transport volumes or different control concepts.

Supply Chain Management und Simulation

Today, standard simulation systems provide extensive module libraries. The effort needed to create and validate models is still considerable though and also requires sound experience and know-how among users. This effort increases exponentially with the size of the model, which forces a holistic analysis of the distributions, procurement, planning and control processes. While planners can obtain unique support for optimizing alternative logistics processes, in practice the resources for modeling are available in the fewest cases however.



L – Supplier plant (max. 5)
M – Assembly plant (max. 10)
WH – Store (max. 10)
LKW – Car transport channel (max. 10)
LL – Supplier line (max. 20)
ML – Assembly line (max. 30)
KM – Dispatching (max. 10)
KP – Final assembly (max. 10)
PA – Palletizing (max. 10)
B – Train transport channel (max. 10)

Figure 2: Structural components in the SC simulation model library.

One approach is the use of preconfigured simulation modules and partial models, which understandably cannot however solve the dilemma described above.

Therefore the objective pursued by the Fraunhofer IFF was to develop an encapsulated simulation solution, which, based on standard components (MS® Excel and eM-Plant), allows planners without previous knowledge of simulation to simply and quickly render, simulate and analyze company-wide production, storage and transportation processes. Logistics indicators and cost data integrated in the model additionally facilitate evaluation of the efficiency and stability of planned supply chain scenarios vis-à-vis demand fluctuations and failures.

User-friendly Simulation

The experimental platform developed by the Fraunhofer IFF in cooperation with the Volkswagen AG is suited for designing, analyzing and evaluating a supply chain. The focus is especially on the evaluation of different supplier strategies and scenarios as well as their control concepts.

The data necessary for the simulation is entered through an Excel-based user interface. The input masks include both the information needed to generate the model structure and to generate the input parameters needed for the operation of the simulation such as production program, company calendar and delivery distribution. Just as with the input, the simulation start, the management of the simulation scenarios and the interpretation of the scenario results were produced in an Excel environment. In conjunction with automatic modeling and parameterization, the encapsulation of the actual simulation core effectuated by the way the input and the output were designed facilitates its use even for users without specific knowledge of simulators.

The eM-Plant model library developed by the Fraunhofer IFF provides all the modules needed for this. Step by step, supported by ready-made masks, users can generate and modify their specific model. The simulation input data is automatically checked for logical and syntactic errors before simulation starts so that model errors can be virtually ruled out. The executable model is automatically generated, run and evaluated by means of interpretation of the structure-based input data. Thus, since the effort needed for modeling and parameterizing is marginal, even users without special simulation experience can test and optimize different structural variants of supply chains for the first time in an acceptable time.

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Collaboration
Volkswagen AG, Werk Wolfsburg, Markenlogistik

Interactive Planning Platform for Logistics Systems

Motivation

The research project »IDEA - Interactive Digital Development and Training Platform Saxony-Anhalt« will facilitate the start of new innovative working methods for research and development as well as for student education and on-the-job training of companies in Saxony-Anhalt and will support university education through effective forms of teaching and training. In addition, virtual reality methods and tools will be developed and reference solutions created.

The planning of factories and thus also logistics systems can no longer be viewed as an isolated task, but rather is increasingly evolving into an ongoing planning task. This results from product life cycles constantly growing shorter, the abundance of variants increasing and the environmental conditions of companies unceasingly changing.

In order to ensure competitive production, factory and logistics system planning will have to keep up. With their different forms of visualization of processes and the visual simulation of processes, modern planning, analysis and visualization tools provide the support needed to do this.

In addition, along with teaching basic knowledge in the field of methodology, the training of skills and proficiencies in handling new techniques and technologies is essential.

Data Acquisition

All factory and logistics system planning systems share the structure of the required data in order to be able to depict a digital factory. Basically, three categories of data can be differentiated:

– Product data,
– Process data and
– Resource data.

Nexuses between this data- created by the process as linking elements between product and resources - can be used to generate a virtual, digital depiction of a company's subprocesses, which constitutes the basis for planning alternative factory and logistics systems as well as corresponding simulations.

Consequently, the first step of this work package was to record the needed data at the project partner AEM Anhaltische Elektromotorenwerk Dessau GmbH.

AEM manufactures high quality three-phase synchronous generators and asynchronous motors for the national and international market. The motors cover the middle to upper power range. Their areas of application are for example wind and water energy plants and emergency power supplies.

Products, processes and resources are managed in hierarchical structures. Every element is described by a parameter set. Along with information such as dimensions, weight, cost or time, images of the products and resources or workflow descriptions of processes in the form of Gant or Pert charts can also be stored.

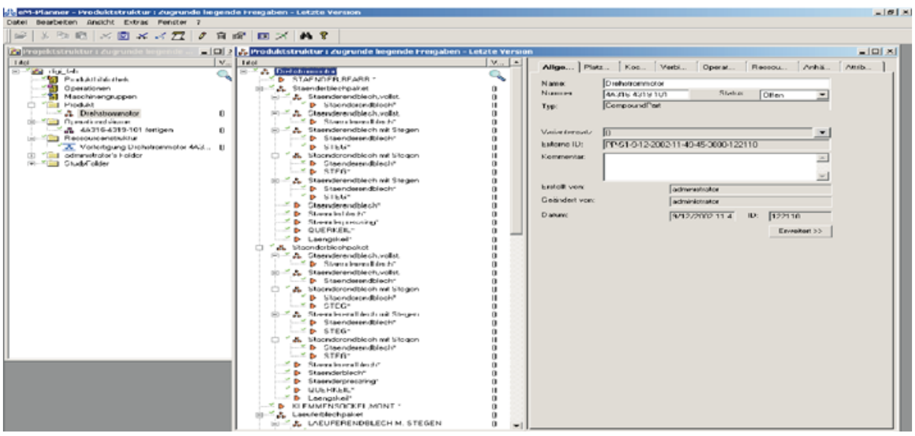

Figure 1: Representation of the product stucture.

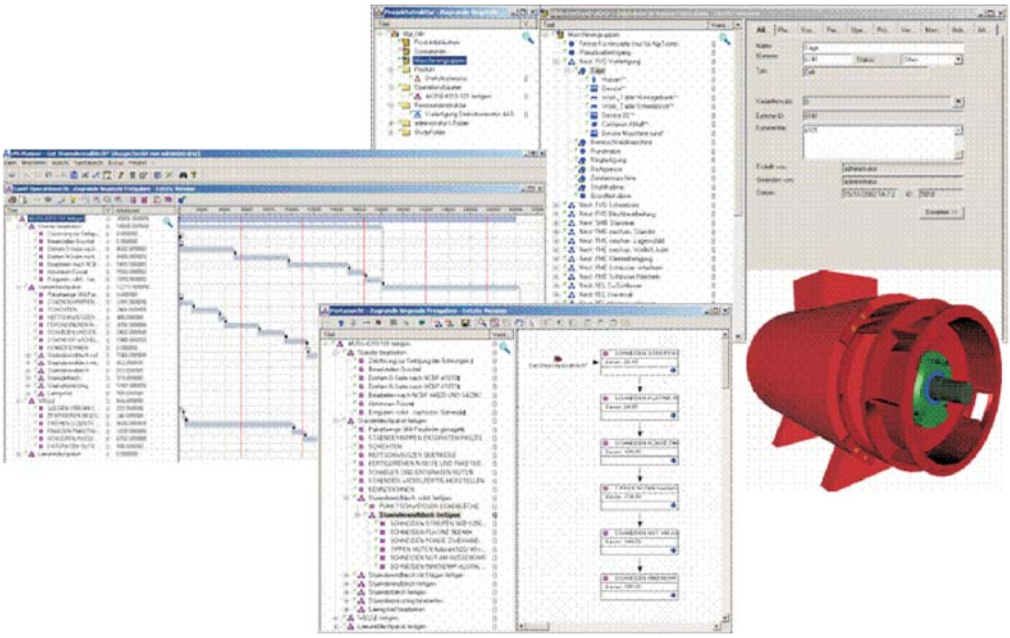

Figure 2: Representation of processes and resources analyzed for the product “AC motor”.

Since the data is not available in companies in the form required but rather has to be compiled from item master data, bills of material, work plans, production plans, layout plans, etc., it needs to be edited into a structure before it is imported into the planning tool.

The import of data makes a data model available on which

- Modifications of the production and assembly processes,
- Modifications of the logistics processes and
- Production of various model variants

can be alternatively planned and simulated for the purpose of optimized production in terms of production costs, resource allocation, material throughput or workplace design.

Data Provision

The product and process models generated with various planning tools are made available on a general Internet platform. Apart from the monitoring function, this platform, in the sense of a 3-D online community, assumes selected navigation, analysis and planning functions. A forum can be used for joint planning or to discuss planning alternatives.

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- Otto von Guericke University Magdeburg
- AEM Anhaltische Elektromotorenwerk Dessau GmbH

Life Cycle Oriented Plant Management: E-Learning for Training Maintenance Workers

Motivation

In the project »Life Cycle Oriented Plant Management LCPM«, offerings of new forms of Internet-supported learning will enable Asian partner institutions in the field of advanced training to strengthen industry executives' problem solving skills in the field of life cycle oriented industrial plant management.

IT Supported Tools and Methods

The Internet is the technical platform for this e-learning offering. Hence, modern IT methods and tools are available, which facilitate efficiently imparting knowledge. The InWent gGmbH is providing the training over its e-learning community Global Campus 21 (www.gc21.de).

Apart from the actual instruction using texts and exercises, another server provides 2-D plant layouts, a 3-D virtual reality community and diverse web services. These support learners when they are applying in practice what they have learned using a virtual plant and processes as an example and when they are completing more complex exercises. Selected chapters contain exercises for the completion of which needed information has to be ascertained from the virtual model. Furthermore, real software systems (e.g. the Fraunhofer IdaSys maintenance planning and control system) and web services are partially integrated for a high level of learning oriented toward practice. Plug-ins and ActiveX elements connect each of the users.

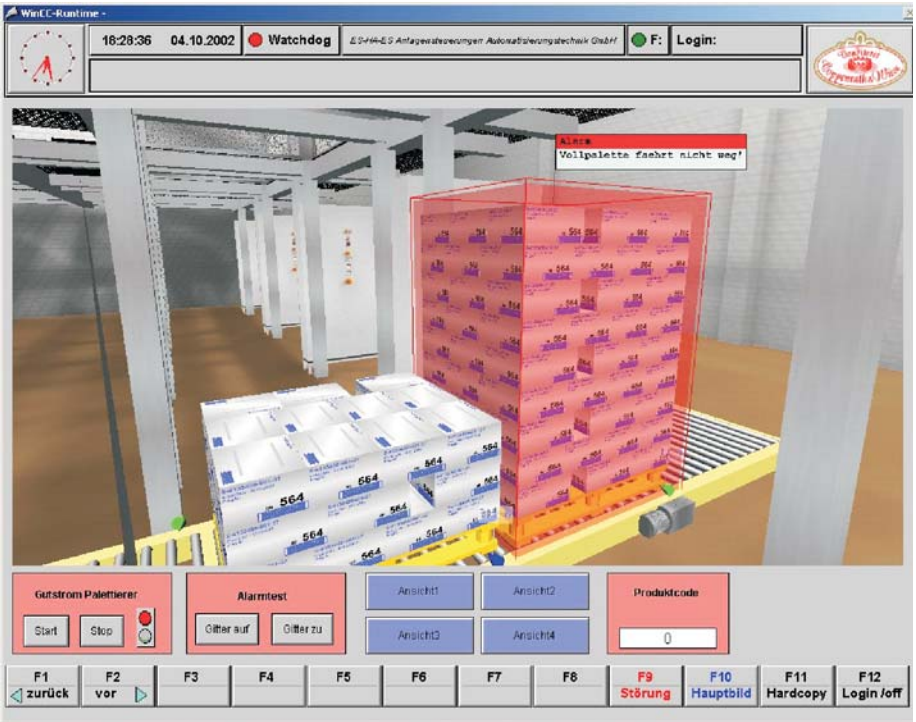

Figure 1: Virtual model of a material flow system.

The manageability of the web technologies is uppermost. As a result, even learners with little or differing knowledge of computers can work with the systems commensurate with their skills. Standard visualization functions make it possible to display scanned documents and 2-D drawings and annotate them. Display and mark-up techniques are likewise available for 3-D CAD models and use the following functions to support learners in different learning sequences:

- Displaying and hiding of parts to explore the structure of an assembly or equipment
- Cross-sectioning of a part or assembly to see its interior
- Exploded views of assemblies to reveal how they are assembled or disassembled
- Animation of assemblies and exploded views
- Addition of notes to views as a tool for product development and change management

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RFID as Building Block of Efficient Logistics

Motivation

Today, companies are confronted by the widest variety of challenges. Progressive networking of markets is generating intensified competition. Being present on the market in the future too makes the greatest demands on the quality, reliability and reproducibility of logistics processes. There is considerable demand to reduce the complexity of logistics systems by simplifying processes or minimizing subprocesses not adding value. Furthermore, the steadily rising demand for customized products, more customized logistics processes in production, storage and distribution. In addition, a greater amount of effort is needed for coordination and control, which can be coped with by efficient information technologies such as radio frequency identification (RFID).

Approach

The control of information and communication flows is acquiring strategic importance and is possible only by using the newest technologies. RFID technology in conjunction with the Internet as well as a link with systems such as PPS, ERP or CRM is an essential element of efficient logistics.

RFID can be used to decentrally provide product and process information on physical objects. Effective control loops based on information accompanying and preceding objects can be implemented through feedback to central information systems. New control concepts are produced, which make it possible to act and navigate within entire value added chains.

Fraunhofer IFF project teams are research partners for the modeling of sustainable logistics models, for piloting them and implementing them under the widest variety of conditions specific to an industry. Thus an RFID based logistics system was developed for VEM motors GmbH, which will enable it in the future to consistently identify and trace electric motors in production logistics as well as in a worldwide distribution and maintenance network. What is more, object-accompanying, continuous documentation of current conditions and events is possible. On the basis of this, control loops can be purposefully established to reliably and efficiently control logistics processes.

Customer Benefits

The use of RFID technologies is instrumental in creating transparency in internal and external company logistics chains. It becomes possible to use limited resources better and as non-destructively as possible, to engineer processes corresponding to requirements and to continuously document their reliability.

The following customer benefits arise

- Worldwide identification, location and tracing of logistic objects
- Process reliability through accompanying and preceeding information
- Control loops for condition and event-based control and navigation
- Reproducibility of processes
- Proof of product originality

Figure 1: Saxony-Anhalt Minister President W. Böhmer learns out about the current project at VEM motors GmbH.

Certification of Components

Beyond the project work, the Fraunhofer IFF is a member of the LICON Consortium (Logistic Ident Consortium). Together with partners such as Kühne und Nagel, Siemens SBS and well known component manufacturers, industry standards for RFID technology are being developed and tested in reference logistics chains. The Fraunhofer IFF has the job of selecting and certifying (Figure 2) hardware components in its own RFID lab.

LICON INSIDE ZERTIFIZIERT

Figure 2: LICON certified RFID technologies.

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Further Development of Wind Power Forecast Systems to Protect Offshore Wind Energy Plants from Overloading

The project involves improving existing wind power forcasting models by combining and optimizing existing systems for

- Forecasting wind yield for the power industry
- Providing long and short range storm warnings for technical management
- Estimating impacts of meteorological factors on the reliability of wind energy-plants for plant manufacturers and service providers and deriving management and maintenance strategies

The various forecasts are pooled in a spatial data information system (GIS) and made available to potential users as an Internet-based information logistics service.

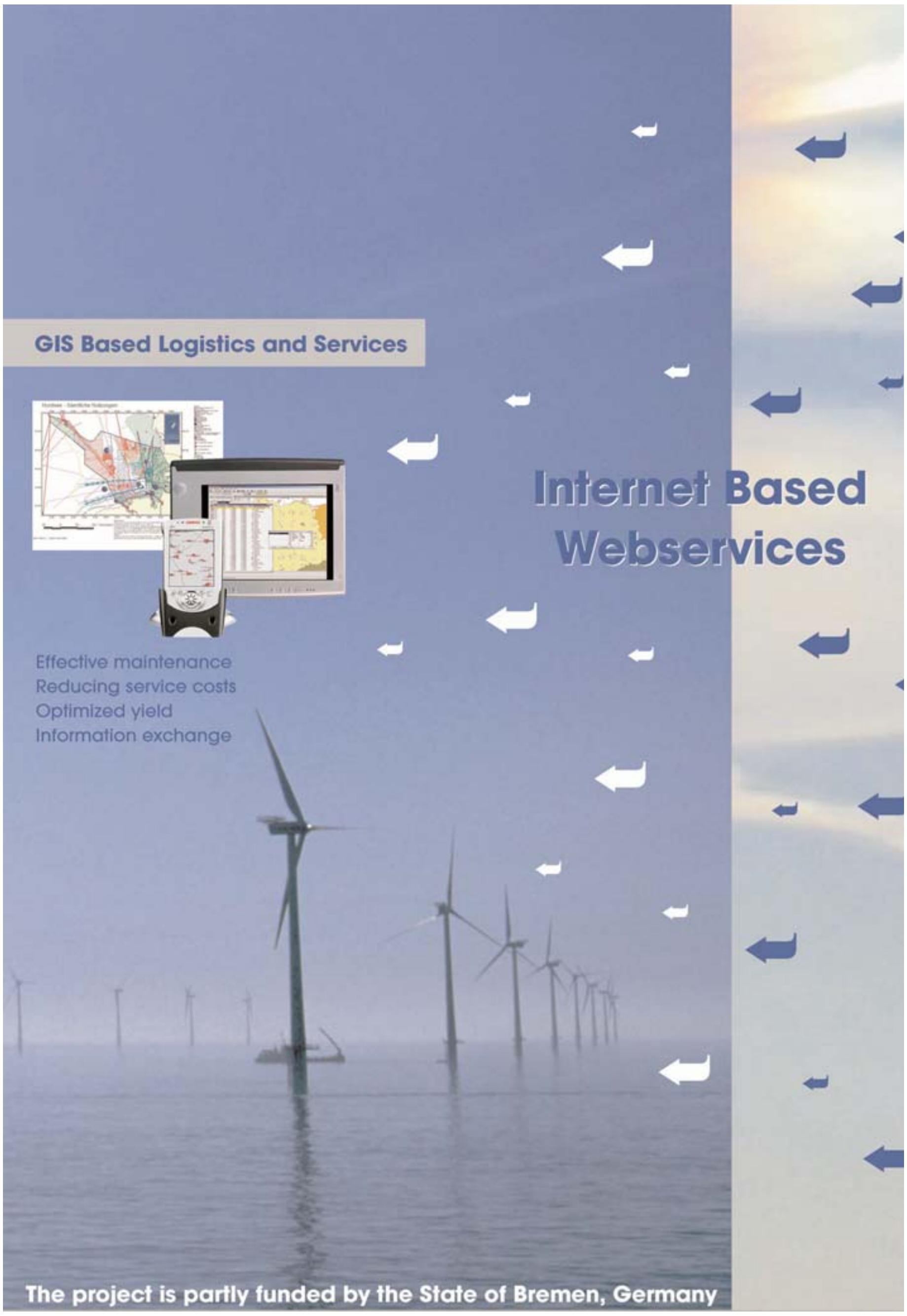

Figure 1: Wind power forecast.

Motivation

Reliable and cost effective operation of the offshore wind parks planned on the German North Sea coast requires dynamic control and feedback control algorithms as well as the control of complex logistics processes to establish supply, disposal and maintenance. A multitude of factors have to be taken into account. Meteorological factors, which decisively influence the anticipated business revenue and operating and failure behavior of wind energy plants, assume particular importance.

Wind power forecasts based on complex weather models are mainly needed by the power industry at least twenty-four hours in advance to operate electric supply lines. A new approach will improve forecast accuracy most notably in the short-term range of one to two hours to optime the yield forecast and by detecting critical operating situations and potential failures. Thus it will be possible to use the control of wind energy plants to proactively activate protective functions in order to prevent overloading, damage and failures when storms occur. Moreover, meteorological events will be evaluated for their impacts on reliability and the expected remaining lifetime of important components of wind energy plants.

Work Packages

The project is divided into different work packages. While the project partners meteocontrol and the University Oldenburg are working on improving the complex physical models for weather forecasting, primarily for expected wind speed, the Fraunhofer IFF is focusing its work on the detection of operating situations critical for wind energy plants and on deriving measures to protect against overloading. A prerequisite for this is the analysis of the complex correlations between meteorological events and the operating and failure behavior of wind energy plants.

On the basis of an extensive and detailed database with weather and operator data over a period of approximately three years, neuronal networks were trained for selected wind parks, which store the individual behavior of the wind energy plants in different weather situations as knowledge. After the network training was completed, the quality of the network was assessed by means of test data. To this end, real weather situations were used as input data for the neuronal networks and the forecast of the power output and occurrence of typical types of damage were evaluated, the wind energy plants displaying extreme individuality depending on the plant type and locations. In the end, the method can be assessed as being very well suited for deriving individual output data of the plants (Figure 2), critical operating situations and potential failures.

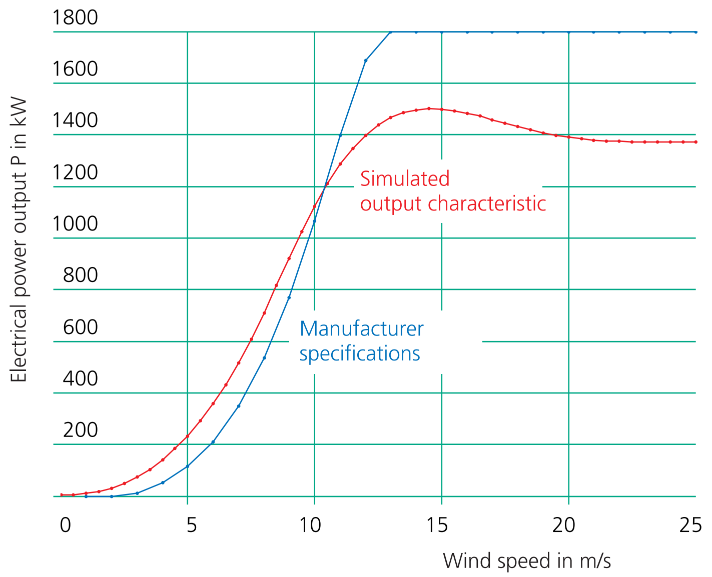

Figure 2: Output characteristic curve

Thus, in conjunction with improved weather forecasting, an efficient tool is available to utilize the time advantage to reduce unplanned plant downtimes. The effects are an increase of plant operational reliability, which in turn will be instrumental in lowering business risk and leading to the success of the planned German offshore wind park project of approximately 20,000 MW installed power in its final phase of construction

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- Universität Oldenburg
- Bosch Maintenance Technologies GmbH, Bremerhaven

Spatial Data Infrastructures: Prerequisite for the Integrated Application of Spatial Information Technologies

Motivation

The spread of information technologies is subject to a great dynamic throughout the world. As a manifestation of globalization, the interoperability of information systems of globally communicating actors in particular is increasingly important not only for companies but also for administrations. Spatial data technology is rapidly spreading to efficiently deal with administrative tasks. In particular, fields of application are tasks focusing on infrastructure such as management of supply and disposal systems as well as cadaster management, regional development and logistics.

Diverse software systems with differing hardware requirements are commercially available. The data format used is also an important feature. Spatial data and geographic information systems (GIS) in administrations, which relate to a bounded geographic area and process various jobs (isolated applications) are widespread. In the future however, it will be essential to ensure the interoperability of different systems.

The necessity for this can be seen in the example of concrete problems such as flood control measures. GIS can be used to continuously deal with this issue only if the areas neighboring a potentially flooding river can exchange the data needed to do this or when their systems can communicate with each other. This in turn requires standards for the spatial data used as well as organizational structures and approaches defined unambiguously.

Throughout the world, efforts are being made to standardize spatial data infrastructure (SDI) in order to ensure the basis for interoperability of different systems in the future.

This project deals with spatial data infrastructures in Thailand. Five provincial administrations with variously developed economic structures are involved in the project in order to obtain as comprehensive a picture as possible of the potential users' requirements profiles.

Project Packages

Initiation and Consolidation of Cooperation between European and Thai Research Institutions in the Field of Information Technologies (Specifically GIS Applications)

The interdisciplinary collaboration of local partners from the provincial administrations, standardization bodies and research institution all involved in the project makes it possible to localize specific demands in the target region, concretize them and develop appropriate approaches incorporating existing European approaches. Bringing European and Asian networks together will create the foundation for long-term European and Asian cooperation on SDI research.

Interdisciplinary Know-how Transfer in Southeast Asia

Part of the project is a continuous transfer of SDI know-how as well as know-how on potentials for applying and linking geoinformation technologies (GI technologies).

Multistage Plan for Implementing a Spatial Data Infrastructure

Based on the conditions determined in Thailand, the outcome will be the provision of a multistage plan for establishing a spatial data infrastructure as well as a specification of fields of GIS application in Thai provincial administrations.

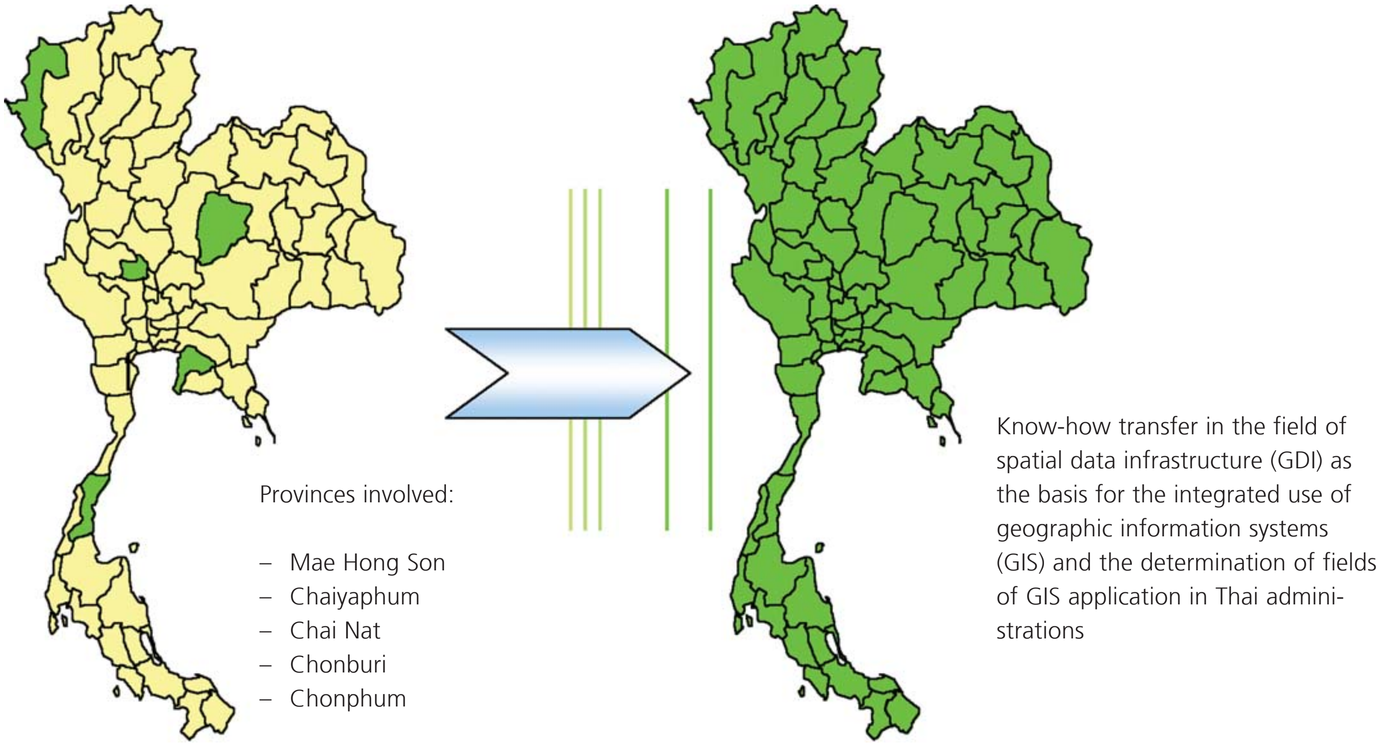

Figure 1: ASIA IT&C FORCE project strategy.

Project Phases

To complete the project, the following phases were defined

1. Analysis Phase
The focus here is on the analysis of specific demands of Thai provincial administrations with respect to the use of GIS and spatial data. The boundary conditions for an SDI for Thailand will also be determined. European experiences in this field will also enter into this project.

2. Evaluation Phase
In the evaluation, results of analysis (both demand analysis and market analysis) will be processed and evaluated. On the basis of this, the transferability of selected concepts and system solutions to the target region will be assessed.

3. Processing of Results and Dissemination
In the final phase, a multistage plan will be formulated to implement and adapt selected solutions. The implementation of specific system solutions in Thailand will be the object of future research cooperation. The collective project results will be presented at an international symposium.

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MC-ProLog: Production and Logistics Structures in the Automotive Industry Supplier Chain for Mass Customization

Motivation

MC ProLog stands for the development of production and logistics structures intended to empower small and medium-sized enterprises (SMEs) to manufacture products in the sense of the concept of mass customization. As a result, above all SMEs in the automotive industry supplier chain will be prepared further than before for the demands to be expected from customizing the product »car«. In this context, »ProLog« in its actual meaning can also be understood as the entry in to a field of competence new for companies in the automotive supplier industry.

MC Capability of Automotive Suppliers

As part of workshops and with the involvement of the project committee, the demands and opportunities relating to mass customization were discussed and the demands on production and logistics structures were defined. The internal green light for MC ProLog was given in the fourth quarter of 2003. The project will last 18 months and will conclude by using a case study to validate the results of research.

The end result will be an application friendly method, which allows quickly and inexpensively analyzing existing production and logistics structures in companies in the automotive supplier industry for potentials for economic adjustment to the requirements of mass customization and to derive necessary measures. With the help of a tool developed in the project, automotive suppliers will be able to manufacture »customized as in small batch production« and »productively as in mass production«.

A first definition of mass customization constitutes the foundation of project work, which is tailored to the particular needs of the automotive supply industry ist:

»Mass customization in the automotive supply industry goes beyond the current manufacturing of variants and sets itself apart through the possibilities to individually configure supplier components for the final product »car«. As a result, parts or assemblies are produced, which are new for the manufacturer. The interfaces in the designed space are however fundamentally known and must be taken into account. Primary fields of engineering are design, dimensioning and functionality, the interactions between the standard and customized products also having to be kept in mind for every modification.«

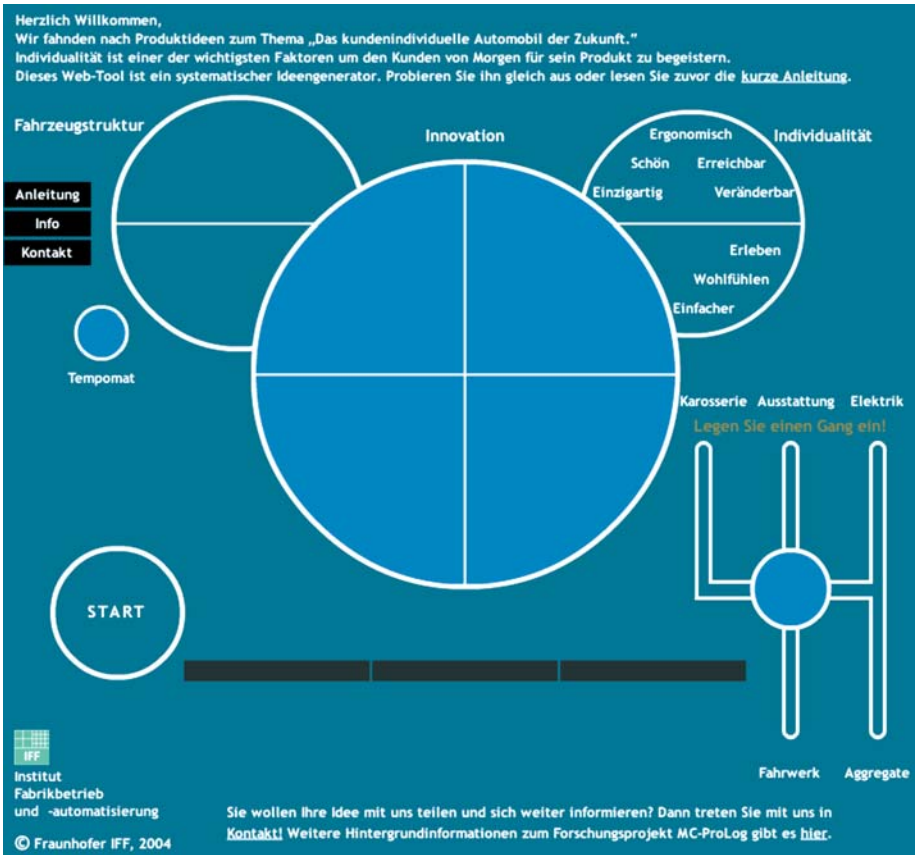

Figure 1: Systematic idea generator.

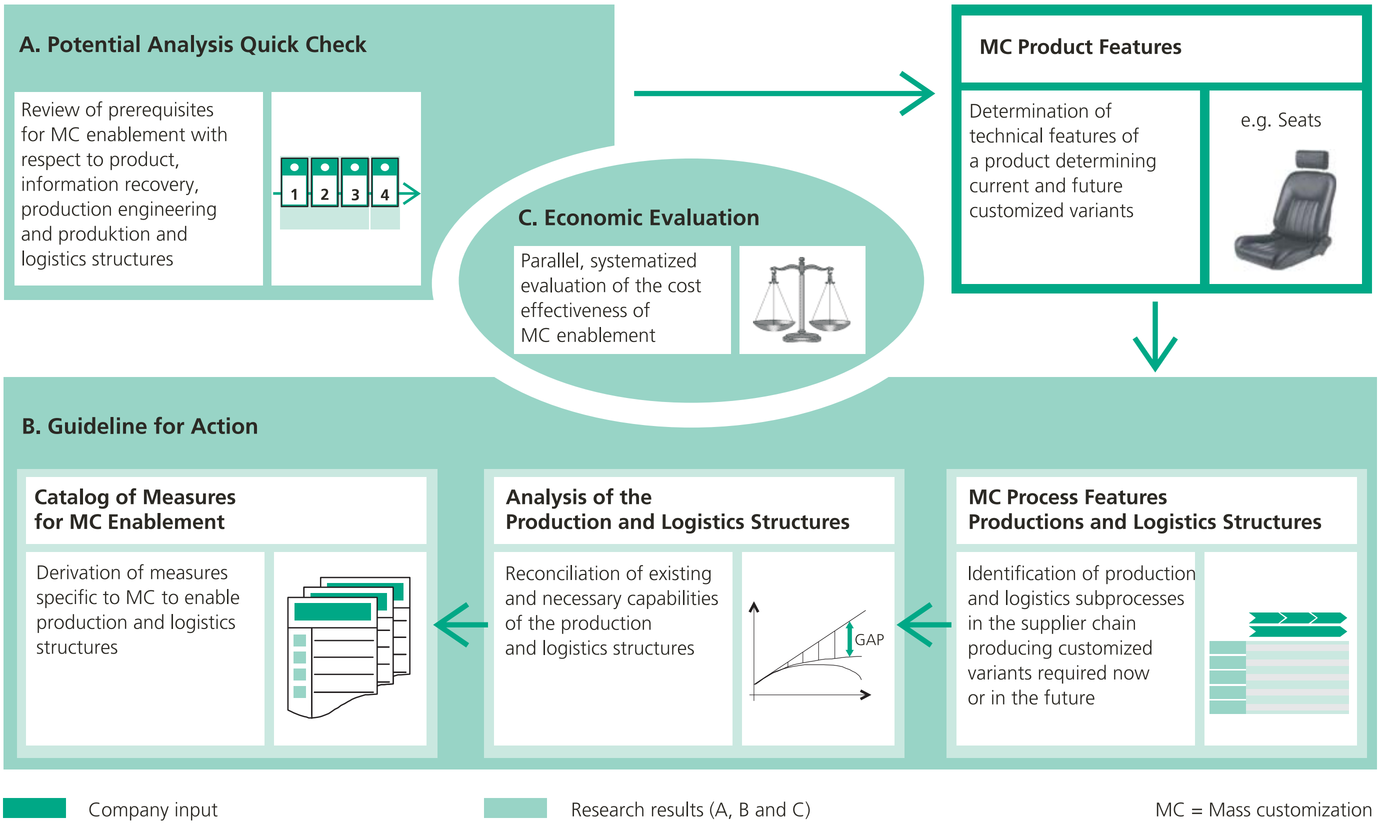

Figure 2: Approach to MC enablement of a company using the target research results (A, B and C).

At the end of the project, users in the automotive supply industry will essentially have three partial results at their disposal in the form of the aforementioned tool for MC enablement. Quick Check potential analysis facilitates an initial assessment of fulfillment of the prerequisites for implementing an MC strategy. A guideline for action will contain the measures needed to design production and logistics structures for MC. In a last step, companies will then be able to use a method for evaluating cost effectiveness to estimate cost and benefit.

Starting point and motivation for the application of the tool are each an idea for a concrete product, which falls in the field of mass customization. SMEs will be able to assess their potentials and assume a proactive role toward the original equipment manufacturer.

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Collaboration
– University of Hannover Institute for Plants and Logistics(IFA)
– Project Industry Working Group of Eight Companies

Funding
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Automation solutions from the idea through practical implementation

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Project Reports

Optoelectronic Inspection of Rivet Joints in Airplaine Fuselage Assembly

Motivation

Airplane safety makes enormous demands on airplane manufacturers with respect to the quality of production processes and the materials used. To meet safety standards, all production processes and materials are checked for quality before and frequently repeatedly during their use. This testing work covers all airplane components.

Today, enormous effort manual effort for testing is also needed at the end of the assembly process to assure faultless riveted joints when assembling fuselages. In the future, these non-value adding but necessary tests will be performed automatically and in-process after riveting.

Airplane fuselages consist of a circular aluminum structure, which is made up of individual fuselage plates. A fuselage consists of cylindrical or spherical aluminum shell panels stabilized longitudinally and transversely by stringers and frames. The stringers are directly connected with the shell panels. The frames are connected by the clips. A sealing compound between the parts protects them from corrosion.

Various riveting technologies are used to join the individual panels. Essentially a solid rivet made of aluminum is used to join the parts. Figure 1 shows the principle of a riveted joint. These riveted joints important for safety absorb all the forces during a flight. In order to ensure that the joints fully guarantee their clamping function, the original head on the outside must project from the counterbore by between 0.05 and 0.15 mm.

At the same time, the projection of the original head may not exceed the permissible maximum for reasons of aerodynamics (influence on airplane noise and fuel consumption). This projection of the original head is the fundamental quality feature of a riveted joint. In the same way, this joint may not exhibit any damage such as notches in the original head or scratches in direct proximity.

These requirements on riveted joints necessitate an intensive manual inspection of all riveted joints at the end of fuselage assembly. The original head is optically inspected for damage and tactilely (with the thumb) for the correct projection. If there are ambiguities, a dial gauge is used for inspection. This type of inspection is subject to strongly subjective factors and is very time intensive. In addition to the inspection effort, there can also be considerable reworking effort since errors are only detected later because the inspection is done later.

Against the background of the present situation, the following requirements were made on a fully automated and in-process, integrated geometric quality inspection:

- 100 % inspection of the rivet joints made with the riveting equipment
- Reliable information about existing errors
- Minimum prolongation of the time of the riveting cycle
- Use for various rivet types and diameters
- Connection to the existing NC control of the riveting equipment
- Easy operation by employees
- Comprehensive documentation of results in accordance with current quality regulations

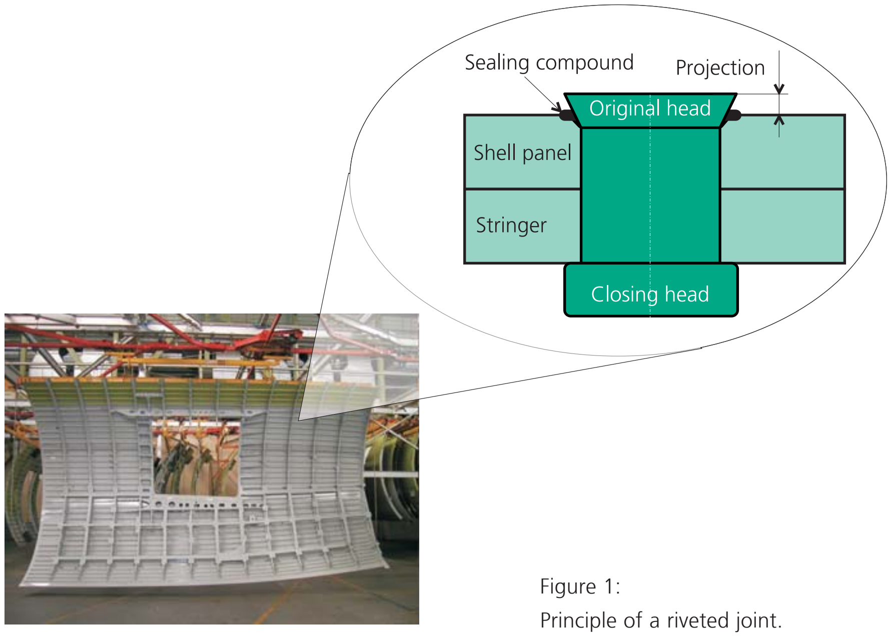

Figure 1:
Principle of a riveted joint.

Concept Development

On the basis of these requirements, a research project was started at the Fraunhofer IFF, which had the objective of developing an in-process quality inspection of riveted joints. The fundamental focus was the automated inspection of all riveted joints made by the riveting equipment.

In view of the short cycle times, (a riveted joint is set every 4.5 seconds), one of the main requirements on the inspection process was to quickly record the respective data to determine the quality. This is why only an optical process was considered.

In close cooperation between the Fraunhofer IFF and the Airbus Deutschland GmbH plant in Nordenham, an inspection concept was worked out, which is based on the method of fringe projection with a coded split-beam. Figure 2 shows a rivet with differently coded illumination.

After a riveted joint is set, 18 fringe patterns are projected on the original head and filmed by a camera within less than one second. A 3-D point cloud is calculated from the fringe pattern so that the projection of the original head and the angle of tilt can be determined. Figure 3 shows the digitized result.

Figure 2:
Rivet under coded illumination.

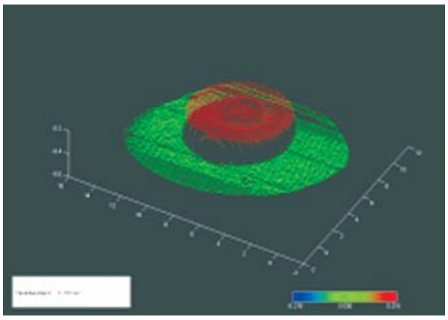

Figure 3: Digitized rivet.

Since all the riveted joints are set with sealing compound, the influence of the sealing compound hanging over under the head has to be allowed for in the measurement. The inspection strategy accomplished this by only taking points for measurement where there usually is not any sealing compound.

The information determined on the projection of the original head and the angle of tilt is displayed to the riveting equipment operator if there is an error. The operator can decide whether the equipment has to be stopped or whether this was a one-time error. Furthermore, the system displays a trend characteristic of the projection of the original head to the operator so that the operator can counteract this early on with the help of equipment parameters, thus preventing errors from happening in the first place.

The data and coordinates of defective riveted joints are documented and made available to the following work station so that rectification can already be completed there. All data from the shell riveting process is electronically archived for purposes of documentation.

Prototype Development

On the basis of the concept described, the Fraunhofer IFF developed a prototype application, which was first tested under laboratory conditions. The test measurements were already taken under realistic conditions, meaning that the riveting equipment’s space conditions were already taken into account and the measurements were taken on an original shell. Figure 4 shows the laboratory prototype.

The 3-D measuring system's projection system projects 160 separately switchable lines on a field 20 x 20 mm^2 large in a working distance of approximately 680 mm. The camera has a resolution of 1.300 x 1.000 pixels and a field of view of approximately 25 x 25 mm^2. The working distance of the camera is 90 mm. The measuring system has a measuring volume of 20 x 20 x 2 mm^3 and a resolution of 0.004 mm in X, 0.13 mm in Y and 0.006 mm in Z.

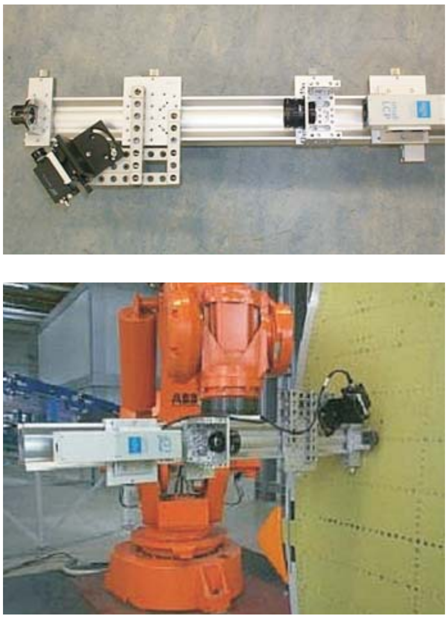

Figure 4: Lab prototype of the measuring system.

The feature-based accuracy is ±0,01 mm, which satisfies present accuracy requirements. The recording time for one rivet is less than one second. the complete prototype system was installed on a robot so that the various riveted joints could be approached.

This prototype demonstrated the technical feasibility of the inspection method under realistic laboratory conditions.

Installation of a Measuring System on Riveting Equipment

The test system was installed on an NC surface riveter, which uses solid aluminum rivets to join all stringers, clips and window frames with the shell panels. Figure 5 shows a surface riveter. Such riveting equipment has a riveting speed of 12 - 14 rivets/minute.

As part of system installation, a multitude of engineering and design solutions had to be developed especially because of the very limited space (integration of the measuring system in the riveter head). A fundamental aspect during installation was the measuring system's communication with the riveting equipment's software.

After installation, test measurements could be successfully taken under real ambient conditions.

Bild 5: Flächennietanlage.

Use in the Field

With the introduction of in-process and automated quality inspection of riveted joints, a clear improvement of productivity is anticipated. In detail, the following benefits can be achieved:

- Reduction of the effort for manual inspection by approximately 90 % through in-process inspection of all riveted joints set by automatic riveting equipment. Only manually set riveted joints will be checked in downstream quality inspection.
- Reduction of reworking by approximately 80 % through the avoidance of mass errors. The in-process display of defective riveted joints allows the riveting equipment operators to intervene in riveting process immediately and initiate the appropriate corrective measures. A downstream work station will only replace individually defective reveted joints.

After having successfully concluded the test measurements, the plant in Nordenham is planning to duplicate this inspection system in mid 2004 on all automatic riveters so that all automatically set riveted joints are inspected for quality in-process.

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Airbus Deutschland GmbH

Geometry Inspection of Train Wheelsets

Motivation

Railway freight and passenger cars as well as their respective locomotives make contact with rails over so-called bogies usually with two rigid wheelsets. The design of the bogies with their wheelsets as well as the state of their maintenance constitute the foundation for driving safety and comfort.

A train wheelset has two wheels rigidly connected with an axle. As a result, both wheels have the same rotational speed and in principle put the same distance behind them with every rotation. In a track curve however the distance the outer wheel has to travel is greater than that of the inner wheel. In order to be able to compensate for this difference in distance, a wheelset's contact surface has a conical, flanged profile. The bogie wheel diameter is larger on its inner side than on its outer side. Possible derailment is prevented by a so-called wheel flange on the back of each of the two wheels. A wheelset, which laterally contacts a rail head with its wheel flange, is »rubbing« it. A relative motion between wheel and rail in the two contact points produces a sliding motion transverse to the direction of travel. Wear occurs on the wheels. As wear increases, the consequence is a growing unsteadiness of travel connected with the development of noise and consequently curtailment of wheelset's useful life.

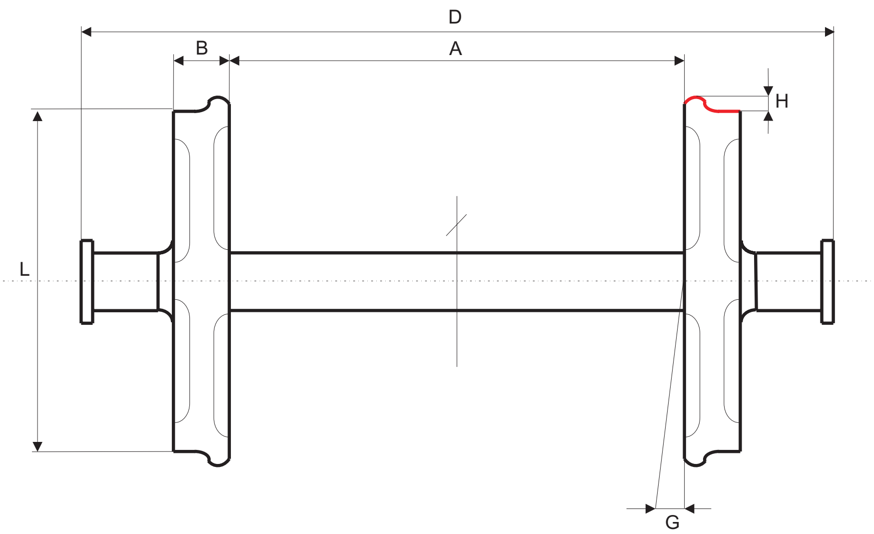
That is why the bogie with its wheelsets is reconditioned at regular intervals in railroad company workshops where the profiles of the contact surfaces are geometrically inspected in order to recondition the wheels as necessary or to replace them completely.

To do this, the bogie and then the wheelset are detached and conveyed to various inspection and machining stations.

First the actual condition of both wheel profiles as well as their position and orientation are determined relative to the wheelset axle. Figure 1 shows a wheelset with the most important dimensions.

Based on the recorded geometric parameters, the wheelsets are reprofiled, i.e. machining restores the target profile. Afterward they are measured again for purposes of quality control. The data relevant for quality is archived in a wheelset database. To ensure the suitability of measuring and test equipment as well as the traceability of the geometric features to a length standard, the measuring machine must conform to common guidelines provided for the measuring and test equipment.

Present technologies were developed some forty years ago and are based on wheel profile measurement using cast shadow methods. The wheel profile is backlit and the wheel profile is displayed on a diffusing screen by being reflected multiple times on diverse surface mirrors.



A = Inner wheel width
B = Wheel rim width
D = Axle length
G = Axial and radial runout
H = Contact surface geometry
L = Wheel diameter

Figure 1: Sectional view of the wheelset with important dimensions.

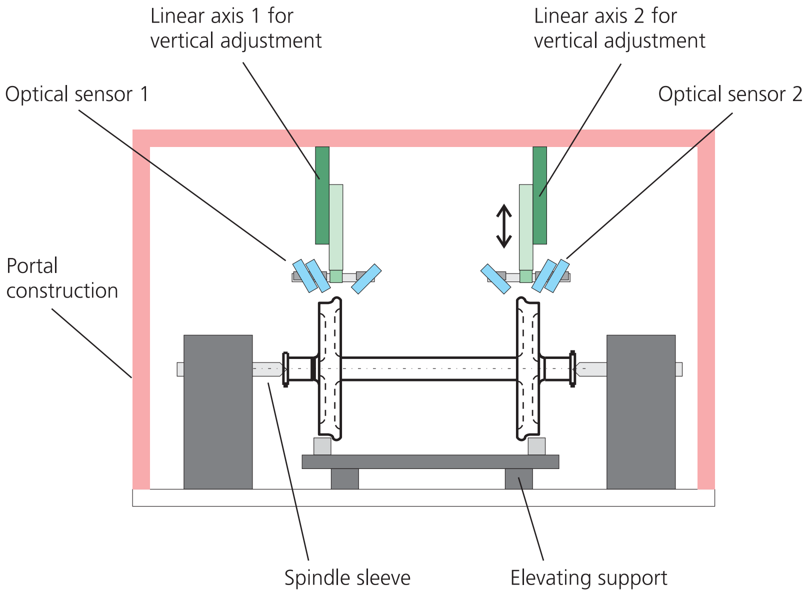


Figure 2: Technical design principle of the measuring machine.

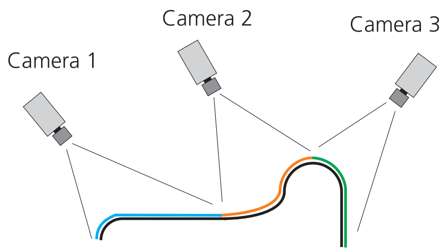


Figure 3: Range scanned by the three cameras per optical sensor.

A full-scale target profile is also on this diffusing screen. Thus the target and actual profile can be visually compared. On the one hand, the complicated system of mirrors makes this system very susceptible to interference and on the other hand a number of subjective error variables exist as a result of operator errors reading and transmitting measured values.

Another measuring technology uses a punctiform sensor, which an upright coordinate measuring machine moves to significant measuring points. The measuring system operates very robustly and precisely, requires a long measuring time however depending on the complexity of the measuring job.

Development of a Measuring System

On the basis of the metrological and logistic requirements of a modern wheelset workshop, the Fraunhofer IFF developed a new measuring technology: The measuring system »OptoInspect 3-D WheelSet«.

The wheelset to be measured is rolled into the measuring machine over a rail system. An elevating support lifts in the wheelset vertically until the axle has reached a specified target position. Two spindle sleeves are used to clamp the wheelset and raise it into the measurement position. Centrically positioning the wheelset makes it possible to move it axially in its clamped state (important when gauges or axle lengths differ). After the wheelset is mounted, the optical sensors 1 and 2, mounted on a vertically adjustable portal construction, are fed in vertically onto the wheelset. Figure 2 shows the technical design of the measuring machine in principle.

Per wheel side, the optical sensors 1 and 2 (split-beam sensors based on the triangulation principle) consist of two lasers and three cameras and are designed so that they can be easily interchanged and equally used on the right and left wheel. They are mechanically connected to the wheelset machine by an adjusting device, which makes it possible to easily align the optical sensors. The sensors were designed based on the wheel width. Figure 3 illustrates the three sensor cameras' overlapping areas of measurement.

Other punctiform measuring sensors measure the reference features to determine the center of the wheelset, to which all geometric features usually relate, and the axial runout on the axle shaft.

After it is positioned in the measuring equipment, the wheelset is set in uniform rotation. At the same time, the optical sensors 1 and 2 in equidistant distances of approximately 20 mm measure profile sections of the right and left wheel over the entire circumference of the wheel. Between 90 and 180 profile sections are digitized per wheel side depending on the wheel diameter. Figure 4 shows the dataset of a digitized wheel side.

After digitization, the measured geometry data is processed and analyzed. The aforementioned geometric parameters and dimensions are determined. Figure 5 is a screenshot of the analysis screen.

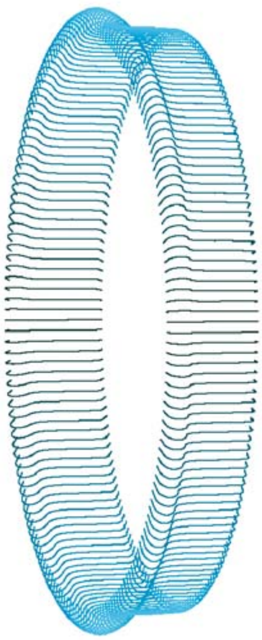


Figure 4: Digitized wheelset.

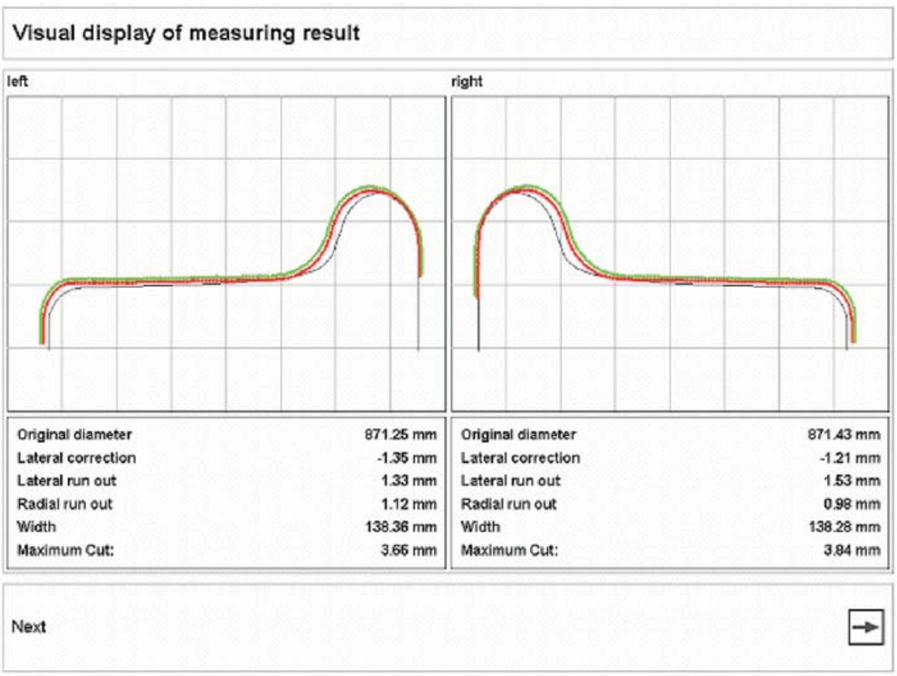


Figure 5: Screenshot of the analysis screen.

Figure 6: Wheelset measuring machine starting up.

Implementation

There is a worldwide need for designing the geometric inspection of train wheelsets more flexibly and more robustly with sufficient precision and simultaneously more quickly. To this end, the Fraunhofer IFF has converted its new inspection technology into application. So far, the solution developed has been successfully implemented in six measuring machines for the South African railway.

Figure 6 shows a nearly complete wheelset measuring machine starting up. The client provided the machine's mechanics.

The next developments are aimed at reliably meeting all metrological requirements of the Deutsche Bahn (DB) as well as the International Union of Railways (UIC). In addition - overseen by the Deutsche Bahn's calibration and inspection offices - the metrological concepts will be optimized and tests conducted on the suitability of measuring and test equipment. This will be followed by working toward broader international implementation of this new measuring technology.

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Collaboration
- TRIMOS-SYLVAC S.A. (PTY) LTD., South Africa
- Deutsche Bahn AG

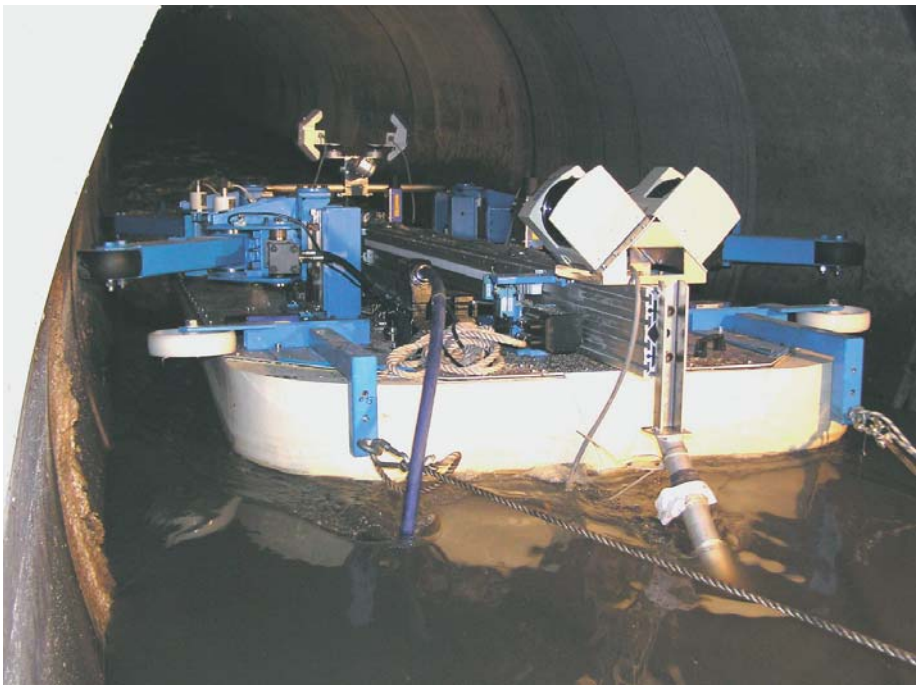
Conception and Development of Inspection and Cleaning Systems for the Emscher Sewer System

Motivation

The Emschergenossenschaft contracted the Fraunhofer IFF as general contractor to prepare a comprehensive concept study of inspection and cleaning systems for the Emscher sewer system.

The Emscher sewer system has a length of approximately 51 km with pipe diameters of DN 1400 to DN 3400. The maximum distance between manholes is 600 m. Constantly large quantities of water are discharged into the sewer even in dry weather.

Legal regulations and directives require scheduled, regular and systematic detection and recording of the sewer system's structural and operational condition. In view of its constant partial filling, the Emscher sewer system cannot be inspected with conventional methods such as TV inspection or walk-throughs. The automatic inspection and cleaning systems to be designed as part of the project should effectively do away with walk-through sewer inspections. The feasibility of automatic inspection and cleaning systems had to be demonstrated completely.



Concept Development

As part of the project, the following main components were designed and tested or further developed for their feasibility and fulfillment of the requirements

- Carrier system (motion kinematics, robot) for positioning along the sewer line
- Sensor and measuring systems for inspecting pipe condition above and below the water line as well as for detecting deposits
- Sewer cleaning systems
- Media supply (power, data communication, water, etc.)
- Control system, navigation, operation
- Handling systems for positioning sensors and cleaning tools on and along the sewer wall

Building upon extensive research and consultations with experts from each of the subfields, sensors and cleaning tools were selected for field tests, adapted and further developed and tested in prototypes and test prototypes of the favored inspection and cleaning system concepts. To this end, a test station with various reinforced concrete pipes and different types of damage (e.g. cracks or spalling) was set up at the Fraunhofer IFF.

Inspection and Cleaning Concept

The favored inspection and cleaning concept is based on a three-stage approach.

In the first stage, a system navigates the sewer for rough inspection. It inspects and measures the entire sewer and performs video inspections, recording larger abnormalities such as erosion, deposits, obstacles and leaks in the gas space.

In the second stage, the cleaning system - if necessary - eliminates the deposits in the bed area detected during rough inspection and cleans the sewer wall before the inspection system is deployed.

In the third step, the inspection system inspects the sewer completely, measuring the sewer with greater accuracy than the system for rough inspection. In addition, joint widths and pipe offsets are measured and cracks and leaks are detected. Building upon the concepts developed in project work and the results from the tests in real sewers, inspection and cleaning systems are now being developed and constructed, which will be used in the sewer system.

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Collaboration
Emscher Genossenschaft

Laboratory Automation: Automating Substance Analyses

Motivation

Today research and development in biotechnology and und pharmaceutics are frequently no longer conceivable without automation. Automation has become an essential engine of progress in the life science sector. As opposed to classical automation however, not products but rather test results are produced. There has been a boom in high throughput screening in recent years. Yet other sectors are also showing great potential for automation.

Laboratories often perform recurring processes as part of experiments. The manual activities are usually identical, while minor variations of process parameters in experiments require great concentration and drastically increase the quantity of data. In order to be able to draw qualitative conclusions from experimental results, requirements on the reproducibility and quality of execution are focused on in particular.

By automating the complete operation, both extremely complicated experiments can be conducted and in-depth data analysis can be performed since data is stored centrally.

As part of an industrial contract, the Fraunhofer IFF had to engineer, develop and implement a complete laboratory automation system. The system had to provide the following basic functions:

- Cultivation of biological tissue samples in multiplates,
- Execution of experiments for specific samples by adding media and substances,
- Integrated image processing for analysis of samples,
- System scheduling and control,
- Central data storage and
- Automatic generation of reports.

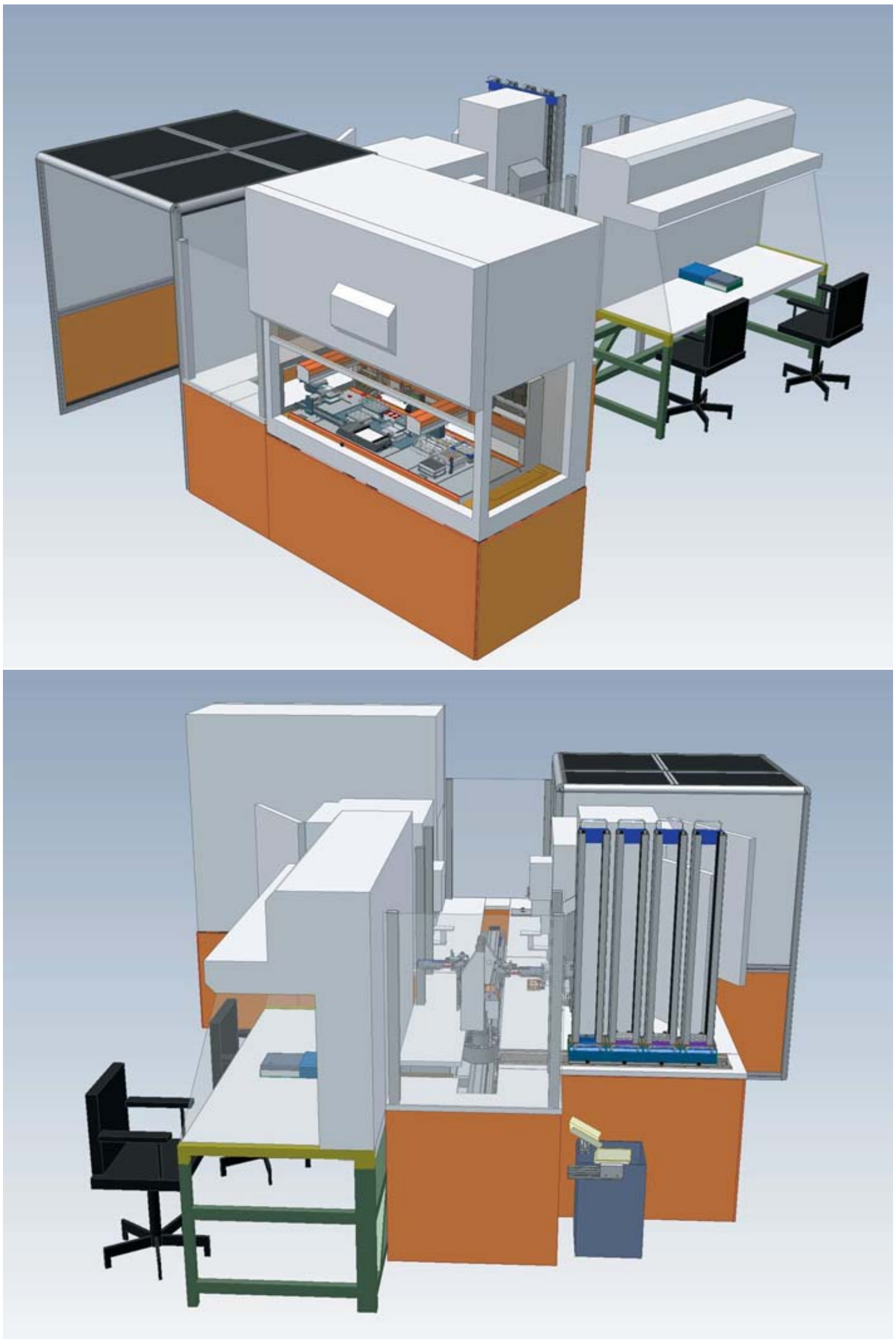

Figure 1: Visualization of the system layout.

The most important requirements on the system were the precise, biologically faultless mapping of processes such as high throughput previously performed manually with greater variability.

Figure 2: Pipeting station.

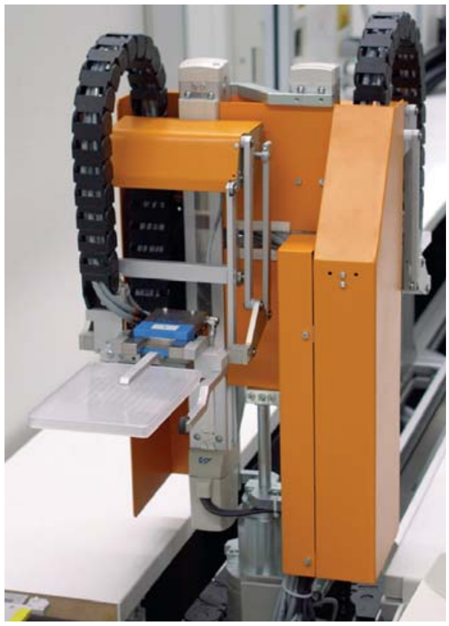

Figure 3: Robot.

System Components

The successful development included the conception and engineering as well as the design of the control and the interface to the operator.

Corresponding to the system requirements, incubators, an image processing station and a laminar box were integrated for the manual preparation of tissue samples. A robot equipped with two grippers was developed for multiplate transport between the stations (Figure 3).

The heart of the system is the pipetting station, likewise specially designed for it (Figure 2). It is able to handle two multiplates simultaneously, i.e. to pipette, suction off or even exchange samples between both.

Two programmable logic controllers, each monitoring several stations, work as part of the hardware. An MS® Windows 2000 computer manages operations. An MS® Windows SQL server 2000 takes care of data storage. Operation is over two terminals, which communicate with data storage and the control computer through a network.

System Parameters

The system demonstrates reproducibility within seconds and allows high comparability of results simply by varying process parameters.

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Designing and Operating Plants Efficiently

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Dr. Gerhard Müller

PAT Process and Plant Engineering
Dr. Lutz Hoyer

PPM Product and Process Management
Ms. Susan Gronwald

SIM Security Management
N.N.

Project Reports

ECOSITES – Development and Production of High Performance Composite Materials

Motivation

Developing new fiber composites made of renewable raw materials is a complex challenge. It opens a broad range of applications and makes a valuable contribution to the development of sustainable applications.

As part of the EU project ECOSITES, the conventional injection molding process was successfully used to integrate the waste product of short cellulose fibers from paper manufacturing processes in a polymer matrix and to develop a material, which has amazingly high resilience. A particular challenge was the process guidance for granulate production, which requires precisely coordinating temperature and pressure control as well as systematically admixing the pretreated cellulose fibers to ensure a stable manufacturing process.

In this project, researchers from Sweden, Spain, Italy, Greece and Germany are working together on optimizing this renewable composite polymer. The goal of development is to use this inexpensive and sustainable material to equip car interiors. Strict emissions criteria representing a particularly demanding requirement. This is where there is currently the greatest need for optimizing the composite polymer developed

Parameters of the Material Developed

Material parameters achieved so far possess sufficient strength to compete with the materials used until now to equip interiors. In addition, tensile, compressive and flexural strength were all tested. Both the granulate production and the injection molding require special processing parameters for this material with considerable variations in density between fiber and matrix. Essentially, critical parameters are pressure and temperature, the easy inflammability of cellulose fiber having to be taken into account.

State of Material Development

Material development is already in prototype application and a final phase of optimization. Selected interior parts have been manufactured and used in test vehicles. The first example was the center console tray illustrated as a 3-D CAD image in Figure 1.

The material was optimized while tests were conducted on hemp fibers and wood additives. Particular problems were presented by the processes of decomposition when there is a permanent thermal load such as can occur in any car in high summer. Stabilizers in the polymer composite clearly reduce this. Thus slight dimensional deviations could also be clearly minimized. However, even after chemical optimization, the polymers with wood additives were unsuited for use when there is a thermal load.

Figure 1: Tray for a center car console.

Significant for the achievable property parameters were the proportion of cellulose fibers and their distribution in the matrix. Important process steps were the drying and commingling of the cellulose fibers, which are delivered in pressed balls. The objective was optimal equipartition. Preformed balls were not used. Aligning the fibers was also not a goal of process control.

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AKT – Altmärker Kunststofftechnik GmbH

Energetic Optimization and Emissions Reduction for the Production of Multicomponent Endless Extruded Material

Motivation

Polystal Composites GmbH in Haldensleben produces high-performance composite materials in the form of round profiles for different purposes. In the course of relocating facilities in Haldensleben, to plant had to be engineered for production and an exhaust treatment plant had to be added. In order to be able to guarantee environmentally compatible and legally compliant operation, the organic impurities (styrene) in the exhaust air were to be dropped below the limit value of the clean air directive. The clean air directive limit value in force at the time of relocation was 100 mg/m^2 for organic hydrocarbons. The goal at Polystal Composites GmbH however was to clearly lower odor emissions and keep below an emission value of 10 mg/m^2.

Corresponding to the ideas at Polystal Composites GmbH, the Fraunhofer IFF had the job of developing and producing a demonstration plant to energetically combine the hardening of Polystal-products with the thermal afterburning of styrene-contaminated exhaust air flows.

The Fraunhofer IFF took over the design of the thermal afterburning process and the heating modules, the basic engineer ing and the design of the control of the entire plant.

Figure 1: Polystal hardening production line.

Concept Research

To select process technologies for such an exhaust air treatment plant, metrological tests were conducted on a production line in operation. Since the thermal processes being considered for the conversion of organic hydrocarbons in the production process require large quantities of process heat, the thermal output needed was compared beforehand with the usable thermal output generated by the exhaust air treatment.

Along with the current energy status, the existing production engineering was also tested for the energy consumption costs. In this regard, proposals for energy savings by using new technologies and concepts could be incorporated in the optimization of the production line aimed at.

The required process heat was originally provided by electric and steam-heated heat feed lines. The energy needed represented a considerable proportion of the manufacturing costs and burdened operating profits accordingly. Expanding the production facility with a conventional exhaust air treatment would have led to a further increase of energy consumption and additional CO^2 emissions.

The envisioned combination of plant components for exhaust air treatment and heating in production with simultaneous optimization of process flows and the use of measures reducing energy consumption introduced an economically as well as ecologically expedient technology. On the basis of the volumetric exhaust air flows determined combined with data on pollutant concentrations from earlier readings, a new data pool was created which would help select technology variants for an exhaust air treatment plant to be developed.

System Components Installed

The outcome of the preliminary tests was the installation of various plant components were installed at the Haldensleben site.

In detail, these were three thermal afterburning plants, one regenerative thermal afterburning plant and three production lines with four heating lines each (Figure 1).

The combination of the thermal exhaust air treatment with heating in production as well as simultaneous optimization of process flows and the use of measures reducing energy consumption demonstrated this economically as well as ecologically expedient technology's suitability for practical application.

For Polystal Composites GmbH the start-up of the exhaust air treatment plant is reflected in a 67 % reduction of the specific energy consumption. Likewise, after changing the energy source, specific energy costs dropped by 87 %.

Figure 2: Thermal afterburning modules with exhaust and combustion blowers.

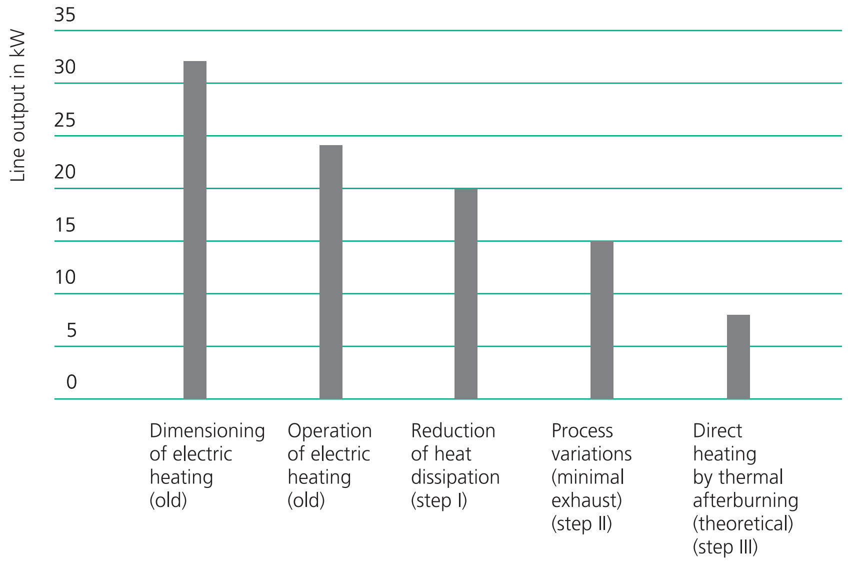

Figure 3: Reduction of energy costs by the exhaust air treatment system.

A 30 % increase of production speed as well as a reduction of the emission values below the limit value of the new clean air directive make the exhaust air treatment plant's value for the operator clear.

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Collaboration
Polystal Composites GmbH,
Haldensleben

ECHAINE – Energy Wood Production Chains in Europe

Motivation

The objective of this project is the analysis and evaluation of energy wood production, supply and utilization chains (e-chains) in Europe. This complex topic is being researched as part of the European support program EESD (Energy, Environment and Sustainable Development).

Since the development of bioenergy greatly depends on the sustainable availability of sources of energy, on their competitiveness and on social acceptance, ECHAINE is focusing its research on:

– Analyzing the state-of-the-art, technological options and processes for energy wood production and the energetic utilization of energy wood
– Conducting market analyses, identifying potentials for cost reduction and market opportunities
– Providing information for public discussion on the acceptance of wood as a source of energy
– Analyzing socio-economic issues of energy wood production
– Formulating proposals with regard to demands for action for successfully promoting energy wood production in Europe
– Analyzing the environmental impacts when wood is used as a source of energy, including the anaysis of specific stages along the entire energy wood chain.

Consequently, the result of the ECHAINE project will be an overview of innovative possibilities for energy wood production including the supply of wood fuels and the technologies for generating heat and power in Europe. The detailed analysis of the current technological state of energy wood production and utilization in Europe will simultaneously identify the different conditions of use and ranges of application in the individual countries.

ECHAINE User Groups

ECHAINE is geared toward the following user groups

– Developers, investors and technology providers
– Government agencies and authorities
– Non-governmental organizations and associations

When know-how is provided for these policy makers the following aspects, among others, are provided for:

– European, national and regional conduct and strategies for energy, environmental and land use
– Pioneering projects in the energy wood sector as well as successful companies and methods
– Differences in energy wood production chains in European countries and regions

ECHAINE Publication

Research results will be disseminated in professional publications and at open seminars, workshops and educational and training activities.
A website will also be developed in which an interactive geographic information system will be integrated.

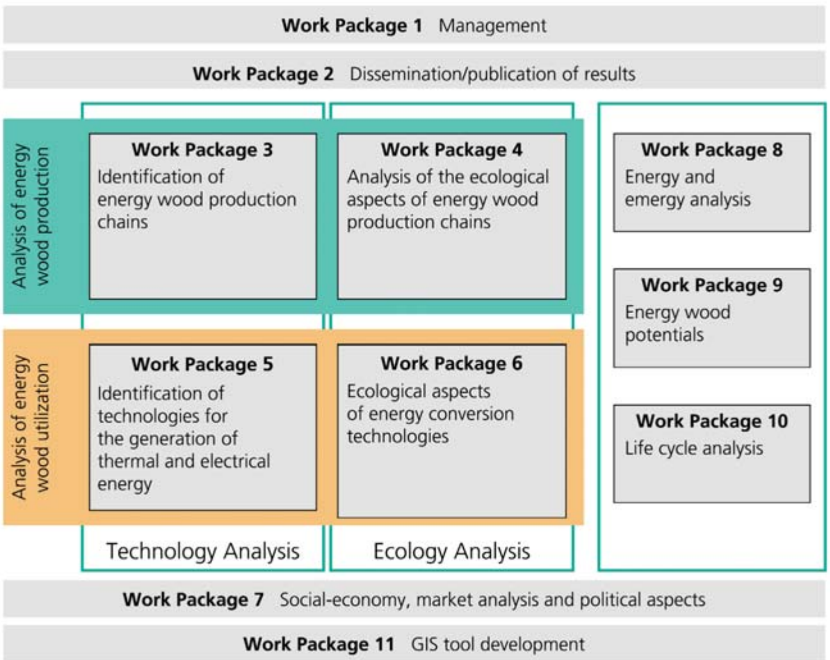

Figure 1: ECHAINE multidisciplinary project approach.

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ECHAINE-Konsortium

- Swedish University of Agricultural Science, Sweden
- Centre for Research and Technology Hellas, Greece
- University of Oulu, Finland
- Center for Renewable Energy, Greece
- The Agricultural College of Beja, Portugal
- Centre for Energy Policy and Economics, Switzerland
- Sema Group sae, Spain
- Technical University of Sofia, Bulgaria
- Oskar von Miller – Conception Research and Design Institute for Thermal Power Equipment, Romania
- Fraunhofer Institutes

The collaboration of the Fraunhofer IFF in this interdisciplinary research topic involves the responsible management of the technical complex of the technological and ecological aspects of the utilization of wood as energy in thermal biomass plants.

Optimizing Gasification Plant Measurement and Control Technology

Motivation

Biogenic solid fuels such as scrap wood and agricultural residues will be gasified in small decentralized units with thermal firing capacities between 1 and 10 MW in order to produce power and heat cost effectively. Locations of the woodworking industry, the waste disposal industry and even municipal supply and disposal companies can be considered for the implementation of this development. Fluidized bed technologies combined with appropriate fuel gas processing plants can use biomasses to generate electrical power by means of combustion engine-generator combinations. Producing this energy conversion chain requires generating fuel gases safely and in the quantities needed. Current activities are aimed at developing and integrating control and monitoring functions in this technology chain.

Use of Control Elements

The screenshot of the process control system displays the circuit arrangement of the IFF's WSV 400 fluidized bed experimental plant with a thermal firing capacity of 150 kW and the connected fuel gas treatment equipment (Figure 1). By adding fuzzy logic controls to the process control system the monitoring of such systems is prepared for standards of low-maintenance and user-friendly operation without supervision. Further metrological additions such as gas-potentiometric probes (Figure 2), which allow characterizing the gas quality in situ by its redox ratio make it possible to intervene quickly and safely to control the gasification process. Consequently, logical controls in conjunction with rapidly responding and quickly reacting measurement options not only ensure high and consistent gas qualities but also simultaneously raise the safety standard of the entire system.

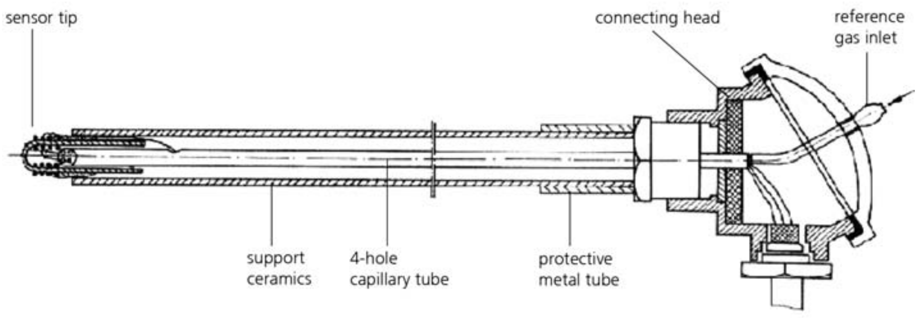

Figure 2: Solid electrolyte probe for gas potentiometry.

The test area has a CHP module based in a pilot injection diesel motor for subsequent conversion of the fuel gases into electrical power and useful heat. In order to counteract future bottlenecks in the supply of solid fuels, series of extensive tests will continuously expand the spectrum of solid fuels. Apart from various biogenic solid fuels from silviculture and agriculture, industrial residues are increasingly being used to substitute energy sources and generate power and heat.

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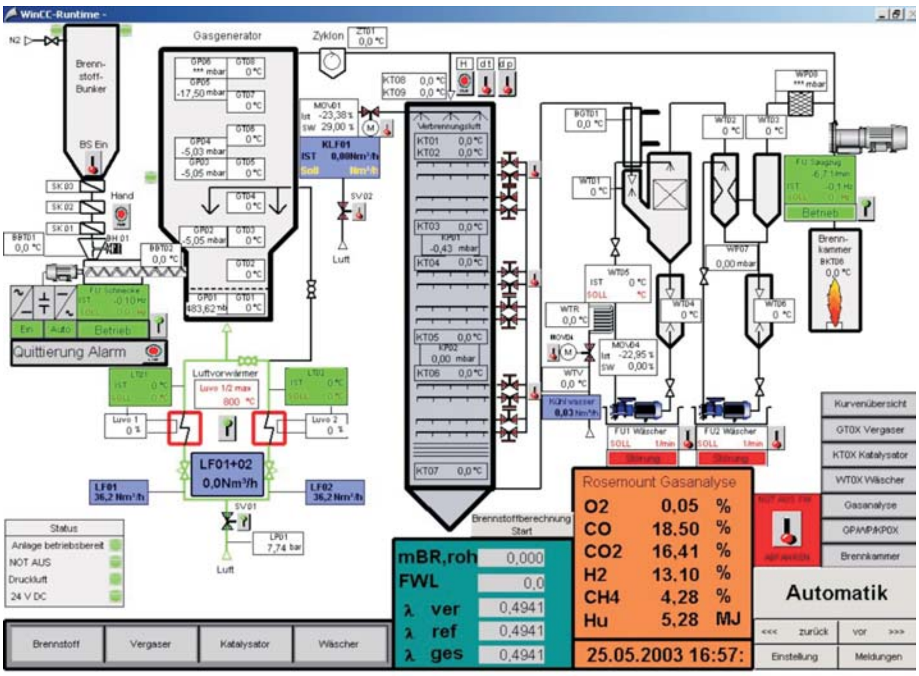
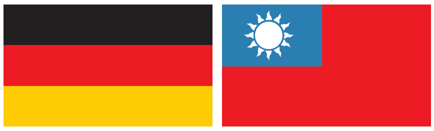


Bild 1: BMSR schematic diagram of the WSV 400 experimental gasification plant.

Thermal Biomass Utilization:
Research Cooperation with Taiwan



Motivation

Taking the Fraunhofer IFF's existing professional contacts in the Republic of China (Taiwan) in the field of environmental management as the starting point, the following objectives were used as the basis as a strategic initiative to strengthen research cooperation in the Fraunhofer-Gesellschaft's internal program »PROFIL« with the thematic complex »Thermal Biomass Utilization in Taiwan«:

- Initiating R&D cooperation for technologies for the energetic utilization of biomass and waste with thermal plants in the low power range
- Analysis of regional potentials for use and application of innovative fluidized bed gasification based on the development advances produced in the Fraunhofer-Gesellschaft.

The particular interest of the Taiwanese (as well as of other countries in Southeast Asia) in this subject matter is the motivation for this initiative. What is more, Germany and the EU equally have interests in broadly introducing advanced technologies for the purpose of climate protection, resource conservation and future decentralized energy supply structures.

Cooperation

The foci set in cooperation with the Industrial Technology Research Institute ITRI Taiwan - the Taiwanese counterpart to the German Fraunhofer-Gesellschaft - is currently concentrated on the thematic field of fluidized bed gasification technology for biomass and waste and is assigned to the institute's Energy and Resources Laboratory ITRI/ERL, Division of Clean Energy Technology, Biomass Energy Laboratory.

Figure 1: Signing of the Fraunhofer IFF – ITRI Taiwan Agreement on Scientific-Technical Cooperation: (from left) Sherman Shen, Director Commercial Department, Taipei Representation in the Federal Republic of Germany; Dr. Liang-Han Hsieh, Director of the Industrial Technology Research Institute, Western Europe Office Berlin; Dr. Reiner Haseloff, State Secretary, Saxony-Anhalt Ministry of Economics and Labor; Dr. Gerhard Müller, Acting Director Fraunhofer IFF.

Based on the already existing memorandum of understanding on research cooperation between the Fraunhofer-Gesellschaft and ITRI, a technical framework was defined with the ITRI in the General Agreement of April 10, 2003 concluded between the ITRI and the Fraunhofer IFF on the occasion of the Hannover Industry Trade Fair. The attendance of the Saxony-Anhalt Ministry of Economics and the Commercial Department of the Taiwanese Representation in Germany underscores the fundamental importance of research cooperation in this field for both parties.

The agreement lays down the technical content and the objectives in the fields of cooperation.

- Gasification of biomass and waste in innovative fluidized bed plants with cogeneration
- Synthesis gas generation, fuel gas treatment, electrical power generation, measurement and control technology for process guidance

Concrete work on problems involving corresponding researcher exchange beginning in 2003 is structured with a long-term orientation toward each of the current foci on the development of special plant components. Presently, special emphasis is being placed on problems of fuel gas treatment with respect to the utilization of generated synthesis gases in electrical power conversion modules. The range of the development of integrated technological lines based both on the active principle of stationary fluidized beds and circulating fluidized beds is oriented toward future collaboration of other Fraunhofer Institutes specialized in these problems as part of the Fraunhofer Production Alliance.

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Highlights, Events and Trade Fair Presentations (Selection)

January 27-28, 2003, Stuttgart
Workshop »Disposal Logistics 2010«
Hosted with: University Stuttgart, IFT
Technical direction:
Mr. Peter Rauschenbach

January 30, 2003, Magdeburg
Workshop and presentation of the results of the study »Structure of Communications Costs in the Public Sector« contracted by the DPAG before the inter-ministry working group »Central Services«
Hosted with: Deutsche Post AG
Technical collaboration:
Ms. Andrea Urbansky
Mr. Axel Müller

January 30, 2003, Magdeburg
Presentation of the project »Development of an Electronic Platform and an e-Commerce Solution for Regional Small and Medium-sized Enterprises – Pilot: Landwarenhaus-Online GmbH«
Hosted with: InfoRegio; Landwarenhaus-Online GmbH
Technical direction:
Ms. Andrea Urbansky
Technical collaboration:
Ms. Veronika Kauert

February 4-7, 2003, Karlsruhe
LEARNTEC 2003 – Conference and Specialist Trade Fair for Educational and Information Technology
Exhibit:
- e-Industrial Services

Technical collaboration:
Mr. Waleed Salem, M.Sc.

February 25-26, 2003, Magdeburg
Symposium »Innovations in Networks: From the Idea to its Implementation through Start-up Support«
Hosted with: Research partners from the projects VIKODI, MikroTOP, Netrepreneur, Harmony u.a.
Technical direction:
Dr. Gerhard Müller
Technical collaboration:
Mr. Peter Rauschenbach
Ms. Katrin Reschwamm
Mr. Andreas Wolf

March 5, 2003, Magdeburg
5th Magdeburg HLA Forum 2003
Hosted with Otto von Guericke University Magdeburg, School of Computer Science
Technical direction:
Dr. Ulrich Raape
Dr. Thomas Schulze
Technical collaboration:
Mr. Marco Schumann

March 6-7, 2003, Magdeburg
Symposium »Simulation und Visualization 2003«
Hosted with: Otto von Guericke University Magdeburg, Arbeitsgemeinschaft Simulation (ASIM), Society for Computer Simulation (SCS) Europe, Gesellschaft für Informatik
Program committee:
Dr. Eberhard Blümel
Technical collaboration:
Mr. Marco Schumann

March 10-14, 2003, Bangkok (Thailand)
»Train the Trainer Workshop on Environmental Performance Assessment for Industry«
Hosted with: InWEnt Germany, ASEP Thailand
Technical direction:
Mr. Ralf Opierzynski
Mr. Frank Müller

March 18-19, 2003, Hannover
Messe CeBIT
Exhibits:
- Presentation at the GZVB Braunschweig
- Virtual Development and Training Center

Technical collaboration:
Dr. Eberhard Blümel
Mr. Waleed Salem, M.Sc.

March 27-28, 2003, Berlin
E-Ecological Manufacturing Colloquium
Host: TU Berlin and UdK
Sponsored by DFG
Technical collaboration:
Mr. Marco Schumann

March 28-29, 2003, Bad Lippspringe
»ERFA«, REFA/VDG Technical Committee Conference
Technical collaboration:
Ms. Sonja Hintze

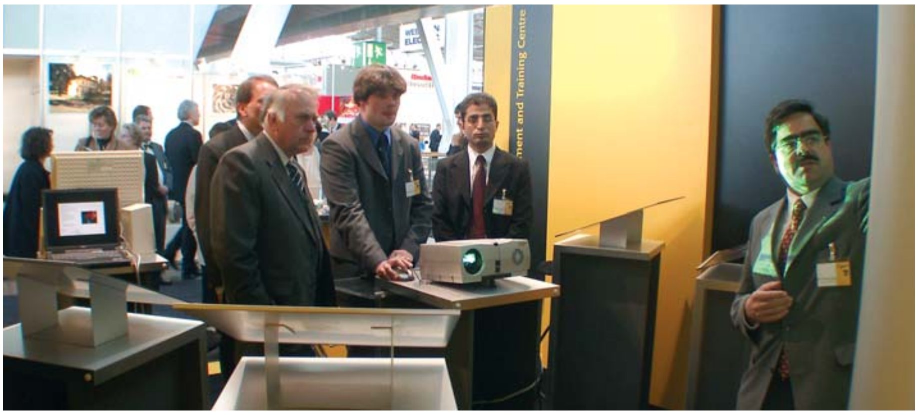
April 1, 9, 23, 30, 2003
May 7, 14, 2003, Magdeburg

6th Logistics Guest Lecture Series
»Logistics as the Field of Work of the Future: Potentials, Implementation Strategies and Visions«
Technical direction:
Prof. Michael Schenk, Director Fraunhofer IFF and Chair for Logistic Systems at Otto von Guericke University Magdeburg
Prof. Karl Inderfurth, Chair for Business Administration, particularly Production and Logistics at the Otto von Guericke University Magdeburg
Prof. Dietrich Ziems, Chair for Logistics at Otto von Guericke University Magdeburg
Patron:
Dr. Karl-Heinz Daehre, Saxony-Anhalt Minister of Housing and Transportation

Dr. Karl-Heinz Daehre, Saxony-Anhalt Minister of Housing and Transportation delivering his opening remarks on the occasion of the 6th Logistics Guest Lecture Series.

April 2-3, 2003, Riga (Latvia)

International Workshop »TELEBALT«
Hosted with: IST European Commission, EDNES France, Infobalt Lithuania, INFO-RING AS, CODATA
Technical collaboration:
Dr. Eberhard Blümel



Saxony-Anhalt Minister President Prof. Wolfgang Böhmer (l.) visits the Fraunhofer IFF at the LSA joint stand (top).

Dr. Eberhard Blümel, Division Director at the Fraunhofer IFF explains examples of applications of the Virtual Development and Training Centre (VDTC) to Minister President Prof. Wolfgang Böhmer (bottom).

April 7-12, 2003, Hannover

Hannover Messe Industry – Fraunhofer IFF represented at the joint stand of the State of Saxony-Anhalt and together with the Magdeburg-Stendal University of Applied Sciences
Exhibits:

– Virtual Development and Training Centre (VDTC)
  LSA Joint Stand
  Technical collaboration:
  Dr. Eberhard Blümel
  Mr. Waleed Salem, M.Sc.
– Autonomous Agricultural Machine joint stand with:
  HS Magdeburg-Stendal, School of Industrial Design
  Technical collaboration:
  Ms. Susan Gronwald
  Dr. Uwe Klaeger

Signing of the Cooperation Agreement between the Fraunhofer IFF and the Harz University of Applied Sciences by Prof. Michael Schenk, Director Fraunhofer IFF and Prof. M. Assenmacher, President of Harz University.

April 10, 2003, Hannover

Signing of the Agreement on Cooperation in Joint Research and Development between the Fraunhofer IFF and the Industrial Technology Research Institute ITRI (Taiwan)
Technical collaboration:
Dr. Gerhardt Müller
Dr. Lutz Hoyer

April 10-12, 2003, Petersburg (Russia)

Petersburg Dialog »Germany and Russia in Europe«
Fraunhofer IFF goes East – Interlogistika: German-Russian Cooperation on Know-how and Technology Transfer.
Fraunhofer IFF technical direction: Prof. Michael Schenk

April 15, 2003, Wernigerode

Opening of the »Harz Regional Competence Center for Virtual Engineering for Products and Processes« at the IGZ Wernigerode and ceremonial signing of a Cooperation Agreement with the Harz University of Applied Sciences
Head of the Competence Center:
Mr. Marco Schumann

April 16, 2003, Magdeburg
Day of Encounters: The Fraunhofer IFF brought partners together to bundle competencies and presented its guests:
- World's firsts from robotics
- A virtual city tour through Magdeburg
- Research results for professional level sports

Technical direction:
Dr. Gerhard Müller, Acting Director

Prof. Karl-Heinz Paqué, Saxony-Anhalt Minister of Finance (top r.) and Dr. Lutz Trümper, Mayor of Magdeburg (center 3rd from r.) learn about the Fraunhofer IFF's newest project – the VDTC.

A development for professional level sports is the digital javelin (bottom).

May 6-9, 2003, Sinsheim
Control 2003, International Professional Trade Fair for Quality Assurance
Exhibit:
- Online 3-D Geometry Measurement in Industrial Manufacturing

May 13-14, 2003, Lahnstein
24th VDI/VDEh Forum on Maintenance
Exhibits:
- Idasys
- VR Control Center
- Transponder

Technical collaboration:
Dr. Eberhard Blümel
Mr. Waleed Salem, M.Sc.
Ms. Cathrin Plate
Mr. Frank Ryll

May 13-18, 2003, Uppsala (Sweden)
ECHAINE Workshop – Energy Wood Production Chains in Europe
Hosted with:
Centre for Renewable Energy CRES, Centre for Research and Technology Hellas CERTH (Greece), Thule Institute Oulu (Finland), Technical University of Sofia (Bulgaria)
Technical collaboration:
Dr. Matthias Gohla
Ms. Janet Schrader

May 14-15, 2003, Nürtingen
Professional Conference on Factory Planning
Hosted with: IIR Deutschland GmbH
Technical direction:
Prof. Michael Schenk
Technical collaboration:
Mr. Gregor Sallaba
Mr. Steffen Gröpke

May 20.-22. Mai 2003, Wolfsburg
Wolfsburg Industry Forum
Exhibit:
- Autonomous Agricultural Machine

Technical collaboration:
Ms. Claudia Falke
Mr. Daniel Reh

June 2-3, 2003, Berlin
Workshop »Process Monitoring in Materials Cycle Management«
Technical direction:
Mr. Peter Rauschenbach

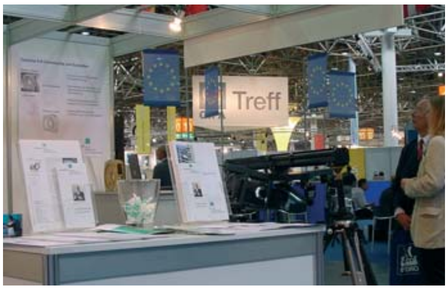
June 5, 2003, Saarbrücken
Closing event to the research project UNIKAT, The Unique Enterprise
Technical collaboration:
Mr. Hans-Georg Schnauffer

June 3-6, 2003, Saarbrücken
36th CIRP International Seminar on Manufacturing Systems
Technical collaboration:
Mr. Waleed Salem, M.Sc.

June 6, 2003, Berlin
6th German-Arab Business Forum 2003
Hosted with: Arab-German Trade and Industry Association
Technical collaboration:
Mr. Waleed Salem, M.Sc.

June 16-17, 2003, Magdeburg
9th International Professional Congress NAROSSA – Accompanying Exhibition
Exhibit:
– Prototype Processing of Biopolymers
Technical collaboration:
Mr. Mario Tanke
Ms. Janet Schrader

June 16-19, 2003, Stockholm (Sweden)
SIW-03 European Simulation Interoperability Workshop 2003
Technical collaboration:
Mr. Marco Schumann



June 16-21, 2003, Düsseldorf
GIFA Trade Fair, WFO-Forum
Exhibit:
– System for Flexible 3-D Digitization
Hosted with: VDG
Technical collaboration:
Ms. Sonja Hintze

June 17, 2003, Magdeburg
Workshop »Explosive Internet«
Hosted with: DeuGerman Explosives Association and megaDOK
Technical collaboration:
Ms. Andrea Urbansky
Mr.. Waldemar Hofmann
Mr. Axel Müller

Juni 25-27, 2003, Magdeburg
6th IFF Science Days »Virtual Platforms – Making Information Graspable – Producing Knowledge«
Technical direction :
Prof. Michael Schenk
- International Symposium »VDTC – Virtual Reality Applications for Development, Testing and Training«
  Technical direction:
  Dr. Eberhard Blümel
  Technical collaboration:
  Dr. Axel Hintze
  Mr. Stefan Stüring
  Mr. Torsten Schulz
  Mr. Waleed Salem, M. Sc.
- Symposium »Planning and Optimizing Logistics Networks«
  Technical direction:
  Dr. Carlos Jahn
- Professional Dialog »Factory Planning as Industrial Service« (closing event to ProTT – Service Products for Planning Teams for Tertiarizing Factory Planning)
  Technical direction:
  Dr. Gerhard Müller
  Technical direction:
  Mr. Gregor Sallaba
- Workshop »IDEA – Interactive Digital Development Platforms – Bridges Between Academia and Practice«
  Technical direction:
  Dr. Eberhard Blümel

Juni 27-29, 2003, Burg

»Saxony-Anhalt Day«
Hosted with: InfoRegio and Landwarenhaus-Online GmbH
Technical collaboration:
Ms. Veronika Kauert

July 3, 2003, Gera

6th Central German eForum
Technical collaboration:
Mr. Marco Schumann

August 18-20, 2003, Magdeburg

ECHAINE Workshop - Energy Wood Production Chains in Europe
Hosted with:
Centre for Renewable Energy CRES, Centre for Research and Technology Hellas CERTH (Greece)
Thule Institute Oulu (Finland)
Technical University of Sofia (Bulgara)
Technical direction:
Dr. Matthias Gohla
Ms. Janet Schrader

September 4-5, 2003, Thailand

Workshop Asia IT & C FORCE »Information Technology and Communication in the Field of Sustainable Environmental Protection for Resource Intensive Enterprises«
Technical direction:
Mr. Ralf Opierzynski

September 16, 2003, Magdeburg

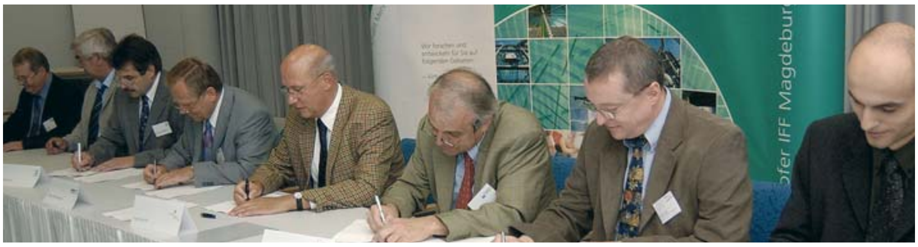
Biomass Gasification
Hosted with:
Industrial Technology Research Institute ITRI (Taiwan)
Technical direction:
Dr. L. Hoyer

September 16-17, 2003, Manila (Philippines)

Workshop on Improving Efficiency and Reducing Costs by Using Environmental Performance Indicator Systems (Observer Training)
Hosted with:
InWEnt (Germany), ASEP (Thailand), Del La Salle University (Philippines), Robautronix Inc. (Philippines)
Technical direction:
Mr. Ralf Opierzynski
Mr. Frank Müller

September 18, 2003, Magdeburg

Workshop on »Development of a Service Connector for Cooperative Bid Management in Plant Engineering«
Hosted with: BEA Elektrotechnik und Automation Technische Dienste Lausitz GmbH, SKL Engineering & Contracting GmbH, TÜV Nord MPA Ges. f. Materialprüfung und Anlagensicherheit mbH & Co. KG, Weber Rohrleitungsbau GmbH & Co. KG, Lindner AG JUCH Industrie-Isolierung GmbH, Eudemonia Solutions AG
Technical direction:
Ms. Mira Kleinbauer
Technical collaboration:
Ms. Melanie Thurow
Ms. Andrea Urbansky



The hosts of the workshop on developing a service connector sign the cooperation agreement

September 16-19, 2003, Magdeburg

17th Simulation Technology Symposium ASIM 2003
Hosted with: Otto von Guericke University Magdeburg, Simulation Working Group (ASIM), Society for Computer Simulation (SCS) Europe, IMACS, EUROSIM, Gesellschaft für Informatik (GI)
Technical collaboration:
Dr. Eberhard Blümel
Dr. Axel Hintze
Mr. Marco Schumann

September 17-19, 2003, Hamburg

InterGEO Trade Fair
Exhibit:
– Geoinformatics in Logistics
Presented with: Fraunhofer AIS and ISST
Technical direction:
Mr. Frank Mewes
Dr. Ulrich Raape

September 18-20, 2003, Riga (Latvia)

The International Workshop on Harbor, Maritime & Multimodal Logistics Modeling and Simulation
Hosted with: DMS Riga TU, DIP Genoa University, Liophant Simulation Club, Genoa & Latvian Centers, LSS Latvian Simulation Society
Technical collaboration:
Dr. Eberhard Blümel
Mr. Marco Schumann

September 19-20, 2003, Braunschweig

German Space Day 2003
Exhibits:
- Harvester
- Virtual Training Scenarios

Technical collaboration:
Ms. Heike Kissner
Mr. Stefan Stüring
Mr. Waleed Salem, M.Sc.

September 20-23, 2003, Salonika (Greece)

ECHAINE Workshop – Energy Wood Production Chains in Europe
Hosted with: Centre for Renewable Energy CRES, Centre for Research and Technology Hellas CERTH (Greece), Thule Institute Oulu (Finland), Technical University of Sofia (Bulgaria)
Technical direction:
Technical collaboration:
Ms. Janet Schrader

September 24-26, 2003, Magdeburg

6th Magdeburg Mechanical Engineering Days
Hosted with: Otto von Guericke University Magdeburg, VDMA, DFG, tti GmbH, State of Saxony-Anhalt, IRC
Program committee:
Prof. Michael Schenk
Technical collaboration:
Dr. Martin Endig
Mr. Marco Schumann
Dr. Axel Hintze
Mr. Stefan Stüring

September 25-26, 2003, Zilina (Slovakia)

6th National Forum on Productivity
Technical collaboration:
Mr. Robert Sturek

September 28 - October 5, 2003, Bernburg

European Biomass Days – Region Days
Exhibitions:
- ECHAINE – Energy Wood Production Chains in Europe

Technical collaboration:
Ms. Janet Schrader

September 29-30, 2003, Aachen

GfA Fall Conference 2003
Technical collaboration:
Mr. Stefan Stüring

October 1-2, 2003, Aachen

ODAM – International Symposium on Human Factors in Organizational Design and Management
Technical collaboration:
Mr. Stefan Stüring

October 2-3, 2003, Magdeburg

Presentation on the »Street of Innovations« on the Day of German Unity
Exhibits:
- Joint stand of the Fraunhofer IFF with the Saxony-Anhalt Ministry of Agriculture and the Environment presenting the research topic »wood logistics«

Ms. Petra Wernicke, Saxony-Anhalt Minister of Agriculture and the Environment learns out about wood logistics at the Fraunhofer IFF stand.

- Fraunhofer IFF stand presenting the »VDTC Virtual Reality for Development and Training« and »Autonomous and Mobile Systems«

Prof. J.-H. Olberts Saxony-Anhalt Minister of Education and Culture talking with Fraunhofer IFF associates about the VDTC.

October 5-9, 2003, Karlsruhe
IFIP – International Federation for Information Processing
Technical collaboration:
Mr. Stefan Stüring

October 6-8, 2003, Munich
2nd Interdisciplinary World Congress on Mass Customization and Personalization (MCPC)
Technical collaboration:
Mr. Ralph Seelmann-Eggebert

October 9, 2003, Magdeburg
Workshop on »Cooperative Projects with ALSTOM« and presentation of the Fraunhofer IFF and selected project highlights to investigate potentials for cooperation between the Fraunhofer IFF and ALSTOM
Technical collaboration:
Dr. Gerhard Müller
Dr. Eberhard Blümel
Dr.. Klaus Richter
Mr. André Hanisch
Mr. Krister Johnson, M.A.
Ms. Andrea Urbansky
Ms. Mira Kleinbauer
Ms. Melanie Thurow

October 9, 2003, Magdeburg
UNIKAT Forum: Potential-oriented Strategy Development
Technical direction:
Mr. Hans-Georg Schnauffer

October 10, 2003, Magdeburg
Special colloquium on the occasion of the appointment of Dr. Peer Witten, member of the Fraunhofer IFF board of Trustees, to honorary professor for »International Distribution Logistics« at the Institute for Materials Handling and Construction Machinery, Steelwork and Logistics (IFSL) in the Otto von Guericke University Magdeburg's School of Engineering

On the occasion of his appointment to honorary professor, Dr. Peer Witten is congratulated by Prof. Jan-Hendrik Olbertz, Saxony-Anhalt Minister of Education and Culture, and Prof. Klaus Erich Pollmann, President of Otto von Guericke University Magdeburg.

October 16, 2003, Stuttgart
German MTM Conference
Exhibit:
– Virtual Training Scenarios
Technical collaboration:
Ms. Heike Kissner
Mr. Torsten Schulz

October 22-24, 2003, Berlin
20th BVL German Logistics Congress »Overcoming limits – Shaping change«;
Session »Innovative Factory and Production Concepts«
Direction and Moderation:
Prof. Michael Schenk, Director Fraunhofer IFF, Member of the BVL Executive Board
Fraunhofer IFF Presentation as part of the exhibition»Logistics Market Live«
»Logistics Intelligence from Magdeburg«
– Intelligently planning and visualizing logistics
– Intelligently controlling logistics
– Intelligently customizing logistics
– Intelligently automating logistics
Workshop »Variant Diversity through Customization – Premises for Logistics«
Moderation:
Mr. Ralph Seelmann-Eggebert

October 29-30, 2003, Taipei (Taiwan)
Conference on Waste-to-Energy and High Temperature Gas Cleanup Technologies under the technical direction of the Industrial Technology Research Institute ITRI
Technical collaboration:
Dr. Lutz Hoyer
Dr. Matthias Gohla

November 3-8, 2003, Wiesbaden
8th IIR Production Congress SYMPRO 2003
Paper »Production Site Germany: Production System with a Future« Prof. Michael Schenk, Director Fraunhofer IFF, Otto von Guericke University Magdeburg, Chair for Logistic Systems
Hosted with: IIR Deutschland GmbH
Technical direction, Congess Chair:
Prof. Michael Schenk
Technical collaboration:
Ms. Sonja Hintze
Mr. Waleed Salem, M.Sc.

November 4, 2003, Magdeburg
IT Trends for Small and Medium-sized Companies: Information and Communications Technologies in Practice
Hosted with: Saxony-Anhalt Association for the Promotion of Mechanical and Plant Engineering (FASA e.V.), Magdeburger Electronic Commerce Zentrum (MD-ECZ), Deutsche Telekom AG
Technical direction:
Ms. Claudia Wilke
Technical collaboration:
Mr. Helmi Matar
Mr. Sven-Uwe Hofmeister

November 5-6, 2003, Magdeburg
UNIKAT Forum: Potential-oriented Strategy Development
Technical direction:
Mr. Hans-Georg Schnauffer

November 7-8, 2003, Hannover
International VDI-MEG Symposium »Agricultural Technology – Agrotechnology for Consumer Protection«
Technical collaboration:
Dr. Eberhard Blümel

November 10-12, 2003, Munich
Symposium »Success Logistics for Production«
Exhibit:
– Mobility and Logistics
Technical collaboration:
Mr. Thomas Dengler
Mr. Daniel Reh

November 18-21, 2003, Ho Chi Minh City (Vietnam)
»Workshop on Environmental Performance Assessment for Industry«
Hosted with: InWEnt (Germany), ASEP (Thailand), VPC (Vietnam)
Technical direction:
Mr. Ralf Opierzynski
Mr. Frank Müller

November 20-21, 2003, Magdeburg
»Logistics Planning and Management, Logistics from a Technical and Economic Perspective« 9th Magdeburg Logistics Symposium
Hosted by: Otto von Guericke University Magdeburg and Fraunhofer IFF
Technical direction:
Prof. Karl Inderfurth, Business Administration Chair for Production and Logistics
Prof. Michael Schenk, Director Fraunhofer IFF and Chair for Logistic Systems
Prof. Gerhard Wäscher, Business Administration Chair for Management Science
Prof. Dietrich Ziems, Chair for Logistics

November 20-21, 2003 in Magdeburg
VDI Seminar: Optical 3-D Metrology for Quality Assurance in Production
Technical direction:
Mr. Dirk Berndt

November 27, 2003, Magdeburg
Fraunhofer IFF takes over the research at the Competence Center for Innovative IT Services for Improving Business Processes for Small and Medium-sized Enterprises and Administration
Technical direction:
Dr. Ina Ehrhardt

The signing of the basic agreement between the State of Saxony-Anhalt by Dr. Horst Rehberger (l.), Saxony-Anhalt Minister of Economics, and the Fraunhofer-Gesellschaft by Prof. Michael Schenk (r.), Director of the Fraunhofer IFF, and Microsoft, T-Systems, Aston Business Solutions laid the foundation for the Competence Center for Innovative IT Services for Improving Business Processes for Small and Medium-sized Enterprises and Administration. Using Magdeburg as its base, this innovative partnership aims at establishing a European excellence association to conceive, develop, introduce and operate innovative and marketable IT services on the basis of Microsoft NET technology. Thus the only competence center at this time based on this technology is being established geared toward the needs of SME business.

November 27, 2003, Wolfsburg
Thyssen Krupp Industry Service: Annual Symposium 2003
Technical collaboration:
Dr. Eberhard Blümel

November 27, 2003, Magdeburg
2003 Annual Meeting of the Magdeburger Maschinenbau e.V.
Technical collaboration:
Mr. Marco Schumann

December 2-5, 2003, Jakarta (Indonesia)
Workshop on Environmental Performance Assessment for Industry
Hosted with: InWEnt (Germany), ASEP (Thailand), IPLHI (Indonesia)
Technical direction:
Mr. Ralf Opierzynski
Mr. Frank Müller

December 3-5, 2003, Berlin
Online Educa Berlin
Exhibit:
– Virtual Training Senarios
Technical collaboration:
Mr. Waleed Salem, M.Sc.
Mr. Torsten Schulz
Mr. Stefan Stüring
Ms. Michaela Bochmann, M.A.

December 3-6, 2003, Frankfurt a.M.
10th EUROMOLD – From Design to Product
Exhibits:
– Material Development for Equipping Car Interiors
– Transferring Residual Thermoplastic Materials from Plastics Industry Recycling Processes to Rapid-Material Systems
Hosted with: Fraunhofer Network for Rapid Prototyping
Technical collaboration:
Dr. Uwe Klaeger
Ms. Susan Gronwald
Mr. Mario Tanke

December 7-10, 2003, New Orleans, LA (USA)
Winter Simulation Conference
Technical collaboration:
Dr. Steffen Strassburger
Mr. Marco Schumann

December 10-11, December 2003, Berlin
5th BMBF Service Conference
»Success with Services – Innovation, Market, Customers, Work«
Participation with a project presentation of the joint project ProTT
Hosted with: IZT – Institute for Futures Studies and Technology Assessment gGmbH
Technical participation:
Mr. Gregor Sallaba

European Projects (Selection)

AITRAM – Advanced Integrated Training in Aeronautics Maintenance

EU - European Union Commission
FLS Aerospace Dublin, Trinity College Dublin (IRL); SR Technics Ltd. Zurich (CH); Air Europe, ECJoint Research Center Ispra (I)
Dept.: Virtual Interactive Training – VIT
April/2000-March/2003

NOMAD – Development of a Work Cell for Welding Large Parts Based on a Mobile Robot Platform

EU - European Union Commission
Caterpillar Belgium SA (B); TWI Ltd (GB); ESAB (S); DELFOI (FIN); Reis GmbH & Co. Obernburg (D); Robosoft SA, Nusteel SA (GB)
Div.: Automation – AUT
Dept.: RS – Robotic Systems
March/2001-August/2004

ECOSITES – Development and Production of High Performannce Composites

EU - European Union Commission
Perplastic, University Oviedo, Gaiker (E); CADAM, FIAT (I); Polykemi, KTH Stockholm (S)
Dept.: Product and Process Management – PPM
April/2001-March/2004

PRISM – Process Industries Safety Management Thematic Network on Human Factors

EU - European Union Commission
The European Process Safety Centre; Technical University Berlin (D); Netherlands Organization for Applied Scientific Research; Det Norske Veritas Ltd.; The Keil Centre Ltd.; John Ormond Management Consultants Ltd.; Politecnico of Milan; Snamprogetti SpA; Aventis CropScience SA; Fina Research SA; Chinoin Chemical and Pharmaceutical Works Ldt.; Solvay S.A.
Dept.: Virtual Interactive Training – VIT
April/2001-March/2004

BALTPORTS-IT – Simulation and IT Solutions: Applications in the Baltic Port Areas of the Newly Associated States

EU - European Union Commission
Riga Technical University, Latvian Intelligent Systems (LV); IDC Information Technologies; Baltic Container Terminal; Joint Stock Comp. Ventamonjaks; University of Ulster; Otto von Guericke University Magdeburg (D); Institute of Cybernetics; Klaipeda State Seaport Authority; Kaunas University of Technology; Warsaw University of Technology, Port of Gdansk Authority (PL)
Dept.: Virtual Development – VD
September/2001-October/2003

MobiLearn – Next Generation Paradigms and Interfaces for Technology Supported Learning in a Mobile Environment Exploring the Potential of Ambient Intelligence

EU - European Union Commission
Giunti Ricerca S.R.L, University of Birmingham, Education.AU Ltd., Liverpool John Moores University Higher Education Corporation, Sheffield Hallam University (GB); Space Hellas SA (GR); Telecom Italia SPA, Cosmote - Mobile Telecommunications S.A., The Open University, Emblaze Systems Ltd., Universita Cattolica del Sacro Cuore di Milano Compaq Computer SRL, SFERA-Societa per la Formazione e le Risorse Aziendali per Azioni (I); UFI Ltd.; University of Tampere; Deutsche Telekom AG, University Koblenz-Landau (D); Nokia Corporation, University Zurich (CH); Stanford University, Massachusetts Institute of Technology (USA); Telefonica Investigacion y Desarrollo SA Unipersonal (E); University of Southern Queensland
Dept.: Virtual Interactive Training – VIT
July/2002-December/2004

ElinCPM – Environment and Logistics Integrated in Construction Project Management

EU - European Union Commission
Schuppe + Siska Elektrotechnik GmbH (D); Instituto Superior Técnico (P); Norwegian Building Research Institute (N), Universitat Politecnica de Catalunya (E); University of Florence (I)
Div.: Logistics Systems and Networks – LSN
Dept.: Logistics Strategies and Networks – LS
September/2002-August/2004

OPTIAS – Development of a Management Concept for Optimizing Location Strategies in Urban and Suburban Commercial Properties

EU - European Union Commission
Amstein+Walthert Zürich (CH); University Miskolc, Inteco Miskolc (HU); Ekspro (PL); IFB AG Magdeburg (D)
Dept.: Logistics System Planning and Operation – LP
September/2002-August/2004

ECHAINE – Energy Wood Production Chains in Europe

EU - European Union Commission
Centre for Research and Technology Hellas CERTH, Centre for Renewable Energy CRES (GR); Swedish University of Agricultural Science SLU Uppsala (S); Technical University of Sofia (BG); Thule Institute Oulu (FIN); Oskar Von Miller - Conception, Research and Design Institute for Thermal Power Equipment (OVM - ICCPET) Bucharest (RO); CEPE - Centre for Energy Policy and Economics, Swiss Federal Institute of Technology Zurich (CH); Escola Superior Agraria de Beja (P); SchlumbergerSema Sociedad Anónima Española Madrid (E)
Dept.: Process and Plant Engineering – PAT
October/2002-September/2005

Pubic Projects (Selection)

Spatial Data Infrastructure for Thai Provinces – Applications of Geographic Information Systems in Local Governments
EU - European Union Commission
University College Cork (IR); Burapha University, Chon Buri (T); Otto von Guericke University Magdeburg (D)
Dept.: Environmental Engineering – LE
September/2003-August/2005

Virtual Cooperation Networks in Small and Medium-sized Knowledge Intensive Service Enterprises – ViKoDi
Subproject: Innovative Structure, Methods and Instrumente
DLR – German Aerospace Center
Div.: Logistics Systems and Networks – LSN
Dept.: Environmental Engineering – LE
September/1999-May/2003

e-Industrial Services – Value Added Services for Intelligent Production Systems
Fraunhofer-Gesellschaft
VF MAVO – Verstärkungsfonds MAVO
FhG-Institutes: IML, IPA, IPT, IPK, IWU, TEG, GMD Institute FOKUS
Div.: Virtual Development and Training – VDT
Dept.: Visual Interactive Systems – VS
Dept.: Virtual Interactive Training – VIT
January/2000-December/2003

Accelerated Market Penetration of Materials Made of Renewable Raw Materials by Further Developing Rapid Shaping Processes
Fachagentur für Nachwachsende Rohstofffe e.V., Alfred Fischer AG, Gütermann AG, Wilh. Förster KG, Gortchakoff & Partner, Biomer, Supol GmbH, IGV GmbH, Novamont GmbH
Dept.: Product and Process Management – PPM
March/2000-February/2003

Development of a Computer-aided Methodology for Establishing, Running and Assessing Maintenance Networks
Saxony-Anhalt Ministry for Education and Culture
Otto von Guericke University Magdeburg, SKET Walzwerkstechnik GmbH, VW AG, MMW GmbH, FAM GmbH, Stahlbau Magdeburg GmbH, SYMACON GmbH, Piepenbrock Dienstleistungen GmbH & Co. KG
Div.: Logistics Systems and Networks – LSN
Dept.: Logistics System Planning and Operation – LP
April/2000-March/2003

Service Products for Planning Teams for Factory Planning Tertiarization – ProTT
DLR – German Aerospace Center; Federal Ministry of Education and Research
FIR Aachen, IAW Aachen, University Münster, Technik & Organisation Munich, Hörmann-Rawema Chemnitz, Carl Zeiss Aalen, Schott Glas Mainz, E-Media Magdeburg, IFB logistics & process consulting GmbH Magdeburg
Div.: Logistics Systems and Networks – LSN
Dept.: Logistics Strategies and Networks – LS
Oktober/2000-September/2003

IDEA Saxony-Anhalt – Interactive Digital Development and Training Platform Saxony-Anhalt
Saxony-Anhalt Ministry for Education and Culture
Otto von Guericke University Magdeburg's Institutes ISG, IFSL und IESK
Div.: Virtual Development and Training – VDT, Logistics Systems and Networks – LSN, Automation – AUT
November/2000-July/2003

Development of Flue Gas Scrubbing for the Utilization of Energetic Scrap Wood with Stationary Fluidized Bed Gasification

Lufttechnik Bayreuth Rüskamp GmbH (LTB), German Federation of Industrial Cooperative Research Associations »Otto-von-Guericke« AiF, Berlin Office
Dept.: Process and Plant Engineering – PAT
January/2001-March/2003

Pilot Project for an Interactive Self-Learning Program (SLP) on Life Cycle Based Plant Management (LCPM)

CDG – Carl Duisberg Gesellschaft e.V.
Div.: Logistics Systems and Networks – LSN
Dept.: Logistics System Planning and Operation – LP
August/2001-June/2004

Uniqueness Comes from Within – Adaptability and Growth by Developing Strategic Potentials – UNIKAT

Federal Ministry of Education and Research
Prospektiv GmbH, FESTO AG + Co, STACO Stapelmann GmbH, Vodafone Pilotentwicklung GmbH, M+W Zander Facility Engineering GmbH, GEMI GmbH, Freudenberg Forschungsdienste KG, März Internetwork Services AG
Div.: Information Logistics – IFL
Dept.: Knowledge and Innovation Management – WIM
January/2002-September/2003

Development and Production of High Performance Composites as part of the ECOSITE GROWTH Project

AKT – Altmärker Kunststofftechnik GmbH (D)
Div.: Production and Plant Management – PAM
Dept.: Product and Process Management – PPM
January/2002-December/2003

Knowledge Management in Product Development (Inno-how)

Research Center CORE BUSINESS DEVELOPMENT GmbH, Otto von Guericke University Magdeburg, Institute for Occupational and Corporate Education (IBBP), BerliKomm, BOS, Brose Fahrzeugteile GmbH & CoKG, Dräger Medical AG & Co. KGaA, Wieland Werke AG
Div.: Information Logistics – IFL
Dept.: Knowledge and Innovation Management – WIM
January/2002-March/2004

Explosives Portal

Saxony-Anhalt State Development Institute
megaDOK Informationsservice GmbH, LKA, Pyrotechnik Silberhütte GmbH
Div.: Information Logistics – IFL
Dept.: PIM – Prozess and Information Management
March/2002-October/2002

Development and Optimization of the Logistics Structures for Mass Customization in the Footwear Industry – EwoMacs

selve AG, DHL Danzas Air & Ocean GmbH, Adidas-SALOMON AG, IWT GmbH, IFB logistics & process consulting GmbH, Technical University Munich, Universit Hohenheim
Project Group: MC – Mass Customization
May/2002-December/2004

Development of an Electronic Platform and an e-Commerce Solution for Regional Small and Medium-sized Enterprises - Pilot: Landwarenhaus Online GmbH

Landwarenhaus-Online GmbH, Volkswagen SERVICE UNIT, Microsoft Deutschland GmbH, T-Systems CSM GmbH, itc GmbH, Saxony-Anhalt Ministry of Economics, Saxony-Anhalt Agricultural Marketing Association
Div.: Information Logistics – IFL
Dept.: Process and Information Management – PIM, Information Systems – ITS
June/2002-March/2003

Development of Innovative Products and Services Utilizing VR Technologies for Small and Medium-sized Mechanical and Plant Engineering Enterprises (ProDIMA – VDTC)

Schiess AG, Anhaltische Elektromotorenwerke Dessau GmbH, SIGMA Innovation Magdeburg GmbH, Bio-Ölwerk Magdeburg, CIMBRIA SKET GmbH
Dept.: Virtual Interactive Training – VIT
July/2002-December/2003

Innovative Vegetable Oil Refining – REGINA I

PPM e.V., ÖHMI Engineering GmbH, Becker Elektro, AWT Eisleben GmbH, TÜV Akademie GmbH, ÖHMI Consulting GmbH
Dept.: Virtual Interactive Training – VIT
July/2002-December/2003

Development of a Virtual Engineering Toolkit for Small and Medium-sized Enterprises – VE-KMU

Saxony-Anhalt State Development Institute
Dept.: Visual Interactive Systems – VS
October/2002-December/2003

Development of Plants for the Energetic Utilization of High Caloric Residues from Mechanical Waste Treatment Facilities
AMB Anlagen und Maschinen Bau GmbH, German Federation of Industrial Cooperative Research Associations »Otto-von-Guericke« AIF
Dept.: Process and Plant Engineering – PAT
October/2002-May/2004

Wind Power Forecasts for Offshore Windparks
Meteocontrol GmbH Augsburg, BIS Bremerhaven, Bosch Maintenance Technologies GmbH Bremerhaven
Dept.: Logistics System Planning and Operation – LP
November/2002-March/2004

Construction and Startup of a Demonstration Plant with Energetic Coupling of Polystal Product Hardening with Thermal Afterburning of Exhaust Air Flows Contaminated with Styrene
Polystal Composites GmbH, Saxony-Anhalt Ministry of Economics and Technology
Dept.: Process and Plant Engineering – PAT
January/2003-April/2003

Distributed, Cooperative Development of a Die Casting Die for Aluminum Structural Modules Applying Innovative Engineering and Simulation Technologies Including Corresponding Necessary Advanced Training Concepts – Vedal SIM
Gesellschaft für Wirtschaftsförderung LK Quedlinburg mbH, Modell- und Formbau GmbH, HARDTOP Gießereitechnologie GmbH, Teutloff - Bildungszentrum GmbH
Dept.: Virtual Interactive Training – VIT
April/2003-March/2004

Virtual City
Capital City of Magdeburg, City Planning and Surveying Office, Geometrik mbH, MaTeG mbH, MSB, Magdeburger Stadtgartenbetrieb, Magdeburg Cathedral Foundation
Dept.: Virtual Development – VD
September/2003-December/2003

MC-ProLog
University Hannover's Institute for Plants and Logistics – IFA, Project Committee
September/2003-January/2005

Business Startup Brochure »Saxony-Anhalt«
Saxony-Anhalt Ministry of Economics, 3D Marketing und Design, Saxony-Anhalt State Marketing Association
Dept.: Process and Information Management – PIM
November/2003-December/2003

Industry Projects (Selection)

Identification of Potentials for New Business
PLASA Ingenieurgesellschaft mbH
Div.: Information Logistics – IFL
Dept.: Knowledge and Innovation Management – WIM
September/2002-January/2003

VR Training/Foundry – Forms of Computer and Internet-based Training for Foundries
VDG – Institute for Foundry Technology Düsseldorf
Dept.: Virtual Interactive Training – VIT
August/2001-January/2003

Project Timekeeping
Kieback & Peter GmbH & Co. KG
Dept.: Process and Information Management – PIM
January/2003-December/2003

Tool Container – Development of a Software Solution for the Identification and Documentation of Tool Container Content and Structure
AIRBUS Deutschland GmbH
Dept.: Virtual Interactive Training – VIT
March/2003-July/2003

Feasibility Study on the Use of VR-based Training Solutions for the A380
AIRBUS Deutschland GmbH
Dept.: Virtual Interactive Training – VIT
March/2003-March/2004

Technical Development of a Biomass Cogeneration Plant and Oversight of its Construction at the Bodelschwingh House in Wolmirstedt
Bodelschwingh-Haus Wolmirstedt e.V.
Dept.: Process and Plant Engineering – PAT
March/2003-March/2004

SIGMA – Visualization and Processing of Design Variants for Technical Equipment
SIGMA Innovationsgesellschaft mbH
Dept.: Virtual Interactive Training – VIT
April/2003-December/2003

Remote Control of Crucible Induction Furnace Visualization
Otto Junker GmbH
Dept.: Virtual Development – VD
May/2003-July/2003

Development of a Service Connector for Cooperative Bid Management in Plant Engineering
BEA Elektrotechnik und Automation Technische Dienste Lausitz GmbH, Lindner AG JUCH Industrie-Isolierung GmbH, SKL Engineering & Contracting GmbH, TÜV Nord MPA Ges. f. Materialprüfung und Anlagensicherheit mbH & Co.KG, Weber Rohrleitungsbau GmbH & Co.KG, Saxony-Anhalt Ministry of Economics, Eudemonia Solutions AG
Dept.: Process and Information Management – PIM
May/2003-February/2005

Interactive Visualization System IVS-VDT with Authoring System
Engelke engineering art GmbH
Dept.: Visual Interactive Systems – VS
June/2003-September/2003

Pilot Operative Early Warning System P.L.A.N. Sys
Fraport AG, Frankfurt am Main
Dept.: Logistics System Planning and Operation – LP
June/2003-December/2003

VA Foundry – Virtual Job Support for Foundries
Rautenbach AG
Dept.: Virtual Development – VD
July/2003-October/2003

Processing and 3-D Visualization of Rotating Electric Machines for Marketing Purposes
Anhaltische Elektromotorenwerk Dessau GmbH
Dept.: Virtual Development – VD
July/2003-December/2003

PIZ IF Rota – Product Development and Innovation Center for Integrated Rotary Machining Manufacturing Cells
BÄR-InnovationsZentrum Mineralguss, citim GmbH, EBEL Maschinenbau, engelke engineering art GmbH, HAB Heiland Apparatebau, Magdeburg-Stendal University of Applied Sciences, IGAM Ingenieur-gesellschaft für angewandte Mechanik mbH, Magdeburg Werkzeugmaschinen AG, H&B OMEGA Europa GmbH, Otto von Guericke University Magdeburg, SYMACON Engineering GmbH, tbz Technologie- und Berufsbildungszentrum Magdeburg gGmbH, Vosswinkel Elektroautomation GmbH
Dept.: Virtual Interactive Training – VIT
July/2003-December/2003

Occupational Training – Development of a Demonstrator for VR-based Training Using the Example of Tool Change on a CNC Milling Machine
engelke engineering art GmbH
Dept.: Virtual Interactive Training – VIT
September/2003-December/2003

Clustering of Objects and Determination of the Reserve of Wear of Selected Equipment in Technical Facility Management at the Leipzig Works
BMW AG Works Leipzig
Dept.: Logistics System Planning and Operation – LP
September/2003-December/2003

Determination of Potentials for Cooperation in Sales
AEM Dessau GmbH, RKW Magdeburg
Dept.: Process and Information Management – PIM
September/2003-December/2003

tti-Company Database
tti Magdeburg GmbH
Dept.: Information Systems – ITS
October/2003-November/2003

VIDOP – Vendor Integrated Decentralized Optimization of Production Facilities
DaimlerChrysler AG
Dept.: Virtual Development – VD
October/2003-February/2004

Vacuum Cleaner Nozzle
H. Hench GmbH
Dept.: Virtual Interactive Training – VIT
October/2003-March/2005

KomMaSys – Visualization of an Example Application as Part of the Communications Management System Study
Industrieanlagen-Betriebsgesellschaft mbH (IABG)
Dept.: Harz Regional Competence Center, Virtual Engineering for Products and Processes – VE
November/2003-December/2003

Development, Dimensioning and Design Support for Fuel Charging in Wood Fired Steam Generators at the Biomass Cogeneration Plant Delitzsch
Hans Brochier GmbH & Co. KG
Dept.: Process and Plant Engineering – PAT
November/2003-April/2004

Integration of VR and Simulation
Deere & Company
Dept.: Virtual Development – VD
November/2003-October/2004

Experimental Studies of the Use of Fluidized Bed Gasification to Generate Fuel Gas from Rejects
Wienerberger Ziegelindustrie GmbH
Dept.: Process and Plant Engineeing – PAT
December/2003-April/2004

Automatic Inspection of Sewers (Study and Test Prototype Development)
Div.: Automation – AUT

Optical 3-D System for Measuring Train Wheelsets
Div.: Automation – AUT

Automatic Rivet Scanning on Airplane Fuselages
Div.: Automation – AUT

Miniaturized 6-D Measuring System for Measuring Spatial Curves
Div.: Automation – AUT

International Research Partners (Selection)

Asia Pacific Roundtable for Cleaner Production (APRCP), Manila, Philippines
Asian Society for Environmental Protection (ASEP), Bangkok, Thailand
ALICER – Asociación para la Promoción del Diseño Cerámico, Castellón, Spain
Baltic Container Terminal, Riga, Latvia
Baumann College Moscow, Russia
Brno University of Technology, Brno, Czech Republic
Budapest University of Technology and Economics, Budapest, Hungary
Burapha University, Department of Geography, Chon Buri, Thailand
California Institute of Technology Mechanical Engineering, Pasadena, USA
Centre for Renewable Energy CRES, Pikermi Attiki, Greece
Centre for Research and Technology Hellas CERTH, Ptolemais, Greece
Hellas, Thermi, Salonika, Greece
CEPE – Centre for Energy Policy and Economics, Swiss Federal Institute of Technology Zurich, Zurich, Switzerland
Ceramic Design Technology Institute (ALICER), Castellón, Spain
Chalmers University of Technology, Göteburg, Sweden
Chulalongkorn University, Bangkok, Thailand
CTO – Ship Design and Research Centre, Gdansk, Poland
Czech Technical University Prague, Prague, Czech Republic
Dansk Teknologisk Institut/Danish Technological Institute, Denmark
Delft University of Technology, Delft, Netherlands
Department of Applied Physics & Instrumentation,Cork Institute of Technology, Ireland
Ecole des Mines dÁlbi-Carmaux, Albi, France
Ecole Normale Supérieure de Cachan, Paris, France
Ecole Polytechnique Universitaire de Marseille, Marseille, France
Escola Superior Agraria de Beja, Beja, Portugal
European Process Safety Centre, Warwickshire, Great Britain
Fundação Getulio Vargas, São Paulo, Brazil
GISAT, Prague, Czech Republic
grupo apex, Madrid, Spain
Hellenic Institute of Transport, Salonika, Greece
Hong Kong University of Science and Technologie, Hong Kong, China
IDC Information Technologies, Riga, Latvia
INAOEP, Instituto Nacional de Astrofisica, Óptica y Électrónika, Puebla, Mexico
Indonesian Society of Environmental Professionals (ISEP), Jakarta, Indonesia
Industrial Technology Research Institute, Taipei, Taiwan
Inesc Porto, Porto, Portugal
Institute of Cybernetics, Tallinn, Estonia
Instituto de Technología Cerámica-AICE (IPC), Castellón, Spain
Instituto Superiore Téchnico de Lisboa, Lissabon, Portugal
Intergraph Computer Services (Romania) Ltd., Bucharest, Romania
Intro solutions Ankara, Turkey
InWEnt Regional Coordination Office for ASEAN, Makati City, Philippines
Iowa State University, Virtual Reality Applications Center, Ames, Iowa, USA
Italian Ship Research Center (CETENA SpA), Genoa, Italy
ITI Aristotle University Thessaloniki, Salonika, Greece
Joint Research Company, Ispra, Italia
Karl-Franzens-University, Graz, Austria
Kaunas University of Technology, Kaunas, Latvia
Laboratory of Design, Production and Management, Universiteit van Twente, Twente, Netherlands
Latvian Intelligent Systems, Riga, Latvia
La Universidad de La Habana, Havana, Cuba
Liophant Simulation Club, University of Genoa, Genoa, Italy
Liverpool John Moores University Higher Education Corporation, Liverpool, Great Britain
Lomonossov University Moscow, Institute of Mechanics, Moscow, Russia
Lund University, Lund, Sweden
Massachusetts Institute of Technology, Massachusetts, USA
MC Gills University, Montreal, Canada
Moscow Automobile-Road Construction Institute MADI (TU), Moscow, Russia
Moskowski aftomobilno-doroschnui Institut, Moscow, Russia
Nanyang Technological University, Singapore
National Aerospace University, Kharkiv Aviation Institute, Kharkiv, Ukraine
National Microelectronics Research Centre (NMRC) University College, Cork, Irland
Netherlands Organization for Applied Scientific Research, Delft, Netherlands
Norwegian Building Research Institute, Oslo, Norway
Oskar Von Miller – Conception, Research and Design Institute for Thermal Power Equipment (OVM – ICCPET), Bucharest, Romania
Philippine Pollution Prevention Roundtable, Manila, Philippines
PIAP – Industrial Research Institute for Automation and Measurement, Warsaw, Poland
Politecnico di Milano, Milan, Italy
Réseau CCSO, Fribourg, Switzerland
Riga Technical University, Riga, Latvia
Rutgers University, New Jersey, USA
SchlumbergerSema Sociedad Anónima Española, Madrid, Spain
School of Mechanical Engineering, University of Leeds, Great Britain
SFERA-Societa per la Formazione e le Risorse Aziendali per Azioni, Italy
Shanghai Jiao Tong University, Shanghai, China

Sheffield Hallam University, Sheffield, Great Britain
SP Swedish Nat. Testing and Research Institute, Boras, Sweden
State Institute of Aeronautical Engineering (GosNIIAS) Moscow, Russia
Stanford University, Stanford, USA
Swedish University of Agricultural Science SLU, Uppsala, Sweden
Technical University Crete, Crete, Greece
Technical University of Denmark, Lyngby, Denmark
Technical University of Lisbon, Lisbon, Portugal
Technical University of Sofia, Sofia, Bulgara
Teknologisk Institut, Denmark
Telefonica I+D, Valladolid, Spain
Temida, Ljubljana, Slovenia
Thai-German Institute, Chonburi, Thailand
Thailand Environment Institute, Bangkok, Thailand
The Open University, Milton Keynes, Great Britain
The University of Athens, Athens, Greece
The University of California, Berkley, USA
The University of Nottingham, Nottingham, Great Britain
Thule Institute, Oulu, Finland
Trinity College Dublin, Dublin, Ireland
T-soft, Prague, Czech Republic
Université Libre de Bruxelles, Department of Mechanics, Brussels, Belgium
UNINOVA/CEMOP – Instituto de Desenvolvimento de Novas Tecnologias - Centro de Excelência de Microelectrónica e Optoelectrónica de Processos Monte da Caparica, Portugal
Universidad Politicnica de Valencia, Valencia, Spain
Universidade Federal Fluminense, Rio de Janeiro, Brazil
Universita Cattolica del Sacro Cuore di Milano, Milan, Italy
Università degli Studi di Genova, Genoa, Italy
Universita di Napoli, Naples, Italy
University »Lucia Blaga«, Mechanical Engineering, Sibiu, Romania
Universitat Politecnica de Catalunya, Terrassa, Spain
Universität von Nottingham, Nottingham, Great Britain
University Zurich, Zurich, Switzerland
Universite de Haute Alsace, Mulhouse, France
University College Cork, Institute of Geography, Institute for Business Information Systems, Cork, Ireland
University College of Borås, Borås, Sweden
University of Athens, Athen, Greece
University of Birmingham, Birmingham, Great Britain
University of Florence, Florence, Italy
University of Glasgow, Glasgow, Great Britain
University of Helsinki, Helsinki, Finnland
University of Information Technology and Management, Rzeszow, Poland
University of Leeds, Leeds, Great Britain
University of Michigan, Virtual Reality Laboratory, Ann Arbor, Michigan, USA
University of Miskolc, Miskolc, Hungary
University of Oxford, Oxford, Great Britain
University of Science and Technology Beijing, Beijing, China
University of Southern Queensland, Toowoomba, Australia
University of Tampere, Tampere, Finland
University of Trondheim, Trondheim, Norway
University of Ulster, Ulster, Great Britain
University of West Bohemia (UWB), Pilsen, Czech Republic
University of Zilina, Zilina, Slovakia
Vietnam Productivity Centre (VPC), Hanoi, Vietnam
VR Centre – University of Teesside, Middlesbrough, Great Britain
Warsaw University of Technology, Warsaw, Poland

Boards and Committees (Selection)

Anhaltinisches Elektromotorenwerk Dessau GmbH (AEM)
Prof. Michael Schenk – Member of the Advisory Board

German Federation of Industrial Cooperative Research Associations »Otto-von-Guericke« (AiF)
Prof. Michael Schenk – Member

German Logistics Association (BVL)
Prof. Michael Schenk – Member of the Executive Board and Steering Committee

German Russian Forum
Prof. Michael Schenk – Member

Fraunhofer-Gesellschaft (FhG) Scientific-Technical Board (WTR)
Prof. Michael Schenk – Member of the Main Commission

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Dr. Klaus Richter – Technical Collaboration
Mr. Frank Ryll – Technical Collaboration

Association for the Promotion of Mechanical and Plant Engineering in Saxony and Saxony-Anhalt
Ms. Andrea Urbansky – Managing Director

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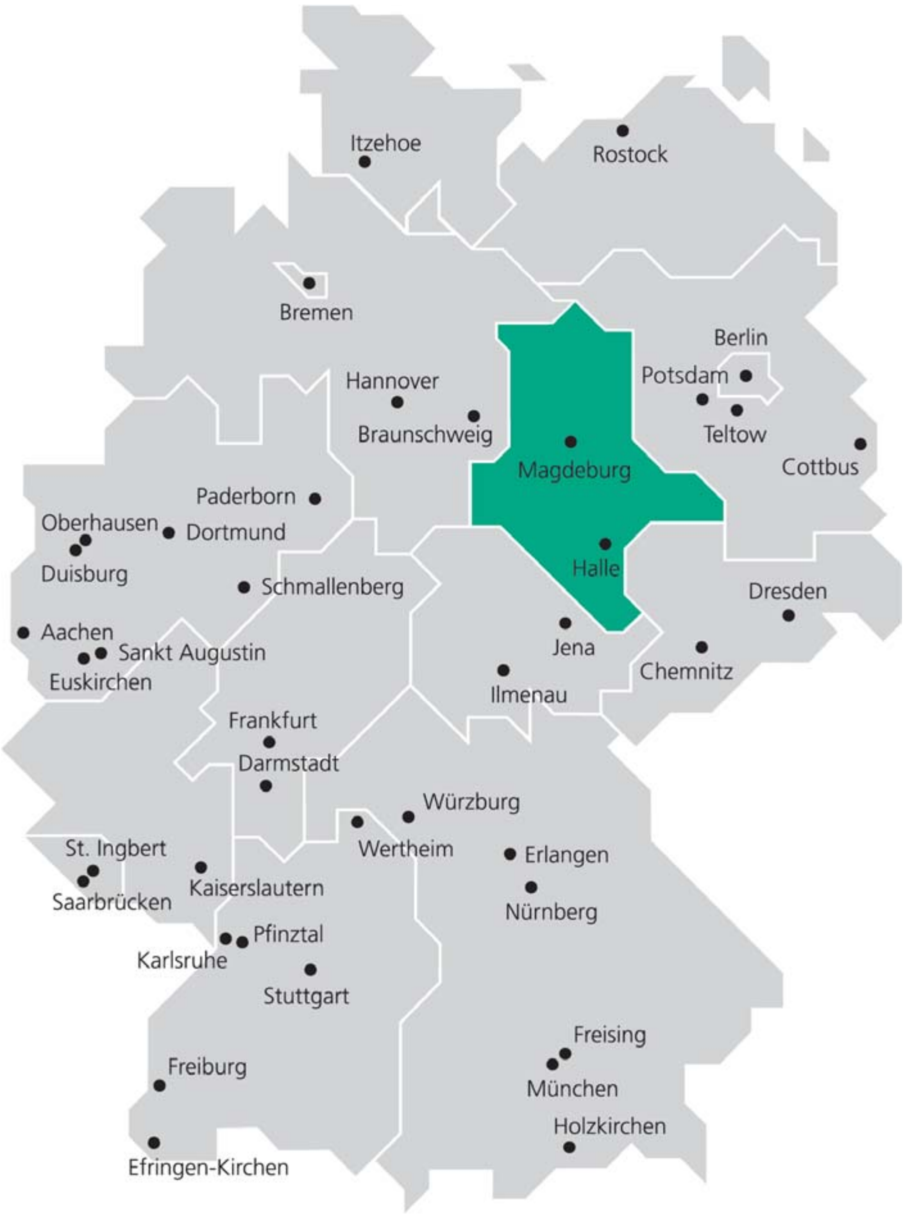
The Fraunhofer-Gesellschaft at a Glance



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Small, medium-sized and large industrial firms and service companies can all profit from contract research. The Fraunhofer-Gesellschaft develops ready-to-implement technical and organizational solutions and helps to spread the deployment of new technologies. For small and medium-sized enterprises that cannot afford to maintain their own R&D departments, the Fraunhofer-Gesellschaft represents an important source of innovative know-how.

Government and Society
Strategic research projects are carried out commissioned by the federal government and the states. They help promote advanced and key technologies or innovations in fields of particular public interest such as environmental protection, energy production and health care. The Fraunhofer-Gesellschaft takes part in corresponding European Union technology programs.

Services

The Fraunhofer-Gesellschaft develops products and processes until they are ready for application. Solutions are worked out in direct contact with the client. If necessary, several Fraunhofer Institutes also work together to produce complex system solutions.

Advantages of Contract Research

The collaboration of all the Fraunhofer-Gesellschaft's institutes makes numerous experts with a broad range of expertise available. The Fraunhofer Institutes' shared quality standards and professional project management ensure results from research contracts are reliable. High-tech lab equipment makes the Fraunhofer-Gesellschaft attractive for companies of all sizes and from all sectors. Along with the reliability of a solid organization, economic advantages also speak for cooperation. The Fraunhofer-Gesellschaft already brings cost-intensive precompetitive research to a partnership as start-up capital.

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