Visions Becoming Reality

VDTC: The Worldwide One of a Kind VR Research Center Opens
Configuring Machinery with the Modular Principle
Really Controlling Virtual Machinery
Dear Readers,

2006 was an extremely eventful year for the Fraunhofer IFF. After nearly two years of planning and construction, we were able to kick off our expansion, the Virtual Development and Training Centre VDTC. A vision became reality on November 22, 2006, the day of its opening. More than 450 guests celebrated a marvelous party with us, full of surprises and tributes that we will remember for a long time. The opening of the VDTC is a significant event in our institute’s history.

This new building’s remarkable technical facilities and equipment provides unique opportunities. We are especially proud of our Elbe Dom in which we can reproduce virtual models deceptively realistically on a large 360 degree projection surface. With the VDTC, the Fraunhofer IFF has laid an important cornerstone for Saxony-Anhalt’s sustainability as a center of research. One can hardly imagine research and science or free enterprise anymore without virtual technologies.

Today, complex technical systems have an ever shorter life cycle, which in turn requires rapidly adapting to changed market situations. Now as before, time and cost factors are playing an important role.

This is precisely where the potential of virtual technologies unfolds. At the VDTC, we develop customized solutions that noticeably expand the potentials of our client’s ventures and projects. The new IFFOCUS presents impressive examples of successful collaboration with partners from research and industry. One immediately thinks of the sectors of aviation or mechanical and plant engineering, yet virtual technologies are increasingly entering other sectors, e.g. medical technology. Ever greater significance is being attached to the issues of learning and training in virtual environments.

Get to know another side of us: The new IFFocus will inform you about our institute and the people who work here, current news and joint project work with our partners from all over the world. I wish you much enjoyment reading.

Yours,

Prof. Michael Schenk

Director of the Fraunhofer Institute for Factory Operation and Automation

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**Editorial Notes**
On November 22, 2006, Saxony-Anhalt’s Minister President Wolfgang Böhmer opened the Magdeburg Fraunhofer Institute’s new research center. The VDTC provides clients from business and industry virtual-interactive scenarios to plan, test and operate technical systems, which can be reproduced deceptively realistically on a large projection surface. At the ceremony, the VDTC was honored as a “Landmark in the Land of Ideas”. More than 450 prominent guests from politics, research and business gathered to officially open the training and development center for virtual technologies. Prof. Wolfgang Böhmer, Minister President of the State of Saxony-Anhalt and Dr. Ulrich Buller, President of the Fraunhofer-Gesellschaft, presented the symbolic key to Director Michael Schenk. Schenk also received his institute’s award as “Landmark in the Land of Ideas” from the hands of Mike de Vries, CEO of FC Deutschland GmbH. “Germany – Land of Ideas” is a national initiative sponsored by the German government and commerce and industry, represented by the German Industry Association (BDI). The initiative’s objective is to present an image of Germany at home and abroad as a country that is innovative, open to the world and inspired. “It is a great honor for us to be allowed to represent Germany in the world as part of this initiative and, on top of that, on such an important day for us,” said a pleased Prof. Michael Schenk. To his surprise, another honor followed: The Regional Conference awarded its Regional Prize to the Director for his contributions in making Magdeburg a center of research. The large laser-based projection system was presented to the public for the first time. Six Jenoptik laser projectors displayed virtual models of complex machinery and plants on a 360 degree projection surface. Jenoptik and Fraunhofer specialists jointly designed the large laser-based projection system and intend to develop it further in the future. Numerous other research and industry partners also displayed great interest in the VDTC. On the day of its opening, the “Virtual Engineering Strategy Group” was constituted. It will closely support developments at the VDTC in the future and devote itself to the latest research findings in the field.

At the VDTC, the Fraunhofer Institute for Factory Operation and Automation IFF pursues applied research in the field of virtual engineering for planning, testing and operating technical systems. Contractual partners and clients include large international concerns, regional small and medium-sized enterprises and contracting authorities. Close collaboration is maintained with academic and non-academic research organizations in Magdeburg, especially Otto von Guericke University and the Max Planck Institute for Dynamics of Complex Technical Systems, the Leibnitz Institute of Neurobiology and the Leibnitz Institute of Plant Genetics and Crop Plant Research in Gatersleben. On the basis of virtual and augmented reality, specialists working together interdisciplinarily develop customized solutions such as virtual-interactive training for specialized staff.

Researchers Take Over the Former Commercial Port

From apprentice glass grinder to famous scientist – the history of Joseph von Fraunhofer’s career reads like an exciting novel. Today, Europe’s largest organization for applied research is named after him: The
Developing Competence in Real and Virtual Work Systems.

Collectively, these technologies are gateways to considerably expanded perception, which can be used as the basis to develop competence on the basis of experience. Since virtual technologies have not been predominantly developed from the perspective of qualification and competence training, research in work and occupational science and didactic reflection are just as necessary as corresponding technological advances in virtual work systems. More and more, basic and advanced educational and training programs that integrate virtual work systems as an educational medium are attracting attention.

Along with interesting presentations and the opportunity to exchange ideas with specialists working interdisciplinarily, convention attendees will be able get to know the Fraunhofer IFF Virtual Development and Training Centre VDTC.

For detailed information on the convention program and registration materials visit www.gfa-online.de.

Specialists from Jenoptik and the Fraunhofer Institute in Magdeburg jointly engineered this large-scale laser projection system. The experts intend to work together on developing it further and developing new fields of application.

To this end, Jenoptik’s Chairman of the Board Alexander von Witzleben, Jenoptik LDT CEO Jürgen Meyer and Fraunhofer IFF Director Michael Schenk signed a cooperation agreement in Magdeburg in October. Central points of cooperation will be visualization principles of stereoscopic laser projections and the development of short demonstration films for industrial applications.

Fraunhofer IFF and Jenoptik Conclude Cooperation Agreement

The heart of the new Fraunhofer research center in Magdeburg’s Port of Science is its round testing facility. Six Jenoptik laser projectors display virtual models of complex machinery and plants on a 360° projection surface, a white cylinder made of curved and perforated aluminum extending over an area of approximately 330 m². Their remarkable brilliance of colors, sharpness and intensity make the three-dimensional reproductions captivating.

“Developing Competence in Real and Virtual Work Systems”.

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Fraunhofer-Gesellschaft. That is not all though. The famous scientist and businessman has been immortalized in Magdeburg’s cityscape. Since September 2006, his name gleams on the sign for “Joseph-von-Fraunhofer-Strasse” in the newly developed Port of Science. Along with Fraunhofer, Werner Heisenberg and Niels Bohr have also been immortalized on street signs in the Port of Science. A lively neighborhood for living and working is developing in the Port of Science. What was once a cargo terminal is evolving into a new neighborhood with high level institutes and business incubators embedded in a lively neighborhood with apartments, service centers and recreational opportunities. The first boat has already docked there: The new building housing the Virtual Development and Training Centre VDTC is located in the immediate vicinity of the Max Planck Institute for Complex Dynamic Systems.

The choice of name makes significant changes in the city of Magdeburg apparent. Research and science in particular have become extremely important in recent years. Development has been so fast paced and vigorous that the structural transformation from a city of heavy machinery manufacture to a city of applied research is clearly observable.

53rd GfA Spring Convention in Magdeburg

Every year at the spring convention of the Gesellschaft für Arbeitswissenschaft e.V. (GfA), researchers discuss current trends and developments in the fields of ergonomics, vocational training research and engineering media research. This year’s GfA spring convention will be held at the Magdeburg Fraunhofer Institute from February 28 through March 2, 2007 and will be devoted to the topic of
New Opportunities through EU Support Programs

The European Union offers a multitude of programs to support the work of small and medium-sized enterprises. How can one obtain an overview of current programs and guidelines though? How can one best take advantage of the opportunities?

The project smE-MPOWER set itself the task of identifying opportunities for EU support for more intensive research work in companies and providing support throughout the entire development process. With partners from Germany, Great Britain, France, Ireland, Israel, Lithuania, Romania, the Slovak Republic, Switzerland and Cyprus, the project provides a connection to an attractive international network.

SmE-MPOWER is intended to help enterprises define potentials for innovation to identify pertinent support instruments. Professional coaching generates project ideas that are supported through the final proposal. Active participation in special interest groups enables interested enterprises to profit from the knowledge of other enterprises and exchange ideas. Participation in virtual discussion forums enables enterprises to recruit one or more partners for their innovation project and carry out a joint research project. The heart of the smE-MPOWER service is an individual coaching process that helps navigate the hurdles of European proposal submission.

Small and medium-sized enterprises can continue to take advantage of smE-MPOWER’s free services to transform their innovative ideas into project proposals until October 31, 2007.

For more information visit www.sme-mpower.net.

15 Years of Research for the Real World
10th IFF Science Days

At the same time as the 10th IFF Science Days, the Fraunhofer IFF will be celebrating its 15th anniversary in June 2007, a splendid occasion to gather at the Fraunhofer IFF to celebrate together, to look back at past accomplishments and above all to take a look forward, to develop new ideas and to initiate joint projects. Clients, partners and friends will be coming to Magdeburg to pick up the latest trends in research at professional conferences, workshops and industry seminars and to accelerate their transfer to industry.

Two international conferences are planned for the 2007 IFF Science Days. Resuming the direction of past years, there will also be a conference on “Virtual Reality and Augmented Reality for Engineering, Testing and Operating Technical Systems” in 2007. The newly opened Virtual Development and Training Centre VDTC with its diverse VR and AR labs not only enables elucidating the potentials of virtual technologies in theory but also experiencing them in practice. As in past years, we are not only explicitly appealing to researchers but also experts from companies to intensify the dialog between research and business.

The second conference will deal with “Logistics: Intelligence in Manufacturing and Transportation” and thus take up another focus of research at the Fraunhofer IFF. It will concentrate on intelligent logistics solutions that are based on state-of-the-art communication, telematics and satellite navigation technologies and suitable for controlling the increasing flows of goods and rising demands in the international exchange of goods. Additionally, there will be workshops and industry seminars on other fields of Fraunhofer IFF research such as automation and production and plant management.

For more information visit www.iff.fraunhofer.de.
INTUITION, a research network supported by the European Union concentrates on the use of virtual and augmented reality to design future workspaces. Researchers are working on means to transfer research findings to corporate practice as quickly as possible. In turn, the application opens insights into how virtual environments must be constituted so that human beings work in them optimally and also accept them as a tool.

The Technical University of Athens is coordinating the INTUITION Network. The 58 organizations involved come from eleven different sectors, including the aviation, automotive and utilities industries. The Fraunhofer IFF in Magdeburg has also been a member since September of last year.

In November 2006, the network partners gathered at the 3rd International INTUITION Workshop where the researchers discussed current issues surrounding the issue of workspace design.

For detailed information on the network visit www.intuition-eunetwork.org/.

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VIRTHUALIS: Engineering Safe Plants – Operating Plants Safely

Preventing accidents at large industrial facilities has utmost priority. As a rule, up to 90 percent of serious accidents can be attributed to human errors during high risk manufacturing processes such as in the chemical industry.

VIRTHUALIS (Virtual Reality and Human Factors Applications for Improving Safety), an international consortium of 43 partners is working on means to reduce dangers in manufacturing and storage facilities. Fraunhofer researchers from the Virtual Development and Training Centre VDTC in Magdeburg are also involved in the project.

The focus is on dangers that are primarily triggered by human behavior, so-called “human factors”. The objective of VIRTHUALIS is to identify weak points in a facility’s safety at an early stage, to increase safety and to organize safety aspects transparently in order to safely manage critical situations.

As part of VIRTHUALIS, researchers are developing a novel technology platform that brings problems with human factors and characteristics of technical processes together in a virtual development environment.

Thus, safety-critical process states will be made easily comprehensible for personnel (operators, safety managers). In the virtual environment, the consequences of human actions will be immediately recognizable, transparently traceable and reproducible anytime. It will be possible to already clearly identify and eliminate safety risks in the phase of facility design. One model application is virtual firefighting by simulating different hazardous situations. The results of the VIRTHUALIS project are especially interesting for assessing risks and preventing and analyzing accidents. Since the researchers involved are working toward reducing accidents and individual damages in hazardous industries, increasing the availability of plants throughout the entire production life cycle and reducing day-to-day safety expenses, VIRTHUALIS will greatly benefit plant manufacturers and plant operators.

For more information visit www.virthualis.org

3rd International INTUITION Network of Excellence Workshop

© Fraunhofer IAO
Open Days 2006: International Research Careers in Germany

The Fraunhofer IFF presented its European research networks at the OPEN DAYS – European Week of Regions and Cities in October. At the opening of the event, Minister of Economics and Labor Reiner Haseloff emphasized the significance of a strong research scene for our state’s long-term and sustainable economic development: “For enterprises in our state, local research and development competence is a factor crucial to rapidly launching innovative products and services on the market.”

Prof. Michael Schenk, Director of the Fraunhofer IFF, described how broadly the institute is anchored in Europe’s international research scene: “Through numerous European research projects and membership in networks of excellence and competence, the Fraunhofer IFF is instrumental in bolstering Magdeburg’s reputation as a center of state-of-the-art research.” The Marie Curie program “ResearchTraining @VDTC” has made the VDTC an international center of research where young researchers receive advanced qualification in the field of virtual engineering.

Some sixty young researchers, doctoral students, graduate students and students attended the event at the Fraunhofer IFF. Presentations were given on European research projects and international researchers reported on their experiences, speaking about their own international researcher biographies. Project managers from the Fraunhofer IFF and international partners presented projects currently ongoing at the research institute such as ResearchTraining @VDTC, VIRTUALIS, HILAS, CADPIPE and sme-MPOWER.

Schavan Announces Further Support Initiatives for Eastern Germany

On the occasion of the kick-off of Eastern Innovation Week, Federal Minister of Research Annette Schavan announced twelve initiatives the Ministry of Education and Research (BMBF) will be supporting with up to 250,000 euros apiece in the second round of its program “Centers of Innovation Competence: Creating Excellence – Securing Talent” starting in early 2007. Two researcher teams apiece will be from Brandenburg, Mecklenburg-Western Pomerania and Thuringia and three researcher teams apiece will be from Saxony and Saxony-Anhalt, including one at the Fraunhofer IFF in Magdeburg.

The program is part of the innovation initiative “Entrepreneurial Regions”. The objective of the program is to sustainably establish high-level research centers in eastern Germany. International orientation, entrepreneurial strategy and innovative approaches to securing the next generation are intended to generate lasting impulses in the new states. “In order to establish clusters with long-term economic success and hold their own against the global competition for talent and young professionals, eastern German regions need internationally excellent research centers,” said Schavan. The program’s first round “Centers of Innovation Competence” has already started: Six centers have supported groups of young researchers since 2005. “The successes of the first round of support demonstrate that the approach selected is right. The concept is taking off,” stated the Minister approvingly.

For more information on the innovation initiative Entrepreneurial Regions visit http://www.unternehmen-region.de.

Run-up Project to BMBF Innovation Cluster Starts in Magdeburg

In preparation for the innovation cluster Virtual Development and Training (VIDET) in the German government’s high-tech offensive, the Fraunhofer IFF in Magdeburg is beginning work on the run-up project on Interface Configuration for Integrated Process Chains in the Development and Manufacture of Mechatronic Systems.

The objective of the planned innovation cluster VIDET is to promote interdisciplinary research and applications in the field of virtual tools for the planning, development and operation of products and systems by networking industry, academic and non-academic research organizations. The innovation cluster is intended to contribute to the development and utilization of methods suitable for application and to create tools that support the integrated utilization of virtual design and virtual reality throughout the entire product life cycle and empower small and medium-sized enterprises to place...
developments of new products or services in dynamic markets even better. Therefore, a particular priority is enabling small and medium-sized enterprises to utilize the methods of virtual product development, virtual process engineering and VR based training.

Based on the extensive preliminary work of the Fraunhofer IFF and its cooperation partners, the run-up project is a self-contained phase in preparation to the innovation cluster VIDET. On the one hand, the results will be of use separately and, on the other hand, they will create important technical and organizational prerequisites to VIDET.

Haseloff Is Patron of the Guest Lecture Series


The annual lecture series at which high profile speakers from business and research report on the use of VR and AR technologies in their companies and institutes was held for the third time.

Power from Rice Husks

Up to now, residual products from Vietnamese rice cultivation have been disposed of as waste. Rice husks hold tremendous potential as energy though. Contracted by the University of Hanoi, Magdeburg Fraunhofer researchers developed a plant that burns this biomass in a circulating fluidized bed combustion reactor (CFBR).

The specialists at the Fraunhofer IFF and Hanoi University of Technology now intend to jointly research how well energy can be recovered from the material. Initial tests in the experimental plant were run in Magdeburg in the summer. In October, the CFBR was started up in Hanoi for the first time. The Fraunhofer Institute for Factory Operation and Automation IFF and Hanoi University of Technology are now drawing up a cooperation agreement on joint research projects.

In their project, the researchers intend to analyze in detail the combustion behavior of rice husks and other biomass typical for Vietnam such as reeds or sugar cane. The researchers are especially interested in whether conventional fuels such as coal of lesser quality can be mixed with biomass in the fluidized bed. “These studies are particularly relevant for the Vietnamese market. They are aimed at finding low cost alternatives to expensive fossil fuels. The environmental pollution generated by landfilling waste will be reduced considerably,” according to Dr. Lutz Hoyer who headed the team at the Fraunhofer IFF that developed the system.

Dr. Pham Hoang Luong, Deputy Director of Hanoi University of Technology, commented: “Our university is investing right now in lab equipment for experimental and educational operation. In the future, we will train prospective engineers on the fluidized bed system. Hence, we are thrilled about the collaboration with the Magdeburg Fraunhofer Institute.”

For more information visit www.iff.fraunhofer.de
Perhaps you could provide one or two concrete examples?

The Fraunhofer IFF’s years of experience in the field of RFID is very demonstrative. In 1999, when hardly anyone was familiar with and using this technology, the institute implemented a tool management system at AIRBUS Germany with which AIRBUS monitors the use of tools at various airlines and service providers’ facilities all over the world. Making information on tool type, service operations, calibration and certificates available directly on an object reduced cycle time by nearly 20 percent and minimized the work to document every operation with an electronic maintenance history file.

Another example is optical 3-D metrology. Stressed-skin fuselages are assembled with riveted joints. For safety reasons, tremendous demands are made on the precision of these riveted joints. Several thousand riveted joints have to be inspected for each stressed-skin fuselage. This was done manually by workers who inspected every riveted joint for damage and used their thumbs to check whether a set head projected the specified amount. The Fraunhofer IFF replaced this intensely subjective and time-consuming inspection method with a fully automatic optical inspection system. This inspection system is integrated directly in the assembly line, allows inspecting quality 100 percent and has no effect on cycle time. Since the riveted joints are inspected immediately after being set, reworking was reduced by approximately 80 percent.

The Sky’s the Limit with Fraunhofer Know-how

An interview with Richard Smyth, Airbus Toulouse Vice President Systems General and Head of a Transnational Developer Team.

Airbus and Fraunhofer. Two big names and an interesting constellation. What relationships do you see between these two organizations?

Compared to low-price countries, Germany and France need ample technological competence to secure their leadership and remain competitive. Airbus needs strong research partners. We feel very connected to Fraunhofer. Together, we have very successfully completed some extremely interesting projects in the widest variety of specialized fields. We have developed especially close relations with the Magdeburg Institute in particular.

How did this close relationship between Airbus and the Fraunhofer IFF in Magdeburg come about?

We completed some projects with the specialists from Magdeburg in recent years. These projects were a real enrichment for Airbus. The outcome was customized solutions for quite individualized tasks. The researchers were able to put themselves in our position remarkably well. Everytime I visited, I was enormously impressed by the degree to which work at the Fraunhofer IFF is oriented toward processes and results. This is especially important considering how complex processes have become in today’s industrial world. The Magdeburg researchers never go just halfway. They have everything industry needs – we value that.
And in the field of virtual reality?

The specialists at the Fraunhofer IFF have developed a virtual-interactive application, which assembly personnel, mechanics and trainees can use to learn how to execute particular manufacturing and servicing jobs for the Airbus A320 aircraft family. The educational contents reproduced include the installation and removal of the aileron control unit. Furthermore, trainees can virtually check the oil level and change the oil in the integrated drive generator of CFM56 engines and complete a course on the installation and removal of the auxiliary power unit. On the one hand, the educational system is an optimal aid to generate better general understanding of the overall technical system and its components’ interrelationships and interactions. On the other hand, selected tasks can be taught in great detail and an aircraft does not have to be made available extra to do so.

What significance will virtual technologies have in the future?

By incorporating real interdependencies, virtual reality can be used to intervene in a process very early on because situations can be evaluated much more precisely. In the near future, no development process will get around this. In this respect, this alone already makes it possible to predict that virtual reality will play an extremely important role. Integrating virtual-interactive models in every phase of the product life cycle – i.e. in development, engineering, testing and operation – will become an entirely normal procedure. This is why I consider the VDTC fundamentally important: A cornerstone for modern and sustainable German industry is being laid here in Magdeburg.

We’ve spoken about joint projects in the past and the future significance of virtual reality in general. Will there again be joint projects in the future too?

I’m sure of that. At the moment, very concrete talks are underway between Airbus and the Fraunhofer in Magdeburg. At this time, I’ll only reveal this much: The competencies in the field of transponder-supported logistics and virtual reality are extraordinarily interesting for us. By the way, we are connected by even far more than these business relationships. We’ve come to appreciate each other through our joint project work in recent years. I’m always glad to return to Magdeburg again and again, especially to the Port of Science on the Elbe. You can stick your finger in the water and know the same water flows to us in Hamburg.

Richard Smyth, born on December 18, 1941
1960-1966
Studied at the Technical University of Berlin, majoring in Aircraft Engineering and Engines
1966-1982
Engineer at Airbus Deutschland GmbH, formerly the Vereinigte Flugtechnische Werke (VFW), in Bremen
Development engineer for engine installations, later head of the engine department
1982-1995
Transfer to Airbus Industrie in Toulouse, head of the engine department at Airbus Industrie
1995-2001
Return to Germany, DaimlerChrysler Aerospace Airbus in Hamburg
2001
Airbus Deutschland GmbH, Director of Systems Development
2001-2006
Airbus Toulouse, Vice President Systems General, head of a transnational development team
ViVERA, the Virtual Network of Competence for Virtual and Augmented Reality, has been around for two years. Its objective: Transferring research findings to the business world as rapidly as possible. ViVERA means “It’s alive!” Nomen est Omen – a particularly lively partnership is the distinctive feature of the research network with the unusual name. Proof of this is the many and diverse activities carried out by the partners – six Fraunhofer Institutes and their partner universities – in the first two years of the project.

At the Fraunhofer IFF VDTC, work is being done on basic technologies and specific applied research. As the lead managing institute, it especially cultivates networking between the partners.
Basic technologies include self-contained virtual reality functionalities that can be used as the foundation for development in different areas of application. The ViVERA consortium has launched a total of seven basic technologies. Two of them are currently being implemented at the Fraunhofer IFF. The process “Generation of Models for VR Applications” employs a new system to generate virtual models. It not only automatically records geometry but also coloration (texture). One important feature is the visualization of objects for which 3-D CAD models do not exist. Applications for this are, for example, the scanning of tissue structures in medicine or the restoration of historical buildings in architecture. The 2/2005 issue of IFFocus already presented this method.

The second basic technology developed at the Fraunhofer IFF “Interfaces to Systems for 3-D Model Generation” allows transferring and automatically postprocessing 3-D CAD models from commercially available CAD systems. Among others, these include ProEngineer, CATIA V5, SolidWorks and UniGraphics NX. This makes it possible to transfer the geometry of 3-D objects and their hierarchical structure to a virtual model. Moreover, the tool supports different levels of detail that can be used to optimize visualization. Thus, since the CAD data is often already available in companies, this technology is a basic prerequisite to cost-effectively generating virtual models.

Another emphasis of ViVERA is the examination of specific industry issues. The automotive industry, mechanical and plant engineering, medical technology and shipbuilding figure prominently. In ViVERA, the team of experts at the Fraunhofer IFF is concentrating on the sectors of mechanical and plant engineering. The objective is to enable small and medium-sized enterprises in particular to access state-of-the-art VR and AR technologies. To do this, already developed basic technologies are being applied and developed further according to concrete industry requirements. The outcome will be the creation of a total of nine demonstrators in the ViVERA Network by the fall of 2007. Two of these will in turn have been developed at the Fraunhofer IFF. Each will clarify one typical industry application of virtual technologies. Thus, they are intended to convince other companies to take advantage of the potentials of these new technologies for themselves.

The work on the “Virtual Control” demonstrator has progressed so far that a machine manufacturer is already using the solution in its real work (cf. IFFocus 2/2006, p. 26). The idea involves coupling a real CNC controller with the virtual model of a heavy machine tool. This enables testing the control programs at a time when the real machine is still being set up. This link with a real controller produces an extremely realistic user scenario, ideal for the qualification and advanced training of machine operators. In the spring of 2006, the demonstrator was presented at one of the world’s biggest trade shows for CNC machine tools in Shanghai and at the leading trade fair for computer innovations, the CeBit in Hannover.

The second demonstrator “Virtual Plant” is currently still in development. To this end, the visualization of process engineering parameters is being implemented, i.e. dynamic characteristics such as temperature and pressure. What is more, the significant process flows are being represented in a VR model. A moving bed reactor that reforms biogenic gases is serving as a model. A system of mathematical equations was devised to describe functional performance. This system of equations is being built upon to simulate the moving bed reactor’s performance.

Simulation of a combustion chamber: Representation of pressure distribution.
Partner networking is another emphasis in the project work. Last year, the Fraunhofer IFF pursued two cooperations in particular. The Fraunhofer IFF took advantage of the experience of its partner in Stuttgart for the “VR Supported Engineering Workstation”. Virtual reality extends and optimizes an engineer’s workstation. Extremely low-noise computer and projector concepts are applied to do this. Another component is a cost effective optical tracking system that detects the position of the new, lightweight interaction devices. The VR software developed at the Fraunhofer IFF to represent visual-interactive training contents is presently being adapted to the new hardware to support expanded interaction techniques.

The second cooperation relates to the use of the visualization library OpenSG and the application Avalon based on it. The software developed by the ViVERA partners in Darmstadt was tested at the Fraunhofer IFF. This will make it possible in the future to use a basic technology “Photorealistic Image Generation in Real Time” developed in Darmstadt in combination with the laser projection system at the Fraunhofer IFF VDTC. Developed by the specialists at the Fraunhofer IGD and presented for the first time in March 2006 at the computer trade fair CeBIT, this technology can be used to interactively present photorealistic representations. This not only makes the technology interesting for design reviews but also for interactive and functional 3-D models.

The visualization is still being fine tuned at present. The results from the flow simulation system (Fluent) will also be integrated in the near future. In order to ensure components and their models are interchangeable, a procedure is being developed to describe components and their connected simulations. A fluidized bed combustion reactor is being used as a validation model. The outcome of the developments will enable superimposing a visualization of process parameters in the 3-D model of the reactor. This representation is intended to support communication between engineers and operators to better jointly coordinate and optimize process parameters.
In particular, delving more deeply into fields of application is planned for the coming year. In addition, a knowledge storage system will be generated, which compiles all relevant project experiences. Thus, other enterprises will also be able to utilize the results of the ViVERA Network’s research.

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Laser projection in the Elbe Dom at the Fraunhofer IFF VDTC. © P. Förster

Partners in the ViVERA Network

- Fraunhofer Institute for Computer Graphics Research IGD in Darmstadt
- Technical University of Darmstadt
- Fraunhofer Institute for Computer Graphics Research IGD-R in Rostock
- University of Rostock
- Fraunhofer Institute for Production Systems and Design Technology IPK in Berlin
- Technical University of Berlin
- Fraunhofer Institute for Machine Tools and Forming Technology IWU in Chemnitz
- Technical University of Chemnitz
- Fraunhofer Institute for Industrial Engineering IAO in Stuttgart
- University of Stuttgart
- Fraunhofer Institute for Factory Operation and Automation IFF in Magdeburg
- Otto von Guericke University Magdeburg
Medical Technical Training in a Virtual Lab

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Once they have completed their basic training, medical technical laboratory assistants or MTLA first have to familiarize themselves with their sphere of activity. Ultimately, every specialized field of medicine has its own methods. In Magdeburg, a new training model has been started, which uses virtual models from the Fraunhofer IFF Virtual Development and Training Centre VDTC to introduce MTLA to their specific field.
Magdeburg is an internationally recognized center of neuroscientific research. Some young and innovative enterprises have established the Center for Neuroscientific Innovation and Technology ZENIT. They collaborate closely with the University Hospital and the Leibniz Institute for Neurobiology (IfN), home of Europe’s first 7 Tesla magnetic resonance tomograph. One of these enterprises is FAN gGmbH, a research organization for applied neurosciences. Part of the MTA from FAN gGmbH are trained by the Fit-Bildungs-GmbH. This educational provider specializing in medical-technical assistant professions attaches great importance to innovative educational concepts. This is why it came to test the use of virtual-interactive models for training jointly with Fraunhofer researchers from the Virtual Development and Training Centre VDTC.

Virtual technologies hold great potentials for the sector of technical staff education and training. Three-dimensional contents open completely new possibilities to exchange information and transfer knowledge in virtual environments. Virtual 3-D models have impressive advantages over a real environment such as the unlimited availability of a virtual learning or work environment, the reversibility of learning actions and the didactic reducibility of real facts to core contents by means of time lapse, transparencies or sectional planes. In addition, virtual models are especially clear and thus easily understandable for users. This realization has already found acceptance in many realms of industry. Three-dimensional and interactive representations of virtual models are already standard in engineering and design, for example.

Experiments in the Virtual Lab
The project partners jointly developed a software prototype conceived as a model for the advanced training of medical-technical laboratory assistants working in neuromedical research labs. To develop the software, the project partners first step was to define a representative analysis procedure. This customized virtual-interactive 3-D scenario teaches MTLA how to produce preparations from the brains of test animals and how test series are prepared, executed and analyzed. The experiments shown here support research on various aspects of stroke treatment.

The procedure was subsequently subdivided into four separate modules. The first module, perfusion, includes the fixation of tissue followed by the extraction of the test preparation, i.e. the extraction of the brain. The subsequent tissue preparation (second module) covers the postfixation and preparation of wafer-thin tissue slices with the cryostat. The third module covers the immunohistochemical reaction. In this process, a dye makes the structures of the antigens visible. This is how the tissue sections are prepared for later analysis. The analysis of the dyed structures under the microscope follows in the fourth module.

Perfusion fixation of a test animal.
Applying the primary antibody to the tissue section.

The main objective was to first transfer these modules to a virtual 3-D learning environment, taking into account the close correlation between the content of individual modules and the impact on the results of analysis. Therefore, the individual modules were assigned to different local workstations in a virtual lab. Thus, both the specifics of the individual process steps per workstation (spatial separation) and their links to the complete analysis procedure can be represented. As a result, along with being able to work on a specific module (e.g. procedural step) at any time, trainees are also able to fit the content into the overall context of the analysis.

When they do not use the VR educational modules, trainees only really comprehend the overall procedure much later. A training process in a real lab usually has only one piece of equipment on hand, which is used during ongoing operations.

Accordingly, the MTLA usually do not complete the process in the proper sequence but rather depending on the availability of the necessary equipment. Thus, insights based on principles of cause and effect are lost and the consequences of mistakes are not apparent. Either a colleague instead of an individual trainee has produced the preparation or the preparation was produced so long before that trainees have already forgotten any potential errors.

**How the VR Educational Module Functions:**

An introduction familiarizes users with working with the system and the chain of analysis. In every module, users can view demonstrations of preparatory steps for work (e.g. instruments involved, chemicals). The presentation mode subsequently shows trainees an ideal approach, whereupon text instructions enable users themselves to interact with the virtual models. A user’s level of interaction has been
adaptively coupled with the particular level of difficulty of a procedural step. While a relatively high level of independence is required to complete difficult job steps, the presentation mode suffices for simple educational content. The entire analysis procedure is completed with a complex test consisting of practical and theoretical sections.

**Test Phase and Test Results**

In a test phase, the Fit-Bildungs GmbH tested the interactive 3-D module's transfer of knowledge in the training process. They focused on the extent to which the software's content and didactic structure is suitable for knowledge transfer and the degree to which it can contribute to the development of professional skills. What is more, issues of ease of operation and acceptance were integrated in the test. Three test groups were formed to conduct practical tests with trainees from Fit-Bildungs-GmbH.

**Group 1:** Participants with sound working knowledge of computers and standard software who also have personal experience navigating computer games but no prior medical knowledge (e.g. medical documentation assistants).

**Group 2:** Participants from the professional environment of medical-technical lab assistants who already have medical lab know-how but little or no experience working with computers.

**Group 3:** Participants with sufficiently good working knowledge of computers and prior medical knowledge, which however is not connected to specific technical lab work (e.g. physiotherapy trainees).

Each test group received individual orientation on working with the software. In particular, the test subjects were familiarized with its didactic structure and user prompting. This was followed by the practical test phase in which participants independently completed the training module without a time limit. Questionnaires and interviews were employed to subsequently assess the test phase.

So far, the test results have confirmed the correctness of the approach. The test persons grasped the complexity of the facts despite the didactic reduction. Relevant process flows were reflected correctly in the overall structured module. In practical training in the teaching lab, it is already becoming apparent that participants have noticeably increased skills handling equipment after they have completed the interactive training. The test results demonstrate that interactive training modules hold great potential to support the training of medical-technical professionals, which is generalizable for other professional fields too.

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Analysis of the structures detected under the microscope.
Virtual Machine Configuration Based on a Modular Principle

Dr. Tamara Nestorovic and Ronny Franke

Constantly changing market requirements demand plant manufacturers quickly respond and quickly adapt their products accordingly. Applying methods of virtual reality to the field of mechanical engineering holds great potential to strengthen manufacturing-oriented enterprises as they move toward adapting to the market more rapidly. To do this, researchers from the Fraunhofer IFF have developed a system for VR Based Technology Development and Machine Configuration (VITECMA).
VITECMA primarily supports technologists and marketing experts in their work. Developers of technical assets obtain an easy to operate tool for design, simulation and optimization for the purpose of holistic product development. Configurable VR models make product marketing easier and this can shorten the bidding phase. Manufacturers can already present clients a concrete model of their potential equipment the first time they meet. Buyers of equipment can already identify potential difficulties in advance and consequently accelerate a machine’s commissioning.

VITECMA is based on methods of virtual engineering for technology development and plant system configuration. The system combines several aspects of product development such as configuration, simulation, sequence planning and visualization in one platform. This new tool is an extension of the Fraunhofer IFF’s proven Virtual Development and Training Platform (VDT Platform), specifically for mechanical engineering.

A customized component library enables users to design new equipment in the briefest time while incorporating specific customer demands (see illustration). High user friendliness also enables non-engineers to virtually develop machinery. A concrete model of a piece of equipment can be assembled by dragging and dropping. In the process, users can resort to so-called snaplines, a support tool to quickly and optimally position individual components. This makes handling considerably easier. A predefined logic behind the snaplines ensures that only “sensible” positions of components are marked. Thus, users, for example sales staff, can assemble a concrete 3-D model of their equipment relatively quickly and uncomplicatedly, which can subsequently be “walked through” virtually in talks with clients. This informs potential
VITECMA can be integrated in a visualization and provide additional insights. The new tool has proven to be exceedingly useful in factory planning too. Thus, for example, local conditions, already existing equipment or interference factors such as columns or stairs can be transferred into the virtual environment. Newly planned equipment can then be embedded in a factory building while incorporating safety parameters and optimal room use and supplemented by necessary peripherals. Even entire assembly lines or machining centers in new factory buildings can be planned in short time. Work stations, machinery and conveyor systems can be positioned differently virtually and their efficiency and accessibility can be tested before one chair is even moved in reality. An integrated measuring tool furnishes helpful services. It can be used to define and designate hazardous areas such as a robot’s workspace.

VITECMA supports holistic product development. Along with a design review of planned equipment, functions and machining processes can be depicted. In addition, planned manufacturing processes can be simulated on the model and machine parameters or component properties can be tested. Structured documentation of the requisite equipment and tool components as well as their supporting data (times, cost, energy consumption, etc.) support a visualization. A single-column milling machine made by SCHIESS GmbH was used to successfully test the approach described. What is more, the system supports automated generation of a product data sheet that compiles all important equipment information, including every hidden component. In combination with a previously generated image, the datasheet can be used to generate high recognition value.

With VITECMA, the experts at the Fraunhofer IFF have created a system that is interesting both for marketing strategists and technologists. Marketing professionals profit from the presentation and configuration functions that enable them to answer spontaneous inquiries from customers without necessarily having to have a technologist’s know-how. As a result, manufacturers can significantly shorten the offer phase for their products. The system can be used to easily compile a database in which every possible combination of their range of products is available in visualized form. This additionally minimizes work planning equipment with the same or similar designs. At trade show appearances or in sporadic talks with customers, manufacturers or their sales representatives can access the database very quickly and easily.
Moreover, automatically generated datasheets can be sent to potential customers in an email. On the other hand, VITECMA also supports customers’ engineers when they are commissioning new equipment. The system can simulate manufacturing processes in real time and thus detect faults at an early stage.

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Really Controlling Virtual Machines
Marco Schumann and Torsten Böhme

The increasing complexity of machines is demanding significantly more time and effort to commission them. At the Fraunhofer IFF Virtual Development and Training Centre VDTC in Magdeburg, components of a machine control system can be tested on a virtual model of a machine before the real machine goes into operation.
The manufacture of automated manufacturing equipment such as machine tools or special machines is characterized by intense cost and time pressure and simultaneously increasing demands on product quality. The time and effort required to develop and manufacture new products is evolving into a crucial competitive factor. Not only product development but also service, training and marketing are increasingly playing a role.

For the most part, automated manufacturing equipment is developed sequentially. The steps of mechanical design engineering, electrical design engineering and control system development are completed successively. Control software in particular is developed and first tested on the real machine. The increasing complexity of manufacturing equipment is causing problems ever more frequently. Mistakes from earlier stages of development often only become apparent when a machine is commissioned. This generates further iterative cycles in development and prolongs the time until a machine is commissioned. In the worst case, this is connected with exploding costs. A sound test of the software on the real machine is often impossible for reasons of time.

Virtual Models in the Product Life Cycle
Interactive visualizations and simulations enable using a computer to clearly and realistically reproduce complex structures and processes. Virtual models can already convey a comprehensive, three-dimensional impression of a product in early phases of development. The preliminary design can be tested, dimensions can be checked and potential error sources can be identified before implementation. Consequently, a key field of application is the use of digital models for the integrated planning, validation and control of product development processes. Moreover, interactive visualization and simulation are increasingly growing in importance for sales since interested parties can be given a convincing impression of a finished machine or a complete system even before making a purchase. In the planning and design phase, a machinery manufacturer’s client can be involved in the broader development and production process so that the product produced is customized for a client’s specific needs.

Creating Virtual Models from Existing Data
The time and effort that go into creating virtual models and incorporating them in existing VR systems is still relatively substantial though. Specialized software solutions exist for many applications, which predominantly employ their own data formats. Frequent data conversions into different formats are laborious, may be afflicted by data loss and often only able to function in one direction. A 3-D CAD system and VR systems interface is a typical example. A CAD system operates with parameterized volume data for example. However, the overwhelming majority of VR systems employ polygonal surface models for visualization. Complex CAD data can often only be transferred into a VR system after great simplification. Modifications of the data in the VR system during a design review often cannot be returned to a CAD system at all and when they can then only with much work.

Really Controlling Virtual Machines

### Development
- Back up
- Reduction
- Commissioning

### Operation
- Optimization
- Diagnostics
- Conversion

### Training
- Operators
- Programmers

### Presentation
- Concepts
- Function
- Design

| Simulation, Visualization, Integration |

Integrated use of virtual models in development, operation and training as well as for presentations.
components (CNC or SPS programs for instance) into the programming code for the VR system. The work required is so great in practice that it outweighs the potential benefits of VR supported training systems and is thus one of the reasons why only a relatively low number of VR based training systems are in use so far.

Here too, the team of researchers at the Fraunhofer IFF succeeded in developing a new approach, which makes already existing electronic information used in product development available in a virtual environment. This approach is described below in the section “Coupling a Real Control System with the Virtual Model”.

Functional Tests on the Virtual Model

So that the commissioning phase does not act as a factor prolonging the overall development time of equipment, the ability to perform functional tests at as early a time as possible is advantageous. In practice, a functional test can only be performed when the design engineering has been completed. Only when a virtual prototype is used can several development tasks proceed simultaneously (simultaneous engineering). The functional test can already be started on digital models in the virtual environment while the machine is still being manufactured.

From the perspective of the engineers involved, a functional test in a virtual environment requires merging two model worlds. On the one hand, design engineers have their CAD model world. The CAD models have to be transferred to the virtual environment and be “revivable” by a kinematic simulation. This means that the degrees of freedom in the movement of individual components must be mapped correctly and thus allow a visualization of the machine’s state.

Control engineers need a functionally oriented model world for their development work, which reproduces a machine’s performance together with the control system. This necessitates a performance simulation that can react to externally acting control signals in real time.

Coupling a Real Control System with the Virtual Model

Specialists from the Virtual Development and Training Centre VDTC coupled the fully functioning control system of a heavy machine tool with its virtual model. Connecting the real control system with the virtual model world can parallelize the development process in the technical domains involved.

Design engineers work in their accustomed CAD environment. The control systems engineers are enabled to develop their software in parallel on the virtual model of the machine. They too can already work on the real control system. The virtual model of the machine created to do this consists of the kinematic model and the performance model. It reproduces the fundamental characteristics of the machine’s performance. The machine's operating performance and disturbance response can already be tested
during the development phase. Thus a machine can be optimized throughout the entire development process.

**Operator Training in the Virtual Environment**

Such a system can be used beyond the development process for many and diverse applications, e.g. operator training or CNC programmer training. The virtual machine model guarantees realistic machine performance. This makes training conducted on the machine especially demonstrative. Thus, manufacturers of technical assets can already provide their customers virtual training environments, while the real machine is still being manufactured. Customers have the advantage of being able to train their operators at an early stage in an environment in which potential operating errors cannot cause damage on a real machine. This additionally saves valuable time. Operators have already acquired initial experience handling a machine before it is put into operation.

Connecting the virtual model with the real control system during the machine's operation generates other advantages. On the one hand, model parameters can be obtained from the real machine's performance. This is used to render the machine model more precisely so that modifications of machine configuration can be tested and implemented parallel to ongoing operation. Thus, setup times can be minimized. Likewise, by coupling the machine model to the real machine, current operating parameters can be documented parallel to machine operation and the machine's condition can thus be diagnosed.

**Virtual-Interactive Product Presentation Supports Sales**

Visual-interactive reproductions of machinery and plants can significantly contribute to efficient product presentation and constitute a universal marketing instrument. Apart from their demonstrativeness, even including images and videos too, interactivity is another extremely important feature of product presentations that use virtual methods.

Users can acquire their first immediate experience with a product and freely move in the virtual environment to explore a machine. It is possible to examine every assembly and every single element of a machine, depending on the representation's level of detail. Techniques that make certain machine components transparent or hide them also make it possible to view internal or difficult to access elements in the virtual world. If functional models underlie the machine's assemblies, it is possible to move a machine's individual parts and learn their functionalities. Naturally, this allows assembling and operating complete products, machines and plants.

Thus, virtual-interactive representations can effectively present a product's advantages as well as its design and operation. A comprehensively designed product scenario can be used for the widest variety of target groups, e.g. sales staff, operator personnel or service staff.

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In the future, the range of customized services for operators of complex plants will be crucial for survival against international competition. Providing innovative documentation, using up-to-date information to systematically support maintenance work or even offering training for specific products are aspects that will be instrumental in attracting new customers and reinforcing existing customer relationships. What do product supporting services look like and how can they be implemented in small and medium-sized enterprises (SME) in particular? Researchers at the Virtual Development and Training Centre have developed PMO Services (Plant Maintenance and Operation Services). PMO Services include services essential for establishing product supporting services in SME. The biomass cogeneration plant in Templin is an up-to-the-minute example that illustrates how the Fraunhofer Institute successively conceptualizes and implements customized services.
It starts with an idea…
The researchers at the Fraunhofer IFF plan and develop small and medium-sized power plants up to 20 MW on the basis of renewable raw materials and secondary fuels (e.g. waste). Energy conversion plants are frequently being operated with less personnel. Responsibility for those integrated in manufacturing or refining processes primarily lies with machine operators additionally responsible for overseeing other plants. Service information needed for operation, servicing and maintenance is located in voluminous supplier documentation. Its management is extremely varied or complicated since individual components are rarely presented from the perspective of processing, servicing or maintenance. Systems engineering support only pertains to a plants’ control systems and the monitoring of process-critical components. An extensive sensor system is usually avoided for reasons of cost. As a result, maintenance-based monitoring cannot be implemented at this time.

The biomass cogeneration plant in Templin (4 MW thermal firing capacity) is a model project already implemented by the Fraunhofer IFF. Operating the power plant involves taking a number of measures to secure the plant’s condition and additionally optimize the process engineering. These measures require information about the plant itself and the process engineering. This data is generated in the engineering process and compiled in technical documents, among other places. Other documents required for approval and operation are added. What is more, spare part catalogs necessary for particular servicing and maintenance measures are compiled. The general contractor compiles all this information and these documents, edits them and delivers them to the operator along with the plant. Here lies the big problem: As a rule, a plant operator receives information and technical documents on paper, which can only be used to a limited extent because the documents are quite extensive and unmanageable. This increases the time spent searching for relevant information. In the end, servicing and maintenance work is more time intensive than planned.

Supporting systems such as maintenance planning and control systems (IPS) or document management systems (DMS) can only provide a remedy when the operator has supplied them with relevant information beforehand. Small and medium-
The point of departure for all services is the setup of a standardized and integrated information and knowledge storage system used to record, interpret and provide service information and documents relevant for the operation of plants. This is done by directly integrating a 3-D virtual plant model, which, among other things, makes new forms of visualization of technical knowledge possible.

According to analyses done by the Fraunhofer IFF, an abundance of data, information and documents exists in enterprises, which can be consolidated in an information and knowledge storage system. The innumerable technical documents from product documentation such as circuit diagrams and drawings are at the very top. Servicing and inspection cycles required for maintenance also add to these however. Moreover, an extensive spare parts catalog exists for every plant. An important point here is the collection of know-how. This information is rarely put on paper. Rather, it is usually passed orally. Today, know-how can be stored in knowledge storage systems and is thus accessible to everyone all the time. The Fraunhofer experts have developed a suitable model for this.

Operators have the overall responsibility for the measures taken in plants. However, hardly any time remains in addition to their day-to-day business to fully tap the potential to optimize service processes. This represents an opportunity for plant manufacturers to develop plant supporting services that help customers cut time and costs. PMO Services makes this possible. For example, condition-based maintenance strategies can result in increased machine availability and reduced down times among other things. The final outcome is hidden potentials for revenue and growth.

… and an innovative solution is soon found
Researchers at the Virtual Development and Training Centre VDTC have developed PMO Services to plan and implement plant supporting services. PMO Services encompass the conception, implementation, provision and operation of plant supporting services within product service.
and delivered to the general contractor. Suppliers all prepare documentation independently as they see fit. Consequently, a plant operator expends considerable additional work and money to collect and use the abundance of different information. Precisely this presents manufacturers an opportunity to better retain customers and boost revenue and growth.

Companies will still not have standardized, supporting services to support the operation of plants in the future. Rather, they will depend on the information and documents available as well as on the specific plant itself and its operator model. Hence, the creation and implementation of appropriate services will necessitate incorporating the following aspects from the very beginning:

- Demand analyses and strategy development: The first step is in-depth analysis of processes, information and organizational structures within an enterprise. Recommendations for action and action plans for the future can be derived from the results. The Fraunhofer IFF provides development of product service strategies as they are needed.

- System development, implementation and operation: Efficient integration, interpretation and provision of relevant service information is only possible with special software solutions that Fraunhofer specialists create on the basis of an enterprise’s specified parameters.

- Systems for demand-oriented service: The goal is to intensify coupling service activities with the demands on plants. The procedure is incremental, from plant modeling to data provision up through plant model integration and validation (test evaluation). In addition, the researchers also guarantee the operation of the software and provide technical support as required.

- Qualification and training: Successful implementation of plant supporting service is a long-term job that can only be done in cooperation with all organizations within an enterprise. Integrating and continuously qualifying every employee plays a crucial role.

**PMO Services in Practice**

To effectively support the operation of the biomass cogeneration plant in Templin by providing up-to-date service information and documents, the actual conditions were analyzed. The available documents and information were the basis for determining future requirements on the product and its user. The analyses revealed:

- The integration of plant components provided by different suppliers with different control and information systems is a fundamental problem. At this time, the different systems make standardized access of service information on the components impossible or only possible with considerable additional work and cost.
In the future, plant operation will become a secondary job. Hence, knowledge about a plant is no longer part of a plant operator’s primary knowledge. Information, documents and technical know-how must be all the more available elsewhere and easily retrievable.

Based on these boundary conditions, the first step was defined together with the operator: Providing a new service solution to integrate, visualize and provide technical documents and information in order to better utilize the existing data. The outcome will be an offline version of this solution delivered to the operator.

A special feature is the direct integration of virtual reality technologies to visualize complex, technical facts. This not only includes the VR based interface to access service information but also the provision of visual-interactive contents from manuals and installation instructions. Such technologies can visualize complex operations “more efficiently” than classical documentation aids. What is more, digital service information facilitates user-specific generation of VR based contents.

**A Look into the Future**

State-of-the-art product service solutions for technical assets enable both manufacturers and operators to develop new potentials for revenue and growth. In the future, such services will become an important sales argument, particularly for plant designers. PMO Services encompass the conception, implementation, provision and operation of plant supporting services within product service. Naturally, the services are customized for a plant or its respective operator model. The example of the biomass cogeneration plant in Templin demonstrates how collaboratively creating customized solutions by integrating every party involved is essential today. It further

All information from the extensive product documentation was prepared to be manageable and user friendly.
demonstrates that the implementation of such a solution was merely a first step. A standardized information storage system provides “all” service information and documents. The next step is to systematically interpret the existing operational data in order to identify and prepare necessary maintenance measures. This will only be possible when know-how is collected and provided. This know-how can help “automatically” define in advance what maintenance measures are needed for specific plant components at what time. Suitable models and strategies are already available today.

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Plants and equipment for processing of oil seeds and vegetable oil

CIMBRIA SKET GmbH offers custom-tailored equipment for the processing of oil seeds and vegetable oil. Equipment is supplied not only for extraction of highgrade vegetable oils for human nourishment but also for production of environmentally compatible fuels like biodiesel. 16 plants erected within the last three years in Europe, Asia and the Middle East stand for the high rate of customer acceptance with regard to CIMBRIA-made equipment.

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Vocational school students in the metals technology program are well versed with computer games played out in virtual worlds. They navigate them easily and confidently. The executive editors at Westermann Verlag wanted to take advantage of their enthusiasm for this technology to teach young people complex lessons. They have already been pursuing the concept of learning fields for a while. These are didactically grounded and prepared levels of action that combine complex problems worked on in action-driven learning situations.

Together with the researchers from the Virtual Development and Training Center VDTC of the Fraunhofer Institute in Magdeburg, a special educational software entitled “Metals Technology: Basic Knowledge” was written for the metals technology product line. An interactive educational CD-ROM supports the concept. The integrated 3-D visualization software BS Contact VRML/X3D made by Bitmanagement enables students to act independently in a virtual work environment. This fosters action-driven work and independent learning.
The educational modules completed deal with the following topics:

- Manual Producing of Components (with a mixing tank as example),
- Mechanical Producing of Components (with an adjustable stop as example),
- Producing Assemblies (with a drilling rig as example),
- Producing Simple Controls (with a gluing rig as example).

In the future, the CD-ROM will expand the range of Westermann Verlag materials for vocational training in the field of metals technology. Along with conventional materials such as a textbook and a workbook, trainees in their first year of metals engineering can use the interactive job orders from these computerized educational scenarios to complete exercises in their work materials and "grasp" the solutions in a virtual environment. Trainees are not however the only users of the CD-ROM. The interactive educational material also provides metals technology instructors many options to organize their lessons more understandably. They can work through model solutions for a job order step by step and reconstruct them on a virtual model. Best practice solutions support discussions on ideal approaches, the virtual model enabling exploration of equipment and models as well as processes.

A complex disassembly order is executed on a drilling rig as an example. The lesson together with the assignment lays the theoretical groundwork, which can then be applied to and tried out on the virtual model of the drilling rig. In another exercise, the virtual model of a gluing jig is coupled with the jig’s pneumatic diagram. A trainee can then reproduce every switch position of the pneumatics as well as their transitions in a clear visualization. Simple machining procedures such as drilling holes are consistently reproduced comprehensively in every step of work, including marking, clamping and machining the workpiece.

The Fraunhofer IFF’s virtual reality platform processes state-of-the-art machinery and plants for development or qualification based on their three-dimensional design data. Qualification mostly focuses on complex tasks for experienced skilled labor. The challenge in this project was processing the tasks in the virtual scenarios in such a way that first year trainees are not overwhelmed and sustainably retain the educational contents by interacting with the model and the processes. Together with the experts from pertinent departments of Westermann Verlag, educational scenarios that are fully usable for vocational education have been produced in many languages.


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Detail from the educational module "Manufacturing Assemblies with a jig as Example".
Augmented reality is a special form of human-technology interaction. It holds great potential to optimize existing processes and simultaneously cut costs primarily in after sales. What is more, productivity improves and the attractiveness of existing services grows.

This technology can be superbly integrated in remote maintenance systems, which can considerably reduce the danger to personnel deployed in military crises for example. This so-called telepresence enables specialists to be virtually present regardless of their location and provide the necessary technical support during service work.
Augmented Perception
The technology of augmented reality can, for example, project maintenance instructions directly onto an aircraft being serviced at a given moment. The parts affected by a repair are virtually superimposed on the real part in correct size and position. Thus, service technicians can dispense with having to carry paper and Web-based documentation with them.

How the Technology Functions
AR service technicians wear a so-called see-through display and a camera on their heads. The camera films the repair scenario – the rear right door of a NH90 transport helicopter in the picture shown here – and executes an image analysis for every frame. In the next step, CAD models of the helicopter door are inserted into the display in real time in the correct size and position. The mechanic’s eye mixes the real and superimposed images so that a combined image is ultimately perceived, thus augmenting the mechanic’s “visual perception” (augmented reality).

AR technology makes high demands on hardware: The video data from the head-mounted camera must be recorded and analyzed. Afterward, the inserted CAD models must be scaled and projected onto a surface. In EADS applications, a mechanic should be able to work autonomously with the AR system. The video and CAD model are processed by a portable computer, which additionally stores all relevant repair and servicing instructions.

EADS applications also make high demands on the display (see left-hand illustration). It has to be equally suited for indoor and outdoor use and not encumber a mechanic during repair work. It has to be lightweight, while simultaneously providing sharp contrast and intense brightness. Rapid head movements “smear” a video image. To compensate for this effect, the head’s inertial values such as angular velocity and angular acceleration must be recorded and processed for sensor fusion.
An AR visualization enables a trainee to attempt a repair immediately without having to laboriously work through the product documentation beforehand. The individual steps of a repair are animated. On the monitor, AR technology superimposes this information directly on the landing gear. A trainee does not have to independently establish a relationship between the landing gear and the repair procedure since this function is integrated in the AR technology.

A context-sensitive representation of contents can further relieve a mechanic. In this form of human-technology interaction, the contents of repairs are processed beforehand and only those repairs are displayed that mechanics themselves have selected in advance or can execute directly from their current position. Context sensitivity furnishes an additional advantage: Bothersome searches for repair instructions are reduced to a minimum of time and a mechanic’s work is made easier as a result.

The illustration on the next page shows an AR application from the service division. In this case, augmented reality makes concealed structures visible. This gives a mechanic a kind of “x-ray vision”. A mechanic can immediately assess whether damage visible in the CFRP (carbon fiber reinforced plastic) outer skin of the NH90 helicopter is critical or cosmetic. When the damage is critical, the aircraft is immediately grounded or its flight is restricted so that no costly consequential damage can occur. When the damage is cosmetic, it is merely covered up and noted for repair during the next scheduled inspection.
Successful Project Work
From January 2004 through June 2006, “Advanced Augmented Reality Technologies for Industrial Service Application” were developed and successfully tested in the project ARTESAS (www.artesas.de).

The feasibility of using markerless tracking methods for industrial service applications was demonstrated. The prototype of a see-through display with a large opening angle was tested and a software package was developed, which supports freely configuring and implementing methods of markerless tracking. Furthermore, a solution to the problem of AR initialization was found. A mechanic strikes a predefined initial pose (position and orientation) relative to the object being repaired.

Globally Acting and Reacting
There is great interest in telemaintenance systems both for military deployment in a crisis and for typical service activities. For example, a specialist in Germany is connected with a mechanic on site in Afghanistan and provides the mechanic support in complex repair operations. AR technology can be superbly integrated in such systems. The video signal from a mechanic’s head-mounted camera enables a specialist to be virtually present at the work site. The mechanic can put the specialist’s instructions directly into action and be monitored by the specialist at the same time. Additionally the mechanic’s line of vision on the real model can be reproduced on a virtual CAD model, which the specialist can view locally on a monitor. This would enable the specialist to provide even better support.

The technology described is especially interesting for military deployments in crises since it can reduce the immediate danger to military personnel considerably. The advantage generated for civil applications is the ability to execute even complex repairs at great distances with the quality and exactitude necessary and with little technical effort.

The national support project ARTESAS successfully demonstrated that industrial utilization of augmented reality is within reach. Successful marketing of this technology will require offering customers an integrated overall system. That system will have to include the following features:

- Inexpensive generation of AR content,
- Adaptation of the human-machine interface to user demands and
- Natural representation of AR content so that users can fully concentrate on their actual activity.

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European Training Program for Young Researchers

Dr. Eberhard Blümel

Funded by the EU as part of its Marie Curie actions, a training program for young researchers has been running at the Fraunhofer IFF Virtual Development and Training Centre VDTC since December 2005. During the runtime of four years, twelve young researchers will come to the Fraunhofer IFF from inside and outside Europe. In “Research Training@VDTC” they participate in international research projects and acquire practical experience in industry projects.

One, two and three years residencies are offered, which the young academics can finish with a Master’s or doctorate, depending on the time they spend here and their interests. The program’s thematic foci cover the innovative field of applied virtual reality and virtual engineering. Three thematic fields can be selected: Virtual product development, virtual process control and virtual-interactive training.

The young researchers attend classes and research in the institute’s labs outfitted with high-tech equipment such as the LogMotionLab or the Elbe Dom with its 360 degree projection surface. Modules in soft skills, language courses and conference attendance supplement their training. The program is being carried out in cooperation with Otto von Guericke University Magdeburg and regional industry partners.

The objective of the training program is to familiarize young researchers, based on their existing competencies, with the latest virtual and augmented reality technologies and to enable them to develop new methods apply these technologies in practice.

To this end, an individual personnel development plan is formulated for every Marie Curie Fellow, in which long-term and short-term goals for future career development and measures to achieve these are defined. These range from the specification of detailed training contents to planning the publication of research findings at international conferences to the acquisition of management skills for research and development projects.

One important step in this direction is the integration of the young researchers in project teams so they can participate in European research projects or acquire practical experience in industry projects.
Since August 2006, Carlo Belardinelli has been researching the development of acoustic models of technical systems to integrate them in virtual engineering platforms for demonstration, evaluation and training systems. These models are used for example in virtual product development to reduce noise from machine tools. Carlos Belardinelli’s qualifications to do this come from his study of acoustic-electronic engineering at the University of Rome and a research residency at the University of Cambridge’s Signal Processing Lab. At the VDTC, he is working closely together with the “Virtual Commissioning” project team.

Bartlomiej Arendarski graduated from the School of Electronics and Electrical Engineering at the Technical University in Wroclaw with a Master’s thesis on intelligent building systems. Since April 2006, he has been studying applications of VR based training for maintenance on complex electrical systems. He has already successfully presented his initial results to the industry partner RWE. Another field of his research is the development of modules for virtual reality-based modeling of intelligent building systems.

Rui Guimaraes earned his Bachelor’s in Computer Engineering from the University of Porto and completed a Master’s of Science in biomedical engineering at the University of London. At the VDTC, he is researching the development of methods, tools and processes to interactively visualize human organs. The results of his research will be applied to support the planning and execution of minimally invasive operations. He is carrying out his work in conjunction with a state project and in cooperation with Otto von Guericke University Magdeburg.

Charikleia Sermpetzoglou graduated from the School of Electrical and Computer Engineering at the National Technical University of Athens. She devoted her Diplom thesis on radar systems to the problem of combining data originating from different sources. Since October 2006, she has been involved in the development of a system to generate and interpret real-time logistic data streams. This system is part of the project LogModelLab that can be characterized as a tool for demonstrating and studying the effects of logistics concrete users can expect when they implement RFID technology.

Tamas Juhasz graduated with a degree in computer science from the School of Electrical Engineering and Computer Science at the University of Budapest. His specialization is the modeling and simulation of complex robotic systems. Since October 2006, he has been working at the Fraunhofer IFF on the development of systems for the interdisciplinary modeling and simulation of mechatronic products. His findings are directly entering the Fraunhofer IFF’s research specialization of virtual product development.

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New VDI State Representative for Saxony-Anhalt in Office

Prof. Michael Schenk, Director of the Fraunhofer Institute for Factory Operation and Automation IFF, has been the new VDI State Representative for Saxony-Anhalt since October 1, 2006. VDI Board Member Prof. Rainer Hirschberg officially installed him in office at the VDI State Chapter’s traditional event, the Fest der Technik, at the Parkhotel Herrenkrug on October 14, 2006. The new state Representative’s first tasks include contacting Saxony-Anhalt’s state government and friendly engineering associations and fulfilling his responsibilities at VDI board meetings and on the advisory board of the Regional Chapters.

How Virtuality Became Reality

It is finished. The Virtual Development and Training Centre VDTC was completed on November 22, 2006, thus opening new possibilities for the Fraunhofer Institute Magdeburg and its project partners to immerse even deeper in the virtual world. If one looks back to the end of 2004 though, the VDTC only existed as a mental construct. Eyk Flechtner who normally works in the Department of Factory Planning and Logistics was selected to execute the planning and realization of this prestigious object while it was still in its nascency. For the next two years, Flechtner was responsible for completing the new building together with the architectural firm ACM.

“That wasn’t an easy task,” he confesses. At the same time, it was a great challenge for him too. Today, when Eyk Flechtner makes his rounds through the VDTC, he’s filled with pride to have been part of the creation of such an impressive structure. During the construction phase, he had his hands full coordinating the numerous installation firms and their workers. “We had to improvise a few times,” says Flechtner smiling. The coordination was also so difficult because the Fraunhofer IFF put off installing equipment until the last minute in order to have the latest, best available technology when the VDTC was completed. Flechtner had to incorporate all these unknown variables exactly in the planning and execution of the construction work. Today, the structure stands in all its grandeur in Magdeburg’s Port of Science.

Fraunhofer graphic designer Bettina Rohrschneider and well-known Magdeburg photographer Viktoria Kühne took over designing the exterior facade of the Elbe Dom, the VR testing facility in the VDTC.

Together, the two developed a convincing concept for the exterior facade. It had to be visually appealing and artistically represent the work of the VDTC at the same time. Among the public, the VR testing facility has the highest recognition value of any part of the building. After an intensive brainstorming phase, a motif was decided on. Today, visitors to the VDTC behold a radiant blue exterior facade encircled by a gigantic data glove. The glove in turn symbolically “reaches” for scientific formulae and equations scattered all over the facade.
Doctoral Fellowship for IFF Computer Scientist

Since 1999, the Fraunhofer-Gesellschaft has announced a program for female doctoral students every year. The program supports young researchers for three years and is intended to increase the proportion of female researchers in the Fraunhofer world.

Kathleen Hänsch from the Department of Data and Information Management at the Fraunhofer IFF landed one of the coveted fellowships. She prevailed against thirty-three applicants from twenty-four institutes. The young researcher is now working on her doctoral dissertation on “Structuring, Searching and Managing Information in Mechanical and Plant Engineering Product Service”. The twenty-four-year old is researching means to help users of information systems track down particular information as easily and quickly as possible.

In her free time, Kathleen Hänsch sometimes shows an artistic side. She is, for example, a trained choir director. She’s happiest on the weekend though when her fiancée, a senior manager at MTU Maintenance in Berlin-Brandenburg, comes to Magdeburg. “Our wedding will be taking place this year,” the doctoral candidate reveals with a charming smile.

Successful Doctorate

“Structuring, Searching and Managing Information in Mechanical and Plant Engineering Product Service”. The native of Chemnitz majored in electrical engineering at the Technical University of Chemnitz-Zwickau. After graduating, the engineer started work as a faculty member at the university in Magdeburg in 1998. Dr. Jens Kroitzsch came to the Fraunhofer IFF in fall of 2005. The thirty-three-year old’s special interests are renewable energies and electric vehicles. His research previously focused on electric machines, power electronics and electric power systems. “For me, working at the Fraunhofer IFF is especially appealing,” says Jens Kroitzsch. “It’s not just all about research here but also about how the results can benefit society.”

New Director of the Institute of Logistics and Material Handling Systems

Since October 1, 2006, Prof. Michael Schenk, Director of the Fraunhofer Institute for Factory Operation and Automation IFF, also heads the Institute of Logistics and Material Handling Systems at Otto von Guericke University in Magdeburg. The newly formed institute where Prof. Schenk also holds the Chair of Logistics Systems has its origins in the materials handling program. The university in Magdeburg has established itself in this field nationally and internationally. The university institute’s new name signifies the reorientation of content toward logistics and material handling systems, which is supported and advanced by Otto von Guericke University’s close cooperation with the Fraunhofer IFF.
Around 200 graduates and affiliated logisticians from all over Germany and many partner countries gathered in Magdeburg on October 2, 2006 to look back on 50 years of the material handling program in Magdeburg and to take advantage of the opportunity to also celebrate the reorganized Institute of Logistics and Material Handling Systems. The Institute for Material Handling and for Steelworks at the former College of Heavy Mechanical Engineering in Magdeburg began programs in material handling and steelwork in 1956. Fifty years later, Magdeburg academics welcomed guests from more than ten countries, including Cuba, Kenya, Russia, Ukraine, China and Japan to this anniversary party.

After a colloquium in the university’s Auditorium 1 presenting the history of material handling education, current trends in research and industry as well as the newly established institute’s prospects, the guests streamed to Fort Mark where, in its historical ambience, they continued their discussions, revived shared memories and establish new contacts for the future.

Karla Zorn took over as the Head of Administrative Services at the Fraunhofer IFF on November 1, 2006. Apart from project controlling, the forty-nine year old’s expanded sphere of responsibilities includes accounting, human resource management and purchasing. With a degree in business administration, she replaces Helga Mägdefrau, a member of the founding Fraunhofer IFF team from 1992, who retired.

Karla Zorn came to the Fraunhofer IFF in 1997. She had applied for a job opening in facility management.

“Actually, I wasn’t really quiet aware of the job requirements for such a “man’s domain,” reveals Karla Zorn with a wink. Yet, precisely this woman would prove herself at the construction site – as a dispatcher to the site manager. Later, Karla Zorn not only coordinated the staff’s move but was also a kind of facility manager for weeks. In 1998, Karla Zorn switched to project monitoring where she could follow her real calling. “My heart and my passion belong to numbers,” explains the ardent controller.

The native of Magdeburg first studied business administration and then headed to Stendal in 1979. The large construction site for the nuclear power plant in Arneburg, today the site of a pulp mill among other things, offered the graduate the career opportunities she aspired to as manager of worker housing. After reunification, gastronomy and hotelry were her second home for several years. In 1994, Karla Zorn started studying accounting, controlling and tax theory while working.

From Munich to Magdeburg for a Doctorate

The School of Mechanical Engineering awarded thirty-three year old mathematician Norbert Heider his doctorate magna cum laude on September 7, 2006. Heider earned his doctorate from the Chair of Logistics Systems under Prof. Michael Schenk. After a successful defense, the native of Freising was pulled atop a barrel through the downtown, followed by his advisors Prof. Schenk and Prof. Augustin, colleagues and friends.
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The Elbe Dom in the newly opened VDTC. The large projection system reveals one-of-a-kind views into the virtual world.

“This testing facility is unique worldwide.”

Alexander von Witzleben, Chairman of the Board of Jenoptik AG
Lutherstadt Eisleben is located in southern Saxony-Anhalt. You’ll only find the virtual model of the over one thousand year old city at the Virtual Development and Training Centre VDTC though. Architecture and tourism development plans are visualized and evaluated in virtual Eisleben, thus giving architects and residents of the city a vivid impression of changes planned in this UNESCO World Cultural Heritage site where urban development must be handled sensitively.
2006 was the Year of Science. More than 200 events with over 100 partners fired up Magdeburg residents’ enthusiasm for science and technology. With the motto “Magdeburg Wants to Know”, 2007 will also bring many noteworthy events such as the Long Night of Science on June 16, 2007.
OLLENS WISSEN!
Events in 2007

February 1, 2007
Magdeburg

February 13 - 15, 2007
LogiMat 2007: International Trade Fair for Distribution, Materials Handling and Information Flow
Stuttgart

February 21, 2007
Workshop on RFID Supported Construction Site Logistics
Magdeburg

February 22 - 23, 2007
b2d – Business To Dialog
Magdeburg

February 28 - March 2, 2007
53rd Spring Convention of the Gesellschaft für Arbeitswissenschaft e.V.
Magdeburg

March 8 - 9, 2007
Simulation and Visualization 2007 (SimVis),
Magdeburg

March 15 - 21, 2007
CeBIT
Hannover

April 17 - June 19, 2006
10th Guest Lecture Series: Logistics as a Field of Work of the Future – Potentials, Implementation Strategies and Visions
Magdeburg

May 14 - 18, 2007
Ligna Hannover 2007
Hannover

May 8 - 11, 2007
Control
Sinsheim

June 12 - 16, 2007
GIFA International Foundry Trade Fair
Düsseldorf

June 12 - 15, 2007
transport logistic 2007
Munich

June 16, 2007
Long Night of Science
Magdeburg

June 27 - 29, 2007
10th IFF Science Days: International Conference “Logistics: Intelligence in Manufacturing and Transportation”
Magdeburg

June 27 - 29, 2007
Magdeburg

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