Logistics Intelligence in Manufacturing and Transportation

Secure Chains of Goods with Galileo Technology
LogMotionLab: Leading RFID and Telematics Lab
Modeling and Simulation in Logistics and Factory Planning
Dear Readers,

2007 is a special year for our institute. This year, we are celebrating our fifteenth anniversary and in June we will be hosting the IFF Science Days for the tenth time, two extremely gratifying events that fill us with pride. We have achieved much in our short but dynamic history. Our employees’ dedication and commitment as well as their enthusiasm for research and new technologies have enabled us to move into our second new building in just two years. With our main building on Sandtorstrasse and our Virtual Development and Training Centre VDTC on Joseph-von-Fraunhofer-Strasse, we have two outstandingly equipped, state-of-the-art institute buildings. At the same time, this is visual confirmation that we have embarked on a successful and sustainable course with our institute’s substantive orientation. Since our inception in 1992, we have been pursuing the goal of planning factories and their logistics systems more efficiently and using new automation concepts to operate them reliably. To do this, we bundle the research and development services of the different disciplines at our institute.

By moving into the VDTC where we primarily concentrate on research and development of virtual technologies and their potential applications, we have made the space for the logistics and automation we urgently needed in our institute building on Sandtorstrasse. With our LogMotionLab, a lab for the development, testing and certification of Auto-ID and telematic technologies, we already have one of Europe’s best equipped RFID labs here at the Fraunhofer IFF. We will use the capacities being freed up in our testing facility for further expansion of the LogMotionLab as well as for new projects in fields of automation. With its development of automated cleaning and Inspection systems for Emscherkanal our Robotic Systems Business Unit is working on one of the largest industry projects in the Fraunhofer-Gesellschaft. Our Measurement and Testing Technology Business Unit develops contactless optical 3-D measuring systems that satisfy even the Deutsche Bahn’s strict standards and have been app-roved by its Calibration and Testing Lab.

I invite you to get to know us better and to find out about our institute’s people, current news, products and services and I wish you much reading enjoyment.

Your,

Prof. Michael Schenk
Director of the Fraunhofer Institute for Factory Operation and Automation
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10 Years of IFF Science Days

The Fraunhofer Institute for Factory Operation and Automation IFF in Magdeburg will hold its 10th IFF Science Days from June 27 through 29, 2007. For more than ten years, executives, developers and users have been meeting to discuss the latest trends and developments in conferences, workshops and industry seminars and to learn about examples of best practice. The IFF Science Days have evolved into a vibrant meeting point for the institute’s clients, partners and friends at the interface between business and research. New ideas are conjointly developed and projects are successfully initiated.

Two international conferences will be held as part of the 10th IFF Science Days. The conference “Logistics Intelligence in Manufacturing and Transportation” will take up a key focus of research at the Fraunhofer IFF. Given that Central Germany’s is clearly developing into an up-and-coming region of logistics, this is an exciting topic. Prime interests here will be issues of Innovation in Transportation, Logistics in Intelligent Manufacturing and Infrastructures for Intelligent Logistics. Take advantage of this opportunity and learn about such current topics as satellite navigation and energy efficiency in commercial transportation at the conference and in our LogMotionLab.

Picking up the direction of past years, there will also be a conference entitled “Virtual Reality and Augmented Reality for Engineering, Testing and Operating Technical Systems” in 2007. The newly opened Virtual Development and Training Centre VDTC will be integrated in the conference for the first time. Its various VR and AR labs not only provide optimal equipment to explain the potentials of virtual technologies in theory but also to experience them in practice. As in past years, not only researchers, specifically from the ViVERA Network and the INTUITION Network of Excellence, but also experts from enterprises have also been invited to intensify the dialog between research and business.

In addition, working meetings and industry seminars in other fields of work such as service robotics or plant engineering will also be offered.

For more information on the Science Days, the program and online registration forms, visit: www.wissenschaftstage@iff.fraunhofer.de

Wood Logistics: Implementing Practicable Solutions

Together with the Landesforstbetrieb Sachsen-Anhalt, the Fraunhofer IFF organized the workshop “Wood Logistics: Implementing Practicable Solutions”. Key individuals from forestry, the lumber industry and the service sector met at Hundisburg Castle near Haldensleben on April 18. The event focusing on practice emphasized the complete logistics chain from the forest to the factory. Introductory presentations outlined economic backgrounds and effects, research findings and technical concepts. Subsequent presentations presented logistical solutions for the wood processing industry: Lumber accounting, deck management, fleet management and an off-road navigation system are intended to organize operations more efficiently and cut costs in wood logistics. Above all, the practical demonstration aroused great interest among the audience of professionals. The experts were able to see for themselves that the solutions were developed for practice and are optimally suited for use in the wood processing industry.
In order to be able to survive on the market, companies are reliant on outstanding logistics solutions among other things. The Logistics Guest Lecture Series being held for the tenth time will address such continually new challenges. From April 17 through 19, experts will deliver a total of eight lectures on “Logistics as a Field of Work of the Future”. With over 2.6 million jobs, logistics has become the third strongest industry in Germany, achieving record sales of 166 billion euros in 2006.

The industry is booming in Saxony-Anhalt too: “Central Germany has evolved into one of the most important centers of logistics in all of Europe,” asserted Dr. Karl-Heinz Daehre Minister of State Development and Transportation at the opening of the Guest Lecture Series.

The economy is profiting from the region’s strengths: Three well known companies have already relocated their logistics centers from Brussels to Halle-Leipzig Airport. Daehre underscored the value of practically oriented lectures for an excellent education in logistics: “The logistics program in Magdeburg is already in the vanguard throughout Germany. With its first rate speakers from the field, the Guest Lecture Series provides students firsthand insight into corporate thinking and action.”

The Guest Lecture Series is organized by Prof. Michael Schenk (Director of the Fraunhofer IFF and Managing Director of the Institute of Logistics and Material Handling Systems at Otto von Guericke University) in collaboration with Prof. Karl Inderfurth (Holder of the School of Management’s Chair for Production and Logistics) and Prof. Dietrich Ziems (Chairholder at the School of Mechanical Engineering). It is under the patronage of Minister Daehre.

For current information on the Guest Lecture Series, visit www.gvr-log.de.

The conference organizer was Interlogistica, a joint organization of the Fraunhofer IFF in Magdeburg, the Russian Institute of Aviation Systems in Moscow (GosNIIAS) and the National Technical University, Moscow Automobile and Road Technical University (MADI). The conference was held in cooperation with the German Logistics Association (BVL) and was under the patronage of the Russian Federal Agency for Industry (ROSPROM) and the Russian Ministry of Transportation (MinTRANS).

Dr. Karl-Heinz Daehre, Minister of State Development and Transportation at the opening of the Guest Lecture Series. © A.-K. Wassilew

Dr. Karl-Heinz Daehre, Minister of State Development and Transportation at the opening of the Guest Lecture Series. © A.-K. Wassilew

Interlogistica deals with aspects of reliability and quality in the field of logistics. © GosNIIAS

MADI Rector Vjacheslav Prihodko took advantage of the opportunity to invite Fraunhofer Director Michael Schenk to deliver a guest lecture at the renowned research organization. © S. Morozov

The high demands in the aviation and automotive industries are making it particularly important to assure the quality and reliability of logistical operations. Since sites of manufacturing and use are globally distributed, new logistics concepts using state-of-the-art technologies are instrumental in making products and processes reliable.
Deutsche Post World Net has opened its lab for the future, the DHL Innovation Center in Troisdorf near Bonn. The DHL Innovation Center's purpose and mission is to develop new, marketable products with a high level of innovation based on future logistics trends. To this end, the lab for the future unites all the positions that have been working in the concern's technical innovation management under one roof.

Developments from the Fraunhofer Institute for Factory Operation and Automation IFF in Magdeburg are also on board. The Fraunhofer IFF developed its Smart Box together with Deutsche Post World Net. This is an intelligent carrier that can keep an ongoing inventory of its contents, register and document every package loaded and unloaded, be located worldwide through various radio technologies and interact with a control center through integrated telecommunication modules. The Smart Box is intended for the secure transport of valuable goods in international chains of goods.

Researchers from the Fraunhofer IFF have integrated other intelligent transport technology in the Sprinter van’s shelves. The cargo room equipped with RFID antennas continuously monitors the vehicle’s cargo. This is another joint initiative to increase transparency and security for parcel service operation in the future. Along with the Massachusetts Institute of Technology’s (MIT) Logistics Institutes in Boston and Saragossa and other Fraunhofer Institutes, the Fraunhofer IFF is one of DHL Innovation Center’s official R&D partners.

Business innovation partners include IBM, Intel and SAP. Some twenty permanent employees at the Center are working on innovation projects. Employees from the innovation and research partners fill another ten jobs there.

The project with a runtime of twenty-four months will focus on different system architectures for logistics and security applications. Industry is already signaling a general need for a localizing solution that functions inside buildings. Potential fields of application include securing chains of goods, registering pedestrian flows in public buildings and even event logistics.

The project GNSS-INDOOR is being supported by the German Aerospace Center’s Space Agency with funding from the Federal Ministry of Economics and Technology under the project identification number 50 NA 0703.
Lower Saxony and Saxony-Anhalt Cooperate on Galileo

At the Forum for Telematics and Navigation during CeBIT 2007, Lower Saxony Minister of Economics, Labor and Transportation Walter Hirche and Saxony Anhalt Minister of State Development and Transportation Karl-Heinz Daehre discussed cooperation between the federal states of Lower Saxony and Saxony-Anhalt on Galileo. Against the background of Galileo’s prominent significance as the most important joint civil project in Europe, Hirche called for bundling resources related to Galileo in Germany while simultaneously concentrating on core competencies.

As the first concrete collaborative state project, Daehre made mention of the application-based research project Best4City that started at the beginning of the year and is integrated in the state initiative Saxony-Anhalt Galileo Transport. Along with the Fraunhofer Institute for Factory Operation and Automation IFF in Magdeburg heading the consortium, the TU Darmstadt and Lower Saxony’s state initiative SatNav are involved in this project supported by the federal government and the State of Saxony-Anhalt. The project is developing a technically innovative concept for commercial and commercially related transportation based on new interchangeable trailers for 3.5 ton vans.

The increasing number of deliveries as delivery sizes decrease has caused a surge in inner city delivery traffic in recent years. The project is being supported with 180,000 euros from the federal government and 25,000 euros from the State of Saxony-Anhalt. Along with the Fraunhofer IFF heading the consortium, the partners are the TU Darmstadt and GZVB Competence Center GmbH in Braunschweig. This collaboration of research partners from different federal states underscores the project’s national significance.

Agreement on Nationwide Galileo Research Project Signed

On March 8, Minister of Transportation Karl-Heinz Daehre and Fraunhofer IFF Director Michael Schenk signed the agreement on the project Best4City. The objective of the project is to ease inner city traffic in Germany. The project is being supported with 180,000 euros from the federal government and 25,000 euros from the State of Saxony-Anhalt. Along with the Fraunhofer IFF heading the consortium, the partners are the TU Darmstadt and GZVB Competence Center GmbH in Braunschweig. This collaboration of research partners from different federal states underscores the project’s national significance.

During the forum, Daehre presented a three-stage concept aimed at developing a core Galileo competence specializing in transportation and logistics in Saxony-Anhalt. The Saxony-Anhalt Ministry of State Development and Transportation will be in charge of overseeing this project and has already budgeted funds for it.

The increasing number of deliveries as delivery sizes decrease has caused a surge in inner city delivery traffic in recent years. The project Best4City will investigate how IT based organizational and technical measures from a new concept for interchangeable trailers can contribute to organizing commercial transportation to be city friendly. To this end, Galileo’s precise position finding will be combined with RFID technology to increase capacity utilization of vehicles, schedule routes optimally and improve navigation.
Fraunhofer IFF Presents RFID Innovation at Industry Highlight

At the BVL’s 23rd German Logistics Congress, the Fraunhofer IFF presented an RFID system that operates dependably even in unfavorable metallic environments. Many companies are already using RFID technology effectively, yet until now it reached its limits in liquids and metallic environments. The researchers at the Fraunhofer IFF have managed to overcome this obstacle. Consequently, RFID technology can finally be used in many container and transport systems and the new system considerably extends the feasibility of RFID. Director Michael Schenk asserts, “With this method, we have taken a crucial step toward organizing international chains of goods more securely, reliably and efficiently. With this reliable RFID system for metallic environments, we are providing a solution relevant for many industries.”

In particular, the chemical, pharmaceutical and beverage industries as well as the automotive and aircraft industries will profit from the newly developed possibilities.

The new system’s UHF unit was designed in such a way that the metal box, which previously was a source of interference, now has a positive effect on the read process. Tests with full metal beverage cans and plastic bottles ran positively.

For over ten years, the Fraunhofer IFF has been demonstrating its competence in the development of RFID systems. It focuses on industrial applications in the manufacturing environment and for the security and reliability of international chains of goods. With its LogMotionLab, the institute has one of the best equipped RFID labs. Years of experience developing, testing and certifying Auto-ID and telematic technologies have already produced several patents. The LogMotionLab is the ideal partner for industry and SME clients implementing RFID projects.

IFF with RFID Solutions at LogiMAT

LogiMAT International Trade Fair for Distribution, Materials Handling and Information Flow was held in Stuttgart from February 13 through 15. Researchers from the Fraunhofer IFF presented an RFID order picking table and container management for industrial use.

The researchers integrated an RFID reader in the Fraunhofer IFF order picking table and created an interface to corporate software that forwards picking orders to employees. Since all the items are tagged with an RFID chip, they are automatically identified when placed on the table. As soon as an order has been picked, a light system signals the status to the employee and the software receives acknowledgement of the completion of the order.

In addition, IFF researchers presented an RFID container management system designed for self-contained logistics cycles using reusable containers. The system’s decisive advantages are the rewriteability of the data storage medium and the distributed provision of information directly on an object.
From Biomass to Fuel Cells

The Max Planck and Fraunhofer institutes have commenced work on a joint project in Magdeburg.

Fuel cells predominantly run with hydrogen. In the future, biomass will increasingly be employed as the base material, thus replacing the fossil fuels used now. In the new research project "ProBio", researchers from Magdeburg and Dresden are investigating how renewable raw materials can be used effectively and environmentally compatibly to generate power.

To construct a semi-industrial pilot plant later, the experts are now researching the optimal combination of the individual processes. The gasification of biomass such as wood or straw produces hydrogen-rich fuel gases. Before they can be fed to a fuel cell, they must be treated and cleaned in special processes. The Fraunhofer Institute for Factory Operation and Automation IFF in Magdeburg will be developing these processes for "ProBio" on the basis of fluidized bed technology. The possibility of flexibly using the fuel gas in more than just fuel cells is particularly noteworthy. Thus, for example, it can also be used in furnaces to provide heat or in gas engines to generate power. The researchers at the Fraunhofer Institute for Ceramic Technologies and Systems IKTS in Dresden are working on using this fuel gas in a high temperature fuel cell. Parallel to this, the Max Planck Institute for Dynamics of Complex Technical Systems is investigating how fuel gases can be used in low temperature fuel cells after novel gas cleaning processes. The fuels cells convert chemically stored energy directly into electrical energy. This process can achieve considerably higher power efficiencies than conventional power plant technologies can.

What is more, the findings from all the partners' experiments will converge at the Max Planck Institute. Researchers at the Max Planck Institute will use them as the basis for a complex simulation of the complete plant.

When the first phase has been evaluated positively, a second, three year phase of research will follow. The theoretical and experimental findings will go into constructing and operating a semi-industrial pilot plant. The three institutes in Magdeburg involved will share responsibility for its construction and operation. The process industry in Germany desperately needs such plants because the energy sector is developing at a rapid tempo.

As part of this research and innovation pact, both the Max Planck Society and the Fraunhofer-Gesellschaft have announced they will be intensifying their varied collaborative activities. By closely linking basic and applied research, these research organizations intend for their joint projects to accelerate innovation processes. "ProBio" is one of their first projects being started in all of Germany.

International Cooperation on Biomass Utilization

The conference “Perspective 2007-2013” was held in Valencia, Spain on February 23, 2007. The conference is based on the interregional cooperation initiative Interreg IIIC and is being supported by the EU. The forward looking project “Interregional Coopera- tion on Biomass Utilization” was also presented along with other projects. The Fraunhofer IFF is in charge of the collaborative partnership that includes the College of Nyiregyhaza (Hungary) and the Valencia and Aidima Chambers of Commerce (Spain). The objective is to prepare and hold a transregional forum on the development and utilization of biomass in Nyiregyhaza in November of 2007. Energy from biomass is already being widely utilized in Saxony-Anhalt and Valencia. Other comparable regions still need to catch up. Innovative services and practical applications for sustainable biomass utilization will be presented to these regions. Logistics and energy conversion will be significant topics.

As resources grow scarce and prices of raw materials rise, biomass is becoming tremendously important a source of renewable energy. © Fraunhofer IFF
Saxony-Anhalt Presents Itself at transport logistic China

Asia’s most important transportation and logistics trade fair is “transport logistic China” in Shanghai and attended by numerous German exhibitors. Federal Minister of Transport Wolfgang Tiefensee was also there and visited, among others, the joint stand of the exhibitors from Saxony-Anhalt where Magdeburger Hafen GmbH, Kranbau Köthen GmbH and the Fraunhofer IFF were presenting. The researchers from Magdeburg presented themselves as practically oriented research partners. International visitors from over eighty countries learned about the institute’s competence and years of experience as a developer of intelligent logistics solutions.

RFID in Maintenance

The Forum Vision Instandhaltung FVI initiated cooperation between leading institutions from all of Germany to advance the utilization of RFID technology in maintenance. The Fraunhofer Institutes IFF in Magdeburg and IML in Dortmund, the VDI Society for Production Engineering (ADB) and the FVI are working on making current RFID technology operational. The researchers at the two Fraunhofer Institutes are making their latest research findings available, the users from FVI are contributing experiences and user requirements. State-of-the-art solutions are intended to benefit medium-sized enterprises in particular. In 1999, the Fraunhofer IFF already developed a system with which AIRBUS monitors and coordinates the use of various airlines’ tools worldwide.

The Fraunhofer IFF developed the “memory motor” together with VEM motors GmbH. An RFID chip directly in the motor’s housing makes it possible to store all the data needed for maintenance directly on an object.

With its LogMotionLab, the Fraunhofer IFF in Magdeburg has one of Europe’s best equipped RFID and telematics labs to develop new RFID applications. Logistics processes are organized more reliably and more transparently. Logistics operations can be tested virtually at the VDTC before being put into practice. The Fraunhofer IML has developed recognized competence in maintenance in many years of cooperation with the Department of Factory Organization at the University of Dortmund.

For over forty years, the VDI has been disseminating practicable solutions for maintenance in its Administrative Committee Maintenance.

As the maintenance providers’ network, FVI intends to bring researchers and practitioners into dialog. Knowledge and experience will be bundled in the network and made available to industry.

What is more, maintenance providers will use the maintenance integration platform (IPIH) on the Internet.
European Innovation Support: New Opportunities for SME

Small and medium-sized enterprises (SME) are the dynamo of the European economy. In Europe, SME provide 58% of the jobs in the processing industry and produce 75% of all export goods.

Despite their major economic importance, SME have had unusual difficulty successfully accessing European funding for research. Small businesses’ lack of knowledge about the funding system and the EU’s sizeable bureaucratic obstacles can doom a proposal. This is where the project smE-MPOWER headed by the Fraunhofer IFF helps. It professionally supports SME when they are submitting proposals, from the initial idea up through the concrete research project. The project has brought together partners from ten European countries and is being supported by the European Commission.

World Class Launch: Producing Automobiles More Successfully

Against the background of fast paced market and technology dynamics in the automotive sector, effectively and efficiently developing new innovative products is becoming a crucial competitive factor for sustainably effective corporate development. Hardly a company in the automotive industry has the requisite comprehensive, cross-company knowledge about strategies, processes and methods for excellent services along the entire value added chain.

World Class Launch establishes the foundation for continuing studies that will be thematically oriented toward automotive value added chains and identify methods to increase effectiveness and efficiency based on analyses of best practice.

Electron Beam Welding Innovation Forum

More than 230 experts from all over Germany gathered at the Innovation Forum “Electron Beam Technology in Mechanical and Apparatus Engineering” on March 7 and 8. Detlef Schubert State Secretary at the Saxony-Anhalt Ministry of Economics and Labor welcomed the attendees in Burg with an optimistic message: “Magdeburg and the surrounding region of the Jerichower Land have had a unique tradition in mechanical and plant engineering in Germany for one hundred years. We are again a land of engineers whose knowledge and creativity is creating the technologies of tomorrow.”

With its large chamber electron beam welding system, pro-beam AG & Co.KGaA has the world’s largest civilian vacuum electron beam welding system and is significantly contributing to the region’s innovation potential. On an excursion to Magdeburg, the attendees experienced another, world-wide one-of-a-kind technological highlight: The laser projection at the Virtual Development and Training Centre VDTC where virtual development and training methods and applications are being researched.

Minister of Finance Steinbrück at the VDTC

On April 17, Federal Minister of Finance Peer Steinbrück visited the VDTC in Magdeburg. Director Prof. Michael Schenk and Deputy Director Dr. Gerhard Müller showed Steinbrück around the Elbe Dom and other labs for virtual reality and process and plant engineering. Afterward, the minister spoke there with representatives from business and research. In a roundtable discussion, Steinbrück took advantage of the informal visit to get a picture of business and research in Magdeburg.
There are several good reasons for this: Since additional takeoff and landing capacities were needed and political decisions made an expansion of the hub in Brussels impossible, this meant finding a new location, a location that in the long run guarantees planning certainty, traffic laws and twenty-four hour operation seven days a week without restriction. Following intensive analyses, it became clear that Leipzig/Halle is most attractive.

A decisive argument for Leipzig/Halle is its central geographic location and its first rate transportation links. The heart is Leipzig/Halle Airport that will be expanded by 2008 and have two take-off and landing runways independent of one another and fully utilizable for intercontinental transportation. It will enable every express freight airline and its customers to use the airport around the clock without restrictions.

What is more, the combination of air, road and rail routes opens sizeable room to maneuver and logistical opportunities. Situated at the intersection of two Autobahn axes (Berlin-Munich and Dresden-Magdeburg), Leipzig has its own freight handling facility (GVZ) equipped with a high capacity terminal for combined rail and road transportation.

The excellent transportation links are one thing. What is more, the Leipzig/Halle hub provides ideal conditions to further expand the airfreight business in Central and Eastern Europe because of its excellent proximity to these growth markets. The eastward expansion of the EU has moved this region to the center of the European economic area.

In addition, there are public authorities and political institutions working quickly and effectively and, not least, an excellent pool of dedicated workers. Our collaboration with the employment agencies, placement agencies and especially Leuna Educational Academy to recruit employees is excellent.

What in your opinion is necessary for Central Germany to be able to further position itself as an international logistics hub?

After more than two years of construction work on the DHL Leipzig/Halle airfreight hub, one can say that Deutsche Post World Net’s decision for Leipzig/Halle was right. Every expectation of the region, its public authorities and the residents has been met. The region has a great future ahead of it as a logistics hub if the state governments, districts and cities and communities’ interstate collaboration continues. We will have to act in concert in the world.

The infrastructure around the airport is excellent. This is a competitive edge in the region. However, there’s no denying that rail transport still needs to catch up to the relations of Leipzig/Halle-Erfurt-Frankfurt/Main and Leipzig/Halle-Kassel. This means quickly connecting the express and logistics hub Leipzig/Halle with the hubs in Frankfurt/Main and Kassel both by road and rail in order to fly as little express cargo as possible. A trimodal hub must be the goal.
DHL is constructing a new hub in Leipzig. What are the particular challenges of such a large scale project?

At present, construction of the DHL airfreight hub is Deutsche Post World Net’s largest building project worldwide. The dimension of the project and its implementation in short time require stringent planning and implementation mechanisms and a team of committed employees geared toward success. What is more, the Deutsche Post Bauen GmbH is a builder that is progressing with the building project very rigorously.

Apart from the construction work, one important and major field is the selection and qualification of personnel suited for the widest variety of activities and requirements in the express and logistics business. The spectrum ranges from simple jobs as a sorter or forklift operator up through highly qualified work as an aircraft mechanic or pilot. We have, for example, at present more than 46,000 applications for one job at DHL. When conditions are equal, applicants from the region around the airport have better chances of being considered.

As of mid 2007, there will be a test and trial phase in which we put both the technology and its interaction with people to the test. This is so important to us because the start of operations in 2008 will present us with great challenges. We intend to bring our hub online without difficulties, without customers even noticing. That is our aspiration and likewise our ambition.

Flows of goods are growing ever smaller in volume. Customer demands regarding delivery times and delivery dependability are mounting. What concepts is DHL using to meet these challenges?

Smaller delivery quantities and unconditional observance of delivery dates are only a part of what customers are demanding today. Just providing this would already be too little. In other words: This is just as standard as shipment tracking on the Internet. Above all, customers want to be served from one source and are ever more frequently looking for a service provider who provides them one source solutions to their problems – and does so worldwide. Our palette ranges from pure transport of shipments of every size and class up through jobs such as warehousing, customs clearance, storage, collection and billing. This holistic and integrative approach satisfies customers today.

What role do research and innovation play here?

A large one – above all wherever unnecessary transports ought to be eliminated, energy consumption cut and stress on humans and the environment reduced. Forecasts of traffic increases also and precisely in commercial transport in conjunction with a growing scarcity of resources is compelling us to think about bundling, selecting the right route and suchlike. The key to successful logistics concepts of the future lies here.

The DHL hub in Leipzig intends to participate in the technology platform MIDAS. The objective of MIDAS is to provide new technology-based logistics solutions that enhance intermodality and low-traffic logistics. Would you let us in on the innovative RFID and telematic services planned for the Leipzig location?

We are implementing a trimodal handling hub in Leipzig/Halle and intend to intelligently combine air, road and rail carriers. Precisely in such a traffic intensive hub, this means eliminating every unnecessary transport. Naturally, we are also banking on other innovations such as electronic ramp handling support. Last but not least, our sorting system is a significant innovation since it allows extreme flexibility when sorting and thus effectively bundling the trans-

Ported volumes. With over 200,000 shipments being sorted and forwarded every day, RFID is not yet a big topic for us however. The sorting system is designed in such a way that it is capable of this too.

Michael Reinboth, born on February 11, 1953 in Walkenried in the Harz region

1971
Starts working for the Deutsche Bundespost, responsible for various jobs: Programming and application planning for diverse projects, organization of budgeting, delivery, management of operations in Heilbronn post office.

1991
Collaborates on “Eastern Development” in Halle regional office.

1993
Project manager “Development of a New Freight Concept”

1994
Branch manager of Leipzig parcel center

1997
President of Post headquarters in Halle

1999
Manager of the North-East Region of parcel post in Germany

2003
Manager of Parcel Operations at the headquarters in Bonn, member of DHL Express Germany’s regional board

Since January 2005
DHL Airfreight Hub Europe project manager
Reliability in the Supply Chain

Dr. Klaus Richter

The business of logistics is sensitive, time critical and susceptible to disruptions. Special services such as same day logistics and emergency logistics close the gap between logistics service providers’ standardized core processes and customers’ special demands. Reasons for the growth of these “special services” lie in general trends of globalization and outsourcing, in ever narrower cycles set for manufacturing chains and in the trend toward smaller shipping units.
Many and diverse value added services are offered for the courier, express and parcel services sector, which, given the specifics of the particular goods, specify different requirements for personnel, technology and underlying infrastructure. For instance, special safety requirements in compliance with IATA aviation transport and ADR road transport regulations apply to hazardous goods. The challenge with temperature sensitive goods is transporting them with a consistently constant temperature. Perishable goods such as food and plants must also be handled with special care. This holds equally true for the transport of living animals. By contrast, using sophisticated security transports to protect goods is a priority for valuable cargo and goods threatened by theft such as electronics. Along with transporting the goods, transmitting the required information represents a great challenge. Recipients want an exact delivery time and information about potential delays as early as possible before goods arrive. When goods are sensitive, both the shipper and the recipient have an increased interest in completely documenting the progression of the transport and processing the transport in accordance with regulations. Therefore, every change in the means of transport not only represents an additional challenge for the physical transport of the goods but also for the upstream, accompanying and downstream information flows.

From the perspective of information transmission in multimodal transportation, differences in the individuals and objects operating between accompanied and unaccompanied combined transportation have to be taken into account. While, when transportation is accompanied, a driver oversees the transport of the carrier of goods the entire time and consequently can function as a communication interface, when transportation is unaccompanied, the means of transportation and when necessary the carrier are swapped repeatedly for one shipment. In this respect, the management of information on the identity, current position and condition of goods, loading equipment and means of transportation as well as the near real-time availability of this data in material planning systems assumes a central role in the unaccompanied transportation of goods.

According to DHL Danzas Air & Ocean and Lufthansa Cargo’s joint venture LifeConEx, studies have revealed that forty-seven percent of all complaints related to the transport of life science products are due to nonfunctioning processes at airports. A need to better train ground personnel and familiarize them with the special requirements of temperature-controlled shipments can be inferred from this.

In 2005, the Institute for Mobility Research ifmo outlined scenarios for the development of passenger and commercial transportation in 2025. Some of these relate to the transport of small volume, valuable goods:
- The value of the transported goods steadily increases from West to East and at airports,
- Goods easily turned into cash are vulnerable to criminal assaults,
- Valuable goods are carried in partial shipments as a concealed transport,
- Localization and communication technologies facilitate tracking shipments on sublevels,
- Modular systems enable loading a commercial transport individually for the shipper,
- Intermodal transportation uses standardized container variants for smaller shipment sizes,
- Value added services are subject to continuous monitoring,
- Routing information is based on information customized for a driver.

**MIDAS Logistics Platform**

In order to utilize new technologies to further consolidate Germany’s leading position in the logistics sector, the Fraunhofer Institute for Factory Operation and Automation IFF in Magdeburg initiated an application and industry-specific platform for logistics with MIDAS. The objective of MIDAS (Central German Logistics’ Development, Testing, Transfer and Marketing Platform, Especially Incorporating Telematic Services Supported by Galileo) is to initiate and provide new technology-based logistics solutions to improve intermodality and “low-traffic” logistics. The solutions are essentially defined by intelligent logistics assets and person-borne mobile business devices.

The unique feature of MIDAS is the availability of real, productive test environments in logistics nodes that reproduce the later operating conditions of new technologies. The potential to perform tests in the productive environment reflects the solution’s unique capability of testing prototypes under load. This distinguishes MIDAS from lab research. Consistently integrating partners to reproduce integrated, intermodal supply chains in the phases of engineering, construction and operation ensures MIDAS will achieve its ambitious goals.
The focus on Central Germany is a response to special logistics requirements of handling small volume, valuable goods the growing Eastern European transportation and the environs of Halle-Leipzig Airport will generate. The MIDAS logistics platforms can fall back on traffic management data and high-tech traffic infrastructures such as the Central German Loop.

**Intelligent Carriers**

The intelligent carrier is the technological model for tracking shipments on sublevels. Intelligent carriers are reusable containers with RFID antenna structures and an autonomous power supply. Assets furnished with RFID labels are automatically identified when they are put in or taken out and the contents of the container is logged for the purpose of a running inventory. Access systems with card readers can monitor access to the goods. A GSM module sends the intelligent carrier’s position and every access operation to a control center. The electronics are normally installed in an intermediate floor.

Since 2004, the Fraunhofer IFF Magdeburg has been continuously performing functional tests with intelligent carriers by employing prototypes and feasibility studies to demonstrate for a client or project a particular technical principle of RFID monitoring and the transmission of events and status information to a control center. This is done at the RFID and telematics lab LogMotionLab, which houses the latest technologies in these fields and its own shop for prototype construction (www.logmotionlab.de).

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The intelligent carrier as a guiding model for intermodal transportation.
The DHL Innovation Center in Troisdorf near Bonn is already developing the logistics solutions of tomorrow.

Working together with business partners from the technology sector and institutes of higher education, our logistics experts are using their inventiveness to come up with innovative ideas. Whether it’s robots that can unload containers or microchips that can provide information about the location and status of an order at any time, our developers are constantly searching for new opportunities to get your delivery to its destination more quickly and easily than ever before. The future is already here: www.dhl-innovation.de
LogMotionLab tests and neutrally evaluates the practicability of RFID technologies for specific company processes. The lab considers itself a service facility for enterprises, providing every client customized RFID and telematic solutions to optimize logistics processes. Apart from the extensive equipment at its Magdeburg location, the lab’s mobile components allow functional tests at clients’ facilities under real operational conditions. In addition to RFID, LogMotionLab tests and develops other Auto-ID and telematic technologies and components. Driven by increasing globalization, the integration of satellite navigation technologies and services is growing increasingly important in this context.

Extensive investments in different testing and measurement technology will make it possible to perform more detailed and more precise tests of the functionality of RFID components in LogMotionLab in the future and obtain better results in this field. Targeted investments have also made it possible to successfully get more deeply involved in the development of individual, customized logistics solutions.
Accelerated advances in RFID, sensor and telematic technologies necessitate constantly keeping the LogMotionLab up-to-date technologically. Only when can existing and new technical solutions coming out of the LogMotionLab be successfully established as advanced pilot solutions. External feedback has demonstrated that the combination of RFID, sensor and telematic technologies in particular and their integration in standardized complete solutions are steadily attracting more customer interest. The continually increasing diversification of target markets is making it necessary to develop customized new products and services and act on the market as a system supplier. Rapid and cost-effective development based on existing solutions is particularly important, yet is upgraded with additional services in the fields of RFID, sensor and telematic technologies.

**Secure Chains of Goods and Technology Applications in Difficult Environments**

The LogMotionLab’s developments fall under two major headings: On the one hand “secure chains of goods” and on the other hand the integration of RFID technology in technically difficult environments.

The issues surrounding secure chains of goods involve various characteristics of active and passive RFID technology and satellite-supported telematic solutions in equal measure. This thematic complex also encompasses LogMotionLab’s developments in indoor localization based on different radio technologies and the development of integrated sensor technologies. Other stages of development are building upon the developments for the Smart Box equipped to continuously monitor its contents with different RFID, sensor, GSM and telematic technology. Thus, there are already developments that introduce technical components in flexible structures to facilitate continuously monitoring goods and items in transport containers that do not have to have a specifically stipulated shape or size. This is a crucial advantage because empty containers can be used for return transport, thus saving space and resources. Another line of development for logistics services involves no longer monitoring individual assets in the future but rather recording and evaluating the overall quality of transports. To do so, the technical solution was miniaturized in several steps. In the meantime, a level of development has been reached which allows simply adding such devices to a transport. The data recorded is collected and evaluated centrally. If such Auto-ID solutions are linked with routing and navigation applications, routing and monitoring of individual transports can be executed automatically and intelligently.

The second emphasis of work at the LogMotionLab is the integration of RFID technology in technically difficult environments, which particularly treats metallic environments in industrial applications. The foundations already developed a few years ago are now being reverted to to support transferring these findings to new frequency ranges too. One example is the “Alubox” solution developed in 2006, which, with a frequency of 868 MHz, enables a nearly 100% read rate in metallic environments. This development is considered the basis for transferring this solution to industrial environments to achieve a nearly 100% read rate even when identifying difficult packaging.

Expansion to various locations in Magdeburg is planned in the course of developing LogMotionLab because, on the one hand, space is needed for the individual fields of development and, on the other hand, new fields of activity, specifically locating technologies, to be integrated in LogMotionLab make expansion to different sites urgently necessary. Attention will be particularly paid to integrating satellite, radio-based and optical position finding technologies. These invest-
State-of-the-art data acquisition systems based on RFID and locating technology frequently deliver very substantial quantities of data with which neither party concerned – computer scientists and logisticians – feels happy. The computer scientists do not know what to use the data for and the logisticians ask themselves “What do we, the expediters and managers, have from this data?” The basis is still lacking for a theoretical model that facilitates effective dialog between computer scientists and logisticians when they are designing and implementing real-time systems. LogModelLab, a joint lab of the Fraunhofer IFF and Otto von Guericke University’s Institute of Logistics and Material Handling Systems, is able to establish this basis. The prerequisite to doing so is having both parties view the temporal aspects of processes being observed and analyzed from an event-oriented perspective and the spatial aspects from an object-oriented perspective.
Early warning systems are a special kind of information system aimed at advance detection of future developments and events with significance for a company, i.e. before any damage occurs. This creates the capability to apply preventive measures to anticipate such (normally negative) developments. Rapid early warning generates a forecast of the development of a system’s key data for a specified period (one hour, one day, etc.). An early warning system uses process concomitant simulation models to reproduce a real system’s processes at cyclical intervals for a brief forecast period. The system’s real-time data is utilized to initiate the model. When selected state variables of the model exceed specified limit values in the simulation, then the appropriate measures must be put forth by the early warning system and in turn evaluated by means of simulation.

Independent of the class of the real-time system, a logistician analyzing a process must primarily be well able to imagine the (physical or abstract) objects to which the analysis applies. About WHAT does the logistician want to know something? This is not a trivial question since most logistical objects of analysis (simply objects below) are freely definable abstract objects. The so-called object-oriented approach can support an analyst above all in the phase of defining pertinent object classes. The so-called event-oriented approach is needed to be able to exactly imagine what is actually a state, an event or a situation.
Analysis: What possibilities does the existing data acquisition system provide to interpret processes in the material handling system?

Synthesis: What data has to be acquired where so that processes in the material handling system can be interpreted as desired?

LogModelLab
LogModelLab is jointly operated by the Fraunhofer IFF Magdeburg and Otto von Guericke University Magdeburg’s Institute of Logistics and Material Handling Systems (ILM) and closely cooperates with LogMotion-Lab, a development, testing and certification lab for RFID and telematic technologies. LogModelLab’s primary objective is to develop and test novel methods to model and interpret real-time logistics data flows. The lab is a collection of tools for the detailed modeling of both elements of every concrete real-time logistics system: A spatially distributed material handling system including data acquisition and a logistics control center that interprets the captured data (see diagram on p. 25). Two problems related to a modeled real-time logistics system can be formulated and resolved:

– Analysis: What possibilities does the existing data acquisition system provide to interpret processes in the material handling system?

– Synthesis: What data has to be acquired where so that processes in the material handling system can be interpreted as desired?

LogModelLab’s software components can be divided in three groups. The group “Generation of Real-time Data Flows” encompasses simulation models that reproduce the functioning of a data acquisition system. Data flows can be generated in a standardized format either specifically for RFID or readable for people. The other software components form the group “Conversion and Storage of Monitored Information”, also often called middleware. A real-time database acts as a storage medium for the primary protocol data, temporarily stored in a standardized format. As long as the monitored information remains in the database, it can be directly interpreted in an online mode.

Monitored information is simultaneously forwarded to the data warehouse where it is converted into virtual protocols, stored for a longer time and made available for all potential offline interpretations.

Among others, the following types of online data interpretation are possible for work in the monitoring mode:

– Visualization of moving objects’ changes of position

– Visualization of state variables (e.g. inventory levels)

– Recognition of predefined situations

The following analysis jobs are part of offline interpretation of data stored as protocols:

– Calculation of freely definable key data

– Retrospective analysis of captured processes including recognition of freely definable situations

– Preparation and running of selected animations

Real-time logistics processes can be analyzed by means of abstract network models. © S. Franke
The primary goal of experimenting with LogModelLab is to quickly and vividly demonstrate a real-time system to potential users, which would provide new possibilities for the analysis and control of processes in their network if implemented.

Demonstration experiments can be based on reference models supplied by the lab’s operator. Naturally, a new simulation model based on a client’s demands, which fully incorporates the distinctive features of the client’s logistics system, must be developed for every concrete application.

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Capturing and interpreting real-time logistics data flows.
By now it is common knowledge that manufacturing enterprises have to be globally oriented to be successful. This present day requirement frequently has familiar consequences: diminished depth of value added, increased intransparency of supplier networks and increased complexity of processes. Logistics – whether interlogistics or intralogistics – is one of the key factors. It must withstand changes and intelligently grow with them. Yet are today’s methods sufficient to react to such changes appropriately in the context of planning supply chains and their logistics processes? Are not methods that proactively identify potential problems during logistics planning and send a planner a signal of potential risks needed instead?

Commercially available, monolithic and functionally oriented planning systems do not satisfy requirements. Very few are proactive and even supply chain event management systems only react to predefined events in the supply chain after they have already occurred. Earlier, strategic identification of a risk during planning and thus its elimination before it occurs would be better than operative monitoring.
Current solutions and methods used when planning decisions about altering supplier relationships, especially with regard to future location and network structure, are usually solely based on — relatively elaborate — business management approaches and are consequently too limited. Assessments of suppliers in the narrower sense also primarily focus on financial evaluations and on quality and product features a supplier has to provide. A risk assessment for logistical purposes, which allows for the potential supplier’s supply network, is lacking.

As a result, either logistical risks remain undetected or even identifiable logistical risks are scarcely or only financially incorporated in any analysis and evaluation of a situation.

There is not enough transparency to assess the impact of logistical risks in a system. Supplier-customer relationships have in the meantime become too complex to be able to provide clear information about them. The increasing division of labor in the economy is fostering this trend. As a result, companies are again finding themselves in a situation in which the impacts of corporate decisions on cross-company logistics processes can only be evaluated to a limited extent and statically.

The practical challenges define the requirements of scientifically developing new planning aids and concepts. The goal is not to merely evaluate logistical risks financially but also, as regards logistical indicators such as delivery reliability or capability, to operationalize risks in a suitable form. The new methods to be created to adaptively plan and evaluate logistics systems will have to be quickly and situationally applicable and support easy integration of data and management knowledge to facilitate the generation of interactive decision scenarios. They will have to be designed to be suitable for SME as well as easily and quickly implementable and applicable.

The Fraunhofer IFF is also pursuing this approach in its research project LogRisk. With support from the state of Saxony-Anhalt, a tool-aided methodology is being developed for risk assessment in manufacturing and supplier networks. The tool environment will integrate a data model to logistically design a manufacturing and supplier network and an approach to evaluating logistical risks based on FMEA. Combining logistical variables of evaluation and logistically quantified risks enables employing the methodology to already identify and evaluate logistical risks in the phase of strategic-tactical supplier network planning. Existing data, probability distributions and experts’ know-how can be used to parameterize the model.

Thus, responsible planners or managers can be sensitized to potential logistical difficulties in a supply chain since they obtain information on a network’s potential logistical performance, risks and critical paths at an early stage in the planning process. Furthermore, they can define different planning scenarios that compare impacts in an evaluation and use this as the basis to define measures or reconcentrate the focus of planning work on selected trouble spots in the network.

This enables companies to perform risk assessments of their supplier relationships, act to minimize risks and evaluate corporate decisions.

The aforementioned developments in the field will increasingly affect small and medium-sized German enterprises in particular. Specifically, those enterprises being integrated in European and global company networks will increasingly have to scrutinize their own supplier relationships but also be dependable partners for their customers. Identifying logistical risks in the supplier chain at an early stage and resolving their own difficulties proactively with their customers will become particularly important in the future.

The project LogRisk is making a key contribution to critically examining existing planning and implementation and to identifying potentials and risks in advance of relocating production facilities and changing a production program long-term. The development of a methodology for logistical risk assessment of industrial supplier networks is intended to create a future capability to take action in logistical corporate relationships at an early stage to control them. Consequently, reorganizations of company networks can be evaluated for logistical purposes and logistical risks can be reacted to appropriately. Only a changeover of present day systems to the modular, process-oriented solutions expected in several years will establish a better basis to meet these requirements. Yet even then, new methodological approaches to identification and evaluation will be needed. It is essential to develop them today.

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A Layout Option for Factories:
Focusing on Engineering Flexible Manufacturing Structures

Holger Seidel and Rolf Walter

No other product has had such an impact on society over the last decades as the automobile. Whether as a means of transportation or a status symbol, a car is always - consciously or unconsciously - associated with individual and flexible mobility. Moreover, customers have widely varying ideas about the functionalities and requirements they expect a vehicle to have and satisfy. Hence, carmakers (OEM) are confronted by constantly varying needs to which they have to react specifically for each customer. In addition, trends (e.g. new technologies, work time models) and legal regulations (e.g. emissions regulations, the scrap vehicle ordinance) that fundamentally impact general competition also have to be considered. In order to be able to operate successfully, companies must establish market-specific structures that ensure manufacturing is flexible yet stable. Against this background, factory planning has the task of reintegrating flexibility in the existing structural and operational organization and allowing for this in future plans right from the start. How can this be done though? Above all, how much flexibility is feasible and what costs does it incur?
The carmaker’s vision is to develop a standardized factory in which all vehicle classes and variants equipped differently can be manufactured on one production line in an unrestricted product mix and, where potentially necessary, process can be adapted (without requiring much time for conversion) without problems. Realizing this vision is anything but trivial: A factory constitutes a complex system of various trades and processes, which affect each other interdisciplinarily or are intensely interdependent. Hence, it is nearly impossible for factory planning to holistically consider all the specifics relevant for planning without aids. This is why factory planning requires specific methods and tools that not only enable interdisciplinarily treating the various factory elements and incorporating internal and external influences but also quantitatively and qualitatively evaluating the generated solutions at an early stage.

One of these specific tools is the Virtual Development and Training (VDT) platform developed by the Fraunhofer IFF in years of work. The platform enables creating and simulating realistic digital models and consequently provides support throughout the entire product life cycle. The VDT platform can thus reproduce a factory and its processes and resources two and three-dimensionally. Should the input information (e.g., products, processes, requirements) change however, adapting a particular model requires great effort. To organize this process more efficiently, possibilities to partially or completely automate adaptation and to develop the tools needed to do so were sought in cooperation with a German automaker.

The starting point was the manufacturing process in the automotive industry. This process was segmented into the areas of press shop, bodywork, paint shop and assembly. Owing to this segmentation, the areas could be considered in detail virtually independently from one another. In order to reduce the level of complexity, the analysis was solely based on the main assemblies. In addition, the product line and the requisite daily output for the factory and the manufacturing process were specified in advance. Taking these premises, the relevant vehicle structures and manufacturing technologies were analyzed. This analysis served as the basis for investigating and mapping the influences and effects of trends and new requirements on the existing manufacturing process.

Scenario techniques were drawn on to represent the influences. These enable detailed mapping of the various influences and effects on the particular products and processes. Here too, the scope of the treatment was initially limited to three scenarios. Scenario 1 encompassed present day vehicle manufacturing. Scenario 2 focused the reduction of value added depth and the re-lated reduction of internal manufacturing processes at the company. Scenario 3 analyzed the impacts of an innovation on the product and process structure. The scenarios were digitally re-produced with the Microsoft Project Server (MSPS), which is used as the planning component in this context. The processes are represented with the help of project plans, the requisite resources and boundary conditions being assigned to the individual operations. So that the MSPS can execute the planning, the requisite information, e.g., manufacturing program, the manufacturing sequence and the machine layout strategy, must be entered through an input mask specially generated to do this. The input information is the basis for generating the data needed for the visualization and is transmitted to the VDT platform through an interface, which in turn interprets the results two and three-dimensionally. Users are able to interactively intervene and correct the machine layout.
Users can use the prototype to prepare and compare different factory layouts and plans allowing for diverse influences. The parameters, total area of the factory layout, total machine floor space and degree of space utilization represented by the VDT platform can be referenced to evaluate the layout. Thus, qualitative and quantitative conclusions about areas and costs incurred by flexible manufacturing can be inferred.

This tool will be successively upgraded in follow-up projects. The level of complexity will be raised by reproducing the processes in more detail and the number of scenarios will be increased so that the variety of potential influences can be represented realistically. Layout methods will be implemented in order to be able to more closely analyze the impacts of processes on the overall layout. The visualization also provides a starting point for further development. The development of a feedback loop is planned here so that data can also be retransmitted to the project server. Finally, further indicators will be implemented to increase the informative value of the generated layouts.

This project succeeded in developing a conceptual approach for a planning tool and successfully prototyping it for the automotive industry. The demonstration of the practicability of the developed concept in the automotive sector opens an opportunity to transfer it to other sectors such as mechanical and plant engineering or the aerospace industry.

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Factory planning with virtual reality is no problem in the Elbe Dom, the large projection system at the Fraunhofer IFF Virtual Development and Training Centre VDTC in Magdeburg. Pictured here is an automotive supplier’s manufacturing facility. © V.Kühne
Global expertise in automotive solutions.

Those who think holistically get where they’re headed faster. Therefore, MBtech’s service portfolio is an exact portrayal of full vehicle expertise. As a global engineering and consulting company, we’re your partner for consulting and training as well as developing and testing. You benefit from our proficiency along the entire product creation process and product lifecycle. Whether it’s systems, modules, or components, sub-processes or complete projects: regardless of what we do or which tasks we assume for you, we always focus on the overall results that correspond to your objectives. And we have vast experience producing such results for automakers and automotive suppliers alike. MBtech – interdisciplinary thinkers, flexible doers.
RFID Technology for Maintenance and Materials Management in the Steel Industry

Maintenance and materials management have grown greatly in importance in recent years. Controlling increasingly networked, highly complex and automated production requires similarly oriented and high qualified maintenance. This is the only way companies can maintain their competitiveness since maintenance and materials management determine approximately forty percent of a company’s costs today. Consequently, maintenance is not only a cost factor but also a value adding subprocess that contributes to a company’s competitiveness.
Maintenance always moves into the limelight whenever a system stops unscheduled, a crash occurs, availability is not maintained or schedule and budget are exceeded. Nevertheless, a plant’s smooth functioning is usually assumed. Maintenance and material management have to deal continuously with technical innovations and their consequences. RFID technology has tremendous potential to accelerate and simplify processes, to minimize identification errors and to improve the information basis for an individual company as well as for the entire value added chain. Arcelor Eisenhüttenstadt and the Fraunhofer IFF jointly studied the potential uses of RFID technology in conjunction with mobile data acquisition.

Studies to capture the actual state focused on:

– Recording operational organization in the maintenance and material management units,

– Basic tests of the use of RFID or barcode identification systems and thus definition of the basic conditions and

– Analysis of the tasks defined for mobile data acquisition.

The main goal of implementing RFID is to improve operational organization and internal and external logistics processes. In detail, this means identifying materials, machinery and tools and their technical positions clearly and quickly as well as handling data and information simply, durably and easily. Mobile data acquisition is intended to additionally save time when data is being entered. The scope of analysis covered all the processes in maintenance and materials management as well as inspection and measurement management in the various plants, in the sintering plant and around the blast furnace. The integration of external firms such as suppliers and service providers was also scrutinized.

Taking the actual processes as their starting point, researchers from the Fraunhofer IFF developed RFID conform target processes incorporating the target criteria compiled. The target processes generally described the sequence of processes and the interaction of software solutions. In maintenance for example, the job orders including detailed workflows and instructions for action are downloaded directly onto the mobile device. The download occurs in a range of seconds or minutes depending on the volume of data and the mobile handheld device’s connection (radio, USB, etc.) to the main system. Once the data transcription has concluded, the job order is delivered and the employee can begin with the work. Identification and condition determination on the object can be used to execute the order with checklists or work schedules displayed on the handheld device. Once the work is completed, the worker reports the completion of the work on site on the handheld device. Once every inspection has ended, the inspection job orders are then reported finished by data upload in the main system. Should faults be detected during an inspection, a damage catalog on the handheld device is used to identify and classify the fault, directly allocating it to equipment or a technical position. The related maintenance order can also be created and then activated by uploading the data onto

Arcelor Eisenhüttenstadt GmbH

Arcelor Eisenhüttenstadt GmbH is a successful and highly productive member of the Arcelor Mittal Group, the largest steel company in the world. Founded fifty years ago as Eisenhüttenkombinat Ost, an ironworks with six blast furnaces, today it is a state-of-the-art integrated steel mill with highly mechanized systems and technologies. As the largest center of industrial development in Eastern Brandenburg, it employs approximately 3,000 highly trained workers in the production of pig iron through the finishing of high grade flat steel products.

View of the sintering plant from the blast furnace. © E. Flechtner
Introducing RFID based process optimization requires a progressive approach that covers analysis, system design, object design, implementation, system integration, testing and startup. The actors must be integrated in the development of the overall system. Often, a development team focuses too much on the details of a technical solution rather than on the intended results.

Unquantifiable effects and potentials for savings were also taken into account, e.g.:

- Improving the identification of parts, equipment and materials,
- Tracking useful life,
- Creating a base of data for long range evaluations and fault analyses,
- Reducing process times and handling work,
- Reducing inventory times and inventory work,
- Reducing time underway and searching and incorrect entries,
- Implementing component serialization to organize processes more efficiently,
- Reducing manual identification work and
- Entering inventory in near real-time.
Arcelor Eisenhüttenstadt GmbH and the Fraunhofer IFF successfully completed the first phase of the project together and were thus able to demonstrate the feasibility, cost effectiveness and benefits. Consequently, the prerequisites to company-wide rollout have been established.

The development solution is intended to have the following system features:

- **Interoperability**: Heterogeneous application components will be able to interoperate.

- **System integration**: It can be integrated with cooperating systems.

- **Transaction processes**: Methods are available for data entry, version and variant management and other tasks.

- **Application upgrades**: Software can be modified.

Their experience in the field of process optimization and RFID technologies make the specialists from the Fraunhofer IFF in Magdeburg outstandingly qualified to support such projects from their planning up through their successful implementation.

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Continuous Factory Planning in the Generator Industry

The Fraunhofer IFF is providing Siemens Power Generation support as it optimizes and develops its Erfurt facility.

Thomas Dengler and René Petri

As markets rapidly grow especially in the Asian region, the demand for energy, electrical energy in particular, is also rising. Covering this mounting demand will require a large number of widely differing power plants that use generators to convert kinetic energy into electrical energy. Generators represent an important capital good, now and in the future.
Growing numbers of manufactured items, improved production technologies and changed product specifics make it necessary to continuously adjust production. Hence, Siemens Generatorenwerk in Erfurt must adapt both its technical equipment and the orientation of its processes and infrastructure continuously. The measures necessary to do so include:

- Refurbishing and reconstructing existing equipment and buildings,
- Integrating new equipment in existing structures,
- Expanding production units and
- Modifying the logistics concept inside and outside buildings.

To implement these measures, the Fraunhofer IFF is providing Siemens Power Generation support in part of these necessary tasks. The spectrum of work completed by the Fraunhofer IFF ranges from the preparation of concept studies to rough planning and up through detailed planning of production units and oversight of their implementation. Depending on the type of job, rough and detailed layouts, moving plans (for equipment and accessories), cost and action estimates or schedules have to be prepared. This work was completed in close collaboration both with individuals from the company involved in the project (e.g. technologists, forepersons and workers, media and construction specialists, etc.) and other external partners (e.g. electrical engineers, structural engineers).

Since large dimensions (size and weight) typify the products manufactured in Erfurt, two restrictions essentially governed the work of factory design: floorspace and logistics, i.e. the transport and handling of the products.

Particular requirements of floor bearing capacities or crane lift loads limit the placement of particular manufacturing units in certain floorspace beforehand. Hence, floorspace needed for expansion can often only be created by reorganizing and restructuring space or compressing or moving other manufacturing units. Apart from consultations with individuals inside the company with knowledge about a building’s structure, a structural engineer frequently has to be integrated in planning to verify the suitability of floorspace and to identify limits and potentials.

Logistics plays the second fundamental role in planning work. So that the later connection to overall plant logistics is guaranteed, one of the first and most important jobs in the planning process is capturing the process flows. This is done by analyzing work plans or surveying and discussing new processes with technologists and individuals responsible for manufacturing. In turn, the logistical potentials at the site influence the placement of manufacturing units. Given the products’ dimensions, potential transport routes are largely fixed or can only be changed with unreasonably great time and effort. Hence, planning at the Erfurt site was often done from the perspective of integrating processes in existing floorspace under optimal logistical conditions.

The timeline on the following page demonstrates how Siemens Power Generation continuously has to face these and other challenges at its Erfurt site to ensure the facility continues to develop. The Fraunhofer IFF is providing active support to do so.
Generatorenwerk Erfurt

Generatorenwerk Erfurt has been part of Siemens since 1991 and is integrated in the international manufacturing network Siemens Power Generation.

For over ten years, the Fraunhofer IFF has been supporting Siemens Power Generation at its Erfurt facility as well as the company’s internal manufacturing, warehouse and transport planning teams and infrastructure services in operative and strategic planning work.

A selection of the planning work so far:

1996-1997
Layout and relocation planning for single rod manufacturing

1999
Layout planning for the construction of a complete impregnating plant for generators

2001-2003
Layout survey and updating

2004
Layout planning for the reorganization of preformed coil manufacturing

2005
Concept and layout planning for the integration of a rotor slot milling machine and the related restructuring of manufacturing units

Floorspace development concept for growing numbers of manufactured items

2006
Concept for reorganizing the material warehouse and planning the layout and move of a drying kiln for generators

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Traditionally, machinery and plant manufacturing directly identify materials with manual labeling methods using an edding marker or steel stamp numbers on an object or combining parts with attached labels (metal tags, plastic tags) to allow identification in the different stages of machining. The disadvantage of these methods is their failure to support the automation of identification or information flows. Paper documents and manual keyboard and terminal entries are the order of the day. This is where technologies such as barcode, direct part marking or radio frequency identification (RFID) come in with the goal of increasing identification certainty, enabling the automation of identification and logging processes and preventing media failures.
manage machining and construction processes with broad transparency and high quality. After a detailed analysis of the relevant logistics processes in receiving up through the construction site at a client’s facilities, management and project management were certain that the combination of bar code and RFID would accelerate internal processes and simplify the complexity of part identification. In addition, the internal reorganization project at FAM had to take account of a large percentage of purchased material and equipment and an SAP system implemented for several years in which the new technologies could organize already implemented workflows more efficiently.

Since the logistics chain in the company begins with the receipt of goods, a subproject analyzed the benefits of RFID in the warehouse. The finding was that delivered goods can not always be uniquely identified either because the labels on the goods and delivery documents differ (goods are delivered differently than ordered) or because information such as the FAM order number are missing on the packing slip. In the past, the company printed plaintext warehouse receiving, issuing and shipping labels with which automatic identification is not possible. At present, cost is still an argument against employing RFID data media in logistics, especially when the extensive assortment of parts has to be identified based on customers. Hence, the project resorted to barcode technology (EAN 128) for pure material identification. The advantage is the availability of particular barcode labels to suppliers through an Internet portal and the suppliers ability to print these when shipping so that in the future the materials can be delivered to FAM with barcode labels already applied.

Barcode can likewise support the actual process of reconciling a delivery with an order, the inspection of delivered parts’ quality and their physical storage. Simply scanning the barcode with a mobile terminal decodes the coded information in the barcode and identifies the materials. This is especially important since, as a manufacturer of complex one-of-a-kind systems, FAM only has a few repeat parts and employees must readjust to “unfamiliar” material in every delivery. Barcode scans eliminate involved manual reconciliation of frequently long series of digits on packing slips and object labels. Errors in notation are reduced.
Along with furnishing materials with barcodes, storage locations in the receiving warehouse were equipped with RFID tags (passive, 13.56 MHz, 200 characters). This eliminates manually noting and checking storage location numbers. If SAP proposes a particular storage location for a material, the RFID scan of a storage location tag checks whether it was stored in the correct location. If not, an error message is issued. Employees in the warehouse can also use the mobile terminal to divide quantities between different storage locations and to qualify them with appropriate scans of material (barcode) and location (RFID). Material issues from storage locations can be documented the same way.

The data from the respective SAP modules and the mobile terminals of employees in the warehouse and quality assurance is reconciled manually depending on the process and through defined interfaces. FAM implemented the interfaces for this itself.

So far, the implementation phase in the company has demonstrated that the combination of barcode and RFID is an excellent option to control processes in receiving and constitutes an improvement of the initial situation. The cost of barcode on items is justifiable when compared with the total value of a plant project. Expenditures for mobile terminals and storage location tags represent a one-time investment. The automation of parts identification is now intended to be continued in the subsequent processes of manufacturing up through the construction of a plant at a construction site.

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The markets of the future are already demanding more efficient prototypes in the early phases of product development. Their features should match series component as exactly as possible. At the same time, more and more functions are being integrated in less and less space. Product requirements are mounting.

Prototypes Are Growing Smarter
Depending on the type of product, the road to marketability can be long. A product’s features and functions have to be tested on a large number of prototypes before mass production can begin. This development phase often costs a great deal of time and money. It goes faster when the prototype is already very similar to the final product and performs certain necessary functions. This significantly shortens the path to the finished product. Developers expect “intelligent” prototypes to considerably cut time and costs by reducing the number of iterations for optimization. How can prototypes be made more intelligent though?
The installation of electronic sensor and actor technology makes this possible: Structural components can be manufactured to handle stresses and outfitted with useful functions.

Integrating mechatronic elements in prototype components brings crucial advantages. Embedded sensor modules can capture data on a component and the behavior of process parameters and process this further as electronic information. Installed actors can even control a component and thus adjust the necessary parameters.

The installed electronics provide such a prototype numerous functions. Sensor, data processing and even actor, i.e. control, elements can already be used on a prototype in early phases of development. Product development is speeded up considerably.

There are a number of methods for manufacturing prototypes. Along with vacuum casting and fiber composite technology, generative rapid prototyping in particular is becoming more important. It can even manufacture components with complex geometry cost effectively. Since generative methods can manufacture any geometry, they are especially suited for integrating sensors.

Vacuum casting employs two-component casting resin and meltable wax materials to produce suitable material combinations and functional materials. Prototype manufacturing only requires low temperatures and pressures so that every electrotechnical function is retained during casting. Thus, sensitive sensors can also be easily integrated. A combination of both methods makes it possible to manufacture a prototype from different materials (hybrid structure).

Rather than having to be attached to the surface later, electronic control elements can be integrated directly in a component during manufacturing.

Faster to Production Thanks to Cleverer Prototypes
The machining of optical lenses is a complex process in which the pressure distributed on a lens was not known until now. Together with a manufacturer of equipment for precision machining of optical components, Fraunhofer IFF researchers developed a prototype to precisely polish optical lenses. Mechatronic elements that use sensors to exactly measure pressure distribution during polishing were integrated in the polishing tool and provide workers immediate information on the polishing process.

“For the first time, it is now possible to already measure various process parameters during operation. The exact measurements enable us to satisfy our client’s demand for optimal surface quality of the lenses. That saves time and naturally money,” says Dr. Christian-Toralf Weber, Managing Director of IGAM mbH quite pleased.

Parameters such as pressure, temperature or acceleration can be measured directly on prototypes and this information can be directly received or even stored. Integrated actors make it possible to speedily and cost effectively manufacture controllable prototypes with moving components. The metrology operates reliably even in flexible materials. Moreover, measurements can also be taken in functional operation even at difficult to access points. A geometrically unchanging surface is particularly important for prototypes in which the design or haptics have priority.

Even RFID chips can be integrated without adversely affecting a component’s surface. Thus, a component can be localized and tracked. A component’s “history” can also be stored.

Prototypes become more efficient when they are outfitted with electronic components. The additional functions acquired can shorten a product’s development phase considerably. Complex components can be manufactured quickly and inexpensively. Thus individual customer demands can be satisfied fully.

Prof. Karl-Heinrich Grote is Dean of the School of Mechanical Engineering at Otto von Guericke University Magdeburg.

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Fraunhofer in Saxony-Anhalt’s Logistics Advisory Council

Seidel manages the Logistics and Factory Systems Business Unit at the Fraunhofer IFF. Having majored in Factory Planning and Logistics, he acquired his first professional experience at a heavy machinery manufacturer in Magdeburg. He helped prepare the founding of the Fraunhofer IFF in 1991 and since then has managed research and industry projects, primarily in factory planning, logistics, supply chain management and reorganization.

Dr. Klaus Richter Is New SANASA Chairman

Dr. Klaus Richter was elected chairman of Satellite Navigation Saxony-Anhalt (SANASA). SANASA is Saxony-Anhalt’s state initiative related to the European satellite navigation system GALILEO. With estimated investments of 3.2 to 3.4 billion euros, Galileo is the largest collaborative civil project in the EU at present. The goal of the association SANASA is to promote commercial and scientific development of satellite navigation and important fields of application for Global Monitoring for Environment and Security (GMES) in Saxony-Anhalt.

State of Saxony-Anhalt 2006 Research Award

Assistant Professor Stefan Heinrich and Dr. Mirko Peglow from the School of Process and Systems Engineering at Otto von Guericke University Magdeburg won the State of Saxony-Anhalt’s 2006 Research Award for Applied Research. The two award winners have worked in the field of particle-forming fluidized bed processes for years. Their joint work has been instrumental in drawing national and international attention to the research work on fluidized bed technology in Magdeburg.
Since earning his degree in Process Engineering and Thermal Mechanical Engineering with a specialization in Apparatus and Environmental Engineering from Otto von Guericke University, Heinrich (36) has been pursuing an academic career. From 1996 to 2000, he was a researcher in the Department for Apparatus and Environmental Engineering and in 2000 he earned his doctorate under Prof. Lothar Mörl. Heinrich was appointed Assistant Professor for Dynamics of Systems with Distributed Properties in Solids Process Engineering in the School of Process and Systems Engineering and habilitated in 2006.

Peglow (33) earned his degree in Industrial Engineering with a specialization in Process and Power Engineering from Otto von Guericke University. Following a one year research residence at Niigata University in Japan, he was a researcher in the Department for Apparatus and Environmental Engineering from 2001 to 2004 and has headed the Product Design and Modeling project group at the Fraunhofer IFF since 2004 and has headed the Product Design and Modeling project group at the Fraunhofer IFF since 2004. Peglow earned his doctorate under Prof. Mörl in 2005 and is currently a habilitation candidate under Prof. Evangelos Tsotsas, Thermal Process Engineering Chairholder in the Department of Process Engineering.

**Careers with Fraunhofer**

The Fraunhofer-Gesellschaft offers young researchers outstanding opportunities for development. Graduates who majored in technical and natural sciences find ideal opportunities to qualify themselves for responsible work in business and research. Practice-related and project-based work provides preparation for the demands of modern business operations. Excellent networking with the research community offers outstanding opportunities for an academic career. Some former Fraunhofer IFF employees’ career moves are presented here.

**Call to TU Ilmenau**

Prof. Steffen Strassburger followed a call to the Technical University Ilmenau where he has been Chair of Business Information Systems for Industrial Enterprises in the School of Economics’ Department of Business Information Systems since April 2007. His research specializations are simulation, distributed simulation and methods and tools for the digital factory with a special focus on their application in manufacturing plants.

Strassburger earned a degree in Computer Science from Otto von Guericke University Magdeburg and a doctorate with his dissertation on distributed simulation from its School of Computer Science’s Department of Simulation and Graphics in 2001. Afterward, he worked on putting the research findings from his dissertation into practice at DaimlerChrysler AG in Ulm from 2001 to 2003. Emphases were the digital factory and simulation. From 2003 until his call to TU Ilmenau in 2007, Strassburger was Head of the Department of Virtual Development at the Fraunhofer IFF. Thematically his work focused on virtual reality, simulation, VR system development and VR applications in product and process design. Strassburger views close cooperation and partnership with business as his chair’s leitmotif. He fondly recalls his time at the Fraunhofer IFF and sees many points of contact for future cooperation.

**Head of Logistics at Schuberth GmbH**

Since March 2007, Manuela Wahl has been the manager of Material Planning and Work Scheduling at Schuberth GmbH. In this position, she is responsible for every component being at the right place at the right time in the right quality and the right quantity. Schuberth GmbH is a globally operating high-tech developer and manufacturer located in Magdeburg and Braunschweig and produces protective helmets and accessories. Wahl earned a degree in Industrial Engineering for Production Engineering with a specialization in Logistics, Production Planning and Control from Otto von Guericke University Magdeburg. During her undergraduate studies, she acquired her first professional experience as a Diplom degree candidate and student assistant at the Fraunhofer IFF. From 1998 to 2004, Wahl simultaneously worked as a project engineer at IFB logistics & process consulting GmbH and a project manager in the Department of Logistics and Factory Planning at the Fraunhofer IFF. From January 2005 until her departure for Schuberth GmbH, Wahl was the deputy manager of the LogMotionLab, which primarily works on RFID in logistics, identification, localization and navigation systems.
Fraunhofer as a Career Stepping Stone

Dr. Rico Wojanowski is responsible for central process optimization in production and logistics management at Gilde meister. With degrees in industrial and mechanical engineering and business administration, he earned his doctorate in engineering in 2002. Wojanowski was a project manager at the Fraunhofer IFF from 1999 to 2004 and completed a postdoctoral degree at McGill University in Montreal in 2002 and 2003.

His experiences during his early years of work at the Fraunhofer IFF were particularly important for the second phase of his career. At the Fraunhofer IFF, Wojanowski learned on the job to independently structure and complete projects, integrate himself in a project team and work oriented toward goals and schedules. The Fraunhofer IFF was the ideal launching point for him.

Master of the Elbe Dom

The Elbe Dom, a large laser projection system, is the heart of the VDTC. Specialists from Jenoptik and the Magdeburg Fraunhofer Institute jointly designed it and are working on developing it further to open up new fields of application. This high level of technology requires intensive support and the complex systems have to be continuously maintained and updated. Steffen Masik attends to this crucially important job at the VDTC, mainly supporting and further developing both software and hardware. Masik is additionally involved in bringing in and working on projects.

Masik majored in Computational Visualistics at Otto von Guericke University and while studying completed a six month internship at the University of Idaho in Moscow, Idaho, USA. Directly after receiving his degree in 2005, Masik started as a Research Manager at the Fraunhofer IFF.

With Marie Curie to the Fraunhofer IFF

Ivan Pechenizkiy from Kharkiv, Ukraine has been supporting the Measurement and Testing Technology Business Unit at the Fraunhofer IFF since March 1, 2007. The degree holding engineer who specializes in aircraft manufacturing technology will be researching a process model and closed process control loop for automated riveting processes in the aircraft industry initially for twelve months. The Fraunhofer IFF already has extensive experience in this field since it has already produced several fully automatic optical 3-D measuring systems to inspect the quality of aircraft hull rivet joints.

Pechenizkiy earned his degree in stress mechanics from the National Aviation University in Kharkiv from 1998 to 2004. He acquired his first professional experience at Aviakontrol developing software to inspect onboard systems for aircraft. Afterward, until transferring to the Fraunhofer IFF, he worked on research, initially as an assistant and later as an engineer for the Chair of Aircraft Instrument Manufacturing Technology in the Department of Aircraft Engineering at the National Aviation University. His current stay is made possible by the EU’s Marie Curie Program, a European training program for young researchers.
Editorial Notes

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At the DHL Innovation Center, Deutsche Post World Net (DPWN) develops and tests new products and services. DPWN and the Fraunhofer IFF jointly developed the Smart Box.
The future of logistics
Testing intelligent transport containers

Die Zukunft der Logistik
Intelligente Transportbehälter im Test

SMART BOX

GPT Coordinates
Temperature
Humidity
Vibration
ok
A glimpse of the earth from space is not only breathtakingly beautiful but also reveals a scientific side. The Galileo satellite navigation system will help us organize our lives more securely and comfortably.
The off-road navigation system developed by the Fraunhofer IFF runs on any commercial PDA.

Here it is being demonstrated at the Fraunhofer IFF workshop “Wood Logistics: Implementing Practicable Solutions” in Hundisburg on April 18, 2007.
June 12-15, 2007  
Transport Logistic 2007  
Munich

June 13, 2007  
2nd Consolidation and Growth  
Trade Fair  
Halle/Saale

June 14-15, Juni 2007  
Workshop on Augmented and Virtual Reality in Product Development  
Paderborn

June 19-20, 2007  
28th VDI/VDEh Maintenance Forum  
2007 “Maintenance Put to the Test”  
Stuttgart

June 27, 2007  
10th IFF Science Days  
Workshop: Robot Technologies for Use in Everyday Environments  
Fraunhofer IFF, Magdeburg

June 27-28, 2007  
10th IFF Science Days  
4th Virtual Reality Conference  
“Virtual Reality and Augmented Reality for Engineering, Testing and Operating Technical Systems”  
Fraunhofer IFF, Magdeburg

June 27-28, 2007  
10th IFF Science Days  
International Conference  
“Logistics Intelligence in Manufacturing and Transportation”  
Fraunhofer IFF, Magdeburg

June 28, 2007  
Seminar with Practical Training  
“Optical 3-D Metrology for Quality Assurance in Manufacturing”  
Jena

July 10, 2007  
Practical Workshop on Reliable Process Chains in the Creation of Value Added  
Munich

July 11-12, 2007  
Training Workshop  
“Improving Business Performance through Sustainability: CSR Concepts and Applications”  
Penang, Malaysia

July 12-13, 2007  
Seminar with Practical Training  
“Inspecting and Characterizing Surfaces with Image Processing”  
Braunschweig

September 18-21, 2007  
A+A 2007 Trade Fair for Safety, Security and Health at Work  
Düsseldorf

September 18-22, 2007  
HUSUMwind Leading Wind Energy Trade Fair  
Husum

September 25-27, 2007  
INTERGEO Conference and Trade Fair for Geodesy, Geoinformation and Land Management  
Leipzig

October 17-19, 2007  
24th German Logistics Congress  
Berlin

October 25 - December 5, 2007  
Guet Lectur Series  
“Virtual Reality: Human and Machine in Interactive Dialog”  
Fraunhofer IFF, Magdeburg

November 7-08, 2007  
TA Cook Conference  
“RFID in Maintenance”  
Berlin

November 13-16, 2007  
ISMAR 2007 6th IEEE International Symposium on Mixed and Augmented Reality  
Nara, Japan

December 5, 2007  
SME Day “Virtual Engineering”  
Fraunhofer IFF, Magdeburg
LogMotionLab: The RFID Specialists

Experience one of Europe’s leading RFID and telematic technology development, testing and certification labs.

We custom develop complete identification solutions for your company’s logistics.

Secure Chains of Goods
- Identification, localization, monitoring and control of mobile logistics assets

Pedestrian Flow Control
- Identification, localization and notification of pedestrian flows and the presence of VIPs

Material Flow Control
- Identification and control of assets in material handling systems

Life Cycle Management
- Dynamic condition documentation on technical systems

Mobile Lab
- Mobile measuring station for on site use

RFID Certification
- Test environment to prepare for certification of RFID supported logistics processes

Fraunhofer Institut Fabrikbetrieb und -automatisierung