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Smart Planning for Sustainable Success

Developing Tomorrow’s Logistics: Interview with Dr. Keith Ulrich from DHL
Efficient Transportation Systems: Smartly Organized Flows of Goods
Driving Green: Smart Management
Meet up with researchers from the Fraunhofer Institute for Factory Operation and Automation at these events. Come talk with us!

August 22 – 26, 2011
"Learning in the context of very high-dimensional data" Seminar
Dagstuhl

August 31 – September 1, 2011
3rd Central German Logistics Forum
Leipzig

August 31 – September 2, 2011
Joint International IMEKO TC1+TC7+TC13 Symposium
Jena

September 7 – 8, 2011
8th Fernausbildungskongress der Bundeswehr
Hamburg

September 5 – 7, 2011
2nd International Plant Phenotyping Symposium
Jülich

September 7 – 10, 2011
Life World Electro Mobility Congress
Mannheim

September 13 – 16, 2011
First International Congress on Cocoa, Coffee and Tea CoCoTea 2011
Novara, Italy

September 13 – 15, 2011
2011 CURAC Jahrestagung
Magdeburg

September 19 – 21, 2011
Security Research Conference 2011
Warsaw, Poland

September 27 – 28, 2011
"Management der Betriebsqualität bei alternden Anlagen und knappen Kassen" Conference
Dresden

September 28 – 30, 2011
Logistics Management 2011 Conference
Bamberg

September 29, 2011
Laser Scanning and Virtual Reality in Plant Engineering Industry Working Group
Magdeburg

October 11 – 13, 2011
Biotechnica 2011
Hannover

October 11 – 20, 2011
Maintain Munich

October 18 – 20, 2011
eCarTe Munich

October 19 – 21, 2011
28th International Supply Chain Conference Berlin

October 23 – 24, 2011
KWF RFID Workshop
Groß-Umstadt

November 8 – 10, 2011
VISION Stuttgart

November 16 – 17, 2011
7th Stuttgarter Wissensmanagement-Tage Stuttgart

November 22 – 24, 2011
SPS/IPC/DRIVES Nürnberg
Dear Readers,

If you want to optimize processes, you have to analyze them precisely first. The more complex they are, the greater the related challenges are. This pertains just as much to transportation systems and all their indicators as to global commodity flows or a company’s complete supply chain. The Fraunhofer IFF meets these challenges because our years of practical experience with our industry partners and our research know-how have enabled us to turn a broad range of technologies and systems into solutions. Our mission has always been to make processes more reliable and more efficient.

You will find a number of examples of such solutions and current projects in this edition of IFFOCUS “Logistics Connects”. First and foremost is the Saxony-Anhalt Galileo Test Bed where the Fraunhofer IFF is significantly involved in the development of future logistics and transportation systems. It is producing state-of-the-art technologies and applications, which make transport and logistic operations transparent, more reliable and more efficient from end-to-end.

The implementation of state-of-the-art RFID technology in the entire transport chain of the garment manufacturer GERRY WEBER is representative of the solutions we are developing. Its logistics providers are relying on the new RFID Tunnel Gate developed here in Magdeburg to make supply and process chains secure from end-to-end without any problem. Surveys, according to which more than ninety percent of the companies are considering non-contact solutions this year, demonstrate that the Fraunhofer IFF is in step with the times with its applications. One of these companies is ENERCON, a manufacturer of wind generators, which uses the Fraunhofer IFF’s RFID and positioning systems to optimize its utilization of its large outdoor storage sites.

In addition, we are also working intensively on companies’ so-called “soft” resources, namely their internal know-how. Their management can be optimized excellently with logistical methods and tools. Management games geared toward practice or digital platforms that structure the exchange of employee know-how help improve the quality of knowledge in a company and retain it long term.

We are also looking intensely into the future. For many years, we have been intensively fostering young researchers – with success. Our “robo-kids” are among the Europe’s elite in the FIRST LEGO League, an international competition for inventive young engineers. Moreover, we are working on the electrical grid of the future and thus on resolving issues of how we will soon deal with the large amounts of renewable energies in our grids. The findings of the large-scale research project Harz. EE-mobility reveal the role that electric vehicle networks could play.

What would you like to improve? Where is your hidden and unutilized potential? We would be pleased if the following pages inspire new ideas and projects and give you pause to take a closer look at our institute as well as our solutions.

I wish you interesting reading and would be delighted to hear from you.

Prof. Dr.-Ing. habil. Prof. E. h. Dr. h. c. mult.
Michael Schenk
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“Jugend forscht” Winners from Saxony-Anhalt also Win at the Nationals
ELECTRIC VEHICLE NETWORKS: STATE SECRETARY BOMBA LAUDS MAGDEBURG’S RESEARCH ORGANIZATIONS

Rainer Bomba, State Secretary at the Federal Ministry of Transport, Building and Urban Development since 2009, paid a working visit to Magdeburg in December of 2010. Together with Saxony-Anhalt Minister of State Development and Transportation Karl-Heinz Daehre, he was given a look at current projects on electric vehicle networks, energy grids and logistics infrastructure security at the Fraunhofer IFF and elsewhere. Allied with Otto von Guericke University Magdeburg, the Fraunhofer IFF is one of the leading research organizations here in Germany. Bomba, in charge of electrical vehicle networks at the Federal Ministry, was impressed by the results presented.

"The complete integration of advanced information and communications technologies, logistics and electrical grids is unique throughout Germany," Bomba out. He was also impressed by the practicability of the demonstrated technologies. One of these was the smart control system for smart electric vehicle systems developed in Magdeburg.

In addition to electric vehicles and state-of-the-art charging stations, its heart is a digital electric vehicle control center that manages the complexities of electric vehicle traffic.

“It enables us to do more than just say where exactly a vehicle is. The control center also tells drivers what their energy status is, how far they can still go and where the next charging station is located. If drivers want to, they can book it while driving or view alternatives," explained Prof. Gerhard Müller, Deputy Director of the Fraunhofer IFF. "Above all, however, we can even use it to control the distribution of electrical power from renewable sources while factoring in the volume of electric vehicle traffic."

The latest developments for smart inner city logistics, like those being pursued at the Fraunhofer IFF and at the Saxony-Anhalt Galileo Test Bed and elsewhere were also every bit as important to the State Secretary. Especially the concept of electric delivery trucks with smart swap bodies attracted the attention of the man from the Federal Ministry of Transport, Building and Urban Development. In closing, he stressed that he considers Magdeburg to be excellently positioned in these fields and he promised further support in the future.

FRAUNHOFER IFF CELEBRATES ITS FOUNDER’S 75TH BIRTHDAY

The Fraunhofer Institute in Magdeburg celebrated the seventy-fifth birthday of its founder Prof. Eberhard Gottschalk with a special event on January 24, 2011. Under the logistics expert’s leadership, the research organization was established in 1992 as an Institute for Factory Operation and Automation, at first with thirty staff members. Today, the institute is an integral part of the international research scene and one of Germany’s leading organizations for factory planning and digital engineering.

Numerous former colleagues, friends and associates gathered in the presence of the birthday boy to recognize the seventy-five year old’s achievements at a colloquium in his honor.

"Without him, a Fraunhofer Institute probably would not have been established in Magdeburg in the early 1990s. We are here today thanks to his energy, his tenacity and his visions,” said Prof. Michael Schenk, Gottschalk’s successor as director, commending his contributions.

Looking under an electric car’s hood, from l. to r.: Prof. Gerhard Müller, Fraunhofer IFF; State Secretary Rainer Bomba, Federal Ministry of Transportation, Building and Urban Development; Saxony-Anhalt Minister of State Development and Transportation Karl-Heinz Daehre; Prof. Zbigniew A. Styczinski, Otto von Guericke University Magdeburg; Dr. Przemyslaw Komarnicki, Fraunhofer IFF. Photo: Viktoria Kühne
Virtually everyone is familiar with the colorful plastic blocks made by the toy manufacturer LEGO. Some students at Werner von-Siemens High School in Magdeburg like to play with them – in an entirely different league however, namely the FIRST LEGO League (FLL). The international youth competition was jointly launched by the American non-profit organization FIRST and the LEGO company to get students interested in science and engineering playfully. Young inventors from all over the world compete against one another in various categories such as the “Robot Game” or “Research Presentation” to gauge their creativity and technical ability.

The young engineering freaks from Magdeburg are “playing” in the first string with their robots based on LEGO systems. Among all of the twenty-four winning teams from Germany, Switzerland, Austria, the Czech Republic, Poland and Hungary at the semi-finals, the team was an extremely successful contender in every category at the 2011 Central European FLL finals in Paderborn. Error Force One was by far the best team in the FLL Live Challenge – a new category in which a task must be solved within fifteen minutes without assistance from a coach. The students from Saxony-Anhalt’s capital especially impressed the jury with their presentation of their project on diabetes. They developed software called InsulAPP, which diabetics can use on a cell phone to calculate German bread units for over 10,000 foods.
The partners involved in AVILUS and AVILUSplus presented the results of their research “live” at twenty-four booths at the conference. An Innovation Alliance member that lead managed the AVILUSplus project, the Fraunhofer IFF also presented some of its developments. For Prof. Dr. Werner Schreiber, CEO of VOLKSWAGEN VARTA Microbattery Forschungsgesellschaft mbH & Co. KG and the Virtual Technologies Innovation Alliance spokesman, these new developments hold great potential for business and industry. “They can play a substantial role in significantly reducing future waste of resources, manufacturing defects or stress on employees in production,” he explained at the conference. He already sees need for research in many sectors, though. In the words of the virtual technologies specialist, development never stops.

The nine-person team, supported by the Fraunhofer IFF from the start with a coach, training rooms and shuttle transportation, placed sixth at the European competition, an excellent outcome. This also qualified them for the FLL Open European Championship in Delft, Holland, where sixty-seven teams from all over the world competed in June of 2011. Only there were they partly bested by some outstanding competitors. Thirty-second place and the knowledge that they are among Europe’s best young inventors are however motivation enough to compete again next year.

AVILUS AND AVILUSPLUS CONCLUDE SUCCESSFULLY

Innovative product developments dictate the German economy’s growth. In global competition among ever more complex and customized products, companies are increasingly relying on virtual technologies. In the Virtual Technologies Innovation Alliance, forty leading German industrial companies, small and medium-sized enterprises and research organizations are working on pre-competitive research and development of high-performance technologies for virtual and augmented reality. The research and industry partners gathered in Braunschweig on January 26, 2011 for the alliance’s second status conference. This meeting was simultaneously the final event of the AVILUS and AVILUSplus projects supported by the Federal Ministry of Education and Research. As part of the Virtual Technologies Innovation Alliance, both projects were geared during their three-year project periods toward researching, developing and utilizing virtual technologies for product and production equipment life cycles. While AVILUS focused on the development of solutions for near-real time use in industry, AVILUSplus primarily concentrated on technologies that will only be marketable several years from now because of their complexity.

A demonstration of an AR application developed at the Fraunhofer IFF. The system being presented will calibrate AR representations in head mounted displays in just one step and thus significantly faster than before. This is made possible by the especially high accuracy of the superimposition of real objects on the display. Users have to superimpose the pattern in a display on the calibration field (pictured above) only once. Such AR displays mounted on a helmet as here can be used in manufacturing, for example. Information would be superimposed for assemblers on their next jobs and next procedures. Photo: Dirk Mahler
The engineers will be concentrating primarily on simulating and testing the vital heart of present-day products: embedded systems such as control software and microprocessors. They will be using the latest virtual and augmented reality technologies to do so. Unlike the first stage of support, regional companies will also be involved in the project this time around. They will transfer the results of research during their own product development to practice.

“The developments being advanced in ViERforES are enabling us to increase the effectiveness of VR technologies many times over. When we are also able to simulate and test products’ control components’ responses to different stresses, disturbances or the like virtually in advance, we improve their reliability and service life significantly,” explained Prof. Michael Schenk, Director of the Fraunhofer Institute in Magdeburg and ViERforES spokesman, welcoming the continuation of the project. The project period will be extended thirty-three months with an additional € 5.8 million in funding starting in January of 2011.

MORE PRODUCT SAFETY: FEDERAL MINISTRY OF EDUCATION AND RESEARCH SUPPORTS THE DEVELOPMENT OF NEW VIRTUAL REALITY TECHNOLOGIES WITH € 5.8 MILLION

The successful national research project ViERforES is going into overtime. The Federal Ministry of Education and Research is continuing to support the creation of new solutions that employ virtual reality technologies to develop and test technical products. The research consortium, consisting of Magdeburg’s Fraunhofer IFF, Otto von Guericke University Magdeburg, the University of Kaiserslautern and the Fraunhofer IESE, will be continuing its successful work until September 30, 2013.

The partners intend to use concepts for new developments that sustainably improve the safety and reliability of technical devices and processes, equipment and systems.
10TH ROBOCUP GERMAN OPEN

Helping, rescuing, playing soccer, dancing – several hundred robots and their developers displayed their capabilities at the 10th RoboCup German Open in Magdeburg from March 31 through April 3, 2011. The fascinating competition in different disciplines once again furnished school students, aspiring engineers and top researchers an ideal platform to exchange know-how and present their innovations.

With a record registration of 1,100 participants and 250 teams, this year’s competitions were more exciting than ever. The competitions primarily focused on the robots’ flexible, learning and collective performance as well as scene recognition and autonomous strategic action.

Spokesman of the German RoboCup committee and Chair of the RoboCup German Open, Dr. Ansgar Bredenfeld summed things up when he said, “The widely known robot competitions uniquely link support for young people urgently needed in technical fields at RoboCupJunior with sophisticated research and teaching, especially in the field of mobile robotics, in the RoboCup Major Leagues.”

Germany’s representatives were especially successful in the international RoboCup Major Competition. Teams of German researchers won six of the nine league competitions. Other first prizes went to teams from the Netherlands, the USA and Iran. The public’s clear favorite among the exhibits at the tournament was the “soccer robot” from the Fraunhofer Institute IFF in Magdeburg.
Its tactile sensors enable it to travel away from points of contact. The distance it travels depends on the intensity of the contact – just like when “kicking” a real ball.

**FRAUNHOFER IFF WITH NEW DEVELOPMENTS AT THE 2011 HANNOVER MESSE**

This year’s HANNOVER MESSE opened its doors from April 4 through 8, 2011 with the keynote theme “Smart Efficiency”. The Fraunhofer IFF was represented at the world’s largest industry trade show with various new developments in the fields of electric vehicles, virtual reality and robotics.

The Fraunhofer IFF represented electric vehicles, one of the most dynamic topics of the moment, with the major project Harz.EE-mobility being run with several partners and supported by both the Federal Ministry of Economics and Technology and the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety. The researchers presented the digital vehicle control system they developed for integrated transportation and energy management.

For more efficiency in manufacturing, the experts in efficient energy conversion demonstrated the model of a compact fluidized bed reactor that recovers heat from renewable solid fuels with cogeneration. Companies can, for instance, use the innovative system to burn waste from their own production with low emissions.

**LOOKING BACK 15 YEARS AGO:**

**INTO THE FUTURE WITH FASA**

Remaining competitive on the world market is a challenge in the age of globalization with its attendant rapid technological advances.

Small and medium-sized enterprises particularly have difficulty responding to these demands. In order to meet these challenges, the Association for the Development of Machinery and Plant Manufacturing in Saxony-Anhalt, or FASA for short, was established in 1996 under the aegis of the Fraunhofer IFF.

“This association’s idea and goal is to allow small and medium-sized enterprises to share in investments and to qualify them for international markets and customers and demands at the same time,” explained Prof. Michael Schenk, Director of the Fraunhofer IFF and first Chairman of FASA.

The association supports globally operating suppliers’ partnerships and advances the application of innovative information and communications technologies. The technologies applied and qualification generate diverse new options and opportunities with which these companies can acquire a significant competitive edge.
Together with its industry partner Alstom, the Fraunhofer experts also exhibited their latest developments for technical training in virtual environments. The realistic virtual interactive training system created for the industry partner is far more efficient than conventional training concepts and, in addition to saving time, are significantly safer for humans and equipment.

Industry’s desire to enable humans and robots work more closely together is also driven by efficiency. The Fraunhofer IFF’s robotic experts are developing new sensor and safety systems, which make such cooperation and interaction safe for humans. One of the projects that Magdeburg’s Fraunhofer Institute presented at HANNOVER MESSE is an optical workplace monitoring system. This new development uses projection and camera systems to “mark” dynamic and freely definable safe zones on a floor with light. They register encroachment by humans and trigger responses, ranging from warning signals to equipment stops.

Together with Emschergenossenschaft, the engineers also presented the world’s only damage detection system that inspects partially filled sewer lines.

NEW FRAUNHOFER AUTOMOBILE PRODUCTION ALLIANCE

Changing transportation and energy sources are global trends, which are also having a tremendous impact on the automotive industry. In order to respond effective and quickly, the Fraunhofer AutoMOBILe Production Alliance was established in 2010. The alliance of seventeen Fraunhofer Institutes intends to support the German automotive industry as a professional full-service partner and deliver cross-process responses for energy and resource efficient production. Generally reducing material, using recyclable materials that can be supplied over long periods and developing resource conserving technologies and systems engineering are the key aims of this new and potent research alliance. As a group the newly established alliance presented the latest Fraunhofer developments for vehicle manufacturers for the first time at the Z Subcontracting Fair in Leipzig from March 1 to 4, 2011.

Among other things, the Fraunhofer IFF is developing new in-line optical measurement systems for quality assurance in automotive manufacturing. Photo: Thomas Dunker
At the trade fair, the alliance, in which the Fraunhofer IFF is a member, presented current technologies for energy and resource efficient production. Among other things, state-of-the-art optical 3-D measurement systems for in-process inspection of rim quality were on display. The researchers from Magdeburg additionally demonstrated a system that recycle production residues resource efficiently and solutions for maintenance-based condition monitoring of manufacturing robots.

www.automobil.fraunhofer.de

LOGISTICS MAKES IT HAPPEN

The annual Logistics Day with the them “Logistics Makes It Happen” was held on April 14, 2011. Companies and research organizations all over Germany opened their doors to enable the public to take a look at the profession of logistics. As one of seven organizations in Magdeburg, the Fraunhofer IFF participated in the nationwide promotional day with a presentation on new and efficient methods that optimize logistic in manufacturing. The event was opened by its patron, Dr. Karl-Heinz Daehre, Saxony-Anhalt Minister of State Development and Transportation. It was simultaneously part of the Logistics Guest Lecture Series being held at Magdeburg’s Fraunhofer Institute for the fourteenth time.

Saxony-Anhalt Minister of Transportation Karl-Heinz Daehre at the opening of the event at the Fraunhofer IFF on the nationwide Logistics Day. Photo: Dirk Mahler

HUMANS AND MACHINES IN INTERACTIVE DIALOG

VIRTUAL REALITY GUEST LECTURE SERIES
OCTOBER 26 TO NOVEMBER 30, 2011
DEVELOPING TOMORROW’S LOGISTICS

Interview with Dr. Keith Ulrich,
Vice President, DHL Solutions & Innovations

DHL is the world’s leading logistics provider and a pioneer in the use of new, innovative technologies. IFFocus editor René Maresch asked Dr. Keith Ulrich, Head of the Research & Innovation Division, about new challenges, collaboration with the Fraunhofer IFF and their joint developments at the Saxony-Anhalt Galileo Test Bed.

Dr. Ulrich, DHL is already the largest logistics provider in the world. Nonetheless, your company is continuing to look ahead and intends to actively shape the future of logistics, too. What will that entail?

DHL is not only the leading logistics provider. We are also the leading innovator in the logistics industry. Logistics is constantly changing in this age of global markets. It is essential both to recognize and to take advantage of the challenges and opportunities of these changes. In order to remain the market leader, we are developing tomorrow’s logistics solutions today and working on current trendsetting topics. The goal of remaining the leading innovator is therefore an integral element of our Strategy 2015.

What concrete new approaches and developments are helping you in the process?

First of all, the logistician of the future will be an information logistician. New technologies such as RFID, sensor systems, geographic data or GPS are allowing flows of physical commodities and information flows to coalesce more and more. This generates potential new solutions for logisticians, enabling them to supply customers needed information at the right time and to combine this with a range of services. Additionally, our current topics are closely geared toward our customers’ demands and needs.

DHL also collaborates with the Fraunhofer IFF. How long have you been collaborating?

Yes, that’s right. The Fraunhofer IFF was one of our first research partners in the DHL Innovation Initiative. We have been collaborating since 2005 and formalized our partnership last year with a partnership agreement.

What is your motivation behind this long-standing partnership?

Our partner network, consisting of research organizations and businesses, constitutes the basis for our steady development of innovations. Trend scouting, the early identification of potential developments, is crucially important.

We are also working on megatrends and include political and social issues such as transportation safety or environmental concerns in our considerations. This leads to the development of concrete solutions such as “GoGreen” shipping without any carbon footprint or the implementation of RFID systems in the Metro chain in France.
A partnership between us, the leading logistics provider, and the Fraunhofer IFF, a globally recognized research institute, is therefore a perfect symbiosis. Our core expertise enables us to collectively take advantage of synergies and optimize logistics services with innovative and practicable solutions.

**What results of collaboration with the Fraunhofer IFF would you personally single out?**

Our first joint development was the smart container in 2006. It transmitted information on location and condition in real time. Then, last year, we implemented the jointly developed tunnel reader at DHL Global Forwarding, which is based on the Fraunhofer IFF’s patented electromagnetic reverberation concept. Theory and practice harmonized optimally here and quickly gave rise to an innovative product.

**The formal Partnership Agreement between DHL and the Fraunhofer IFF already mentioned has existed since 2010. What do you expect from even closer collaboration with the Fraunhofer IFF? Is this related to the new Saxony-Anhalt Galileo Test Bed?**

The signing of the agreement between DHL and the Fraunhofer IFF to strategically collaborate in the Galileo Test Bed is certainly connected with certain expectations. Just like the Fraunhofer IFF, we also see the key logistics products of the future in the fields of navigation, tracking and communication. As a logistics provider, we especially depend on having information on our vehicles and thus also on our customers’ freight available all the time. The more precise the geographic data are, the more efficiently and more effectively we can plan and control routine logistics. This is where Galileo starts and facilitates more precise positioning.

**What future issues do you associate with the test bed and what challenges will future logistics have to overcome?**

Direct and apparent effects are not always the ones that mean changes and optimization. Certainly, primarily these more precise positioning data from Galileo in particular will constitute a tremendous advantage for logistics.

The related indirect effects shouldn’t be ignored, either. More precise positioning also means more security when accessing freight, more precise forecasts of congestion, lower CO₂ emissions, optimized delivery routing and a lower volume of traffic.

This is where the challenges of the future are: Our customers will demand even more specific and more customized solutions, globalization, urbanization and the industry’s dynamic will continue and thus the volume of traffic and pollution will grow. In the future, we will need holistic approaches that factor in all of these aspects throughout the complete supply chain.

**BRIEF CV**

Dr. Keith Ulrich,  
Vice President, DHL Solutions & Innovations,  
Head of Research & Innovation

**Education**  
Undergraduate degree in business administration and subsequent doctorate in finance from Bochum University

**Career from 2000 to present**  
Deutsche Post DHL, various managerial posts in the finance unit and corporate development and head of the Research & Innovation unit

**Professional fields**  
Dr. Keith Ulrich was initially in charge of the Deutsche Post AG’s capital market unit. In addition to successfully collaborating on its initial listing on the stock exchange, he was also in charge of the company’s first rating and first bond issue.

Afterward, he lead managed the establishment of innovation management at the Deutsche Post DHL. Today, he manages the Research & Innovation Management unit in the DHL Solutions & Innovations Division. It implements company-wide innovation projects that lead to new solutions and products for the concern.

In recent years, DHL has successfully developed new solutions, including GoGreen transportation without any carbon footprint and the new SmartTruck concept for urban centers and has implemented RFID.
EFFICIENT TRANSPORTATION SYSTEM

INTELLIGENTLY ORGANIZING FLOWS OF GOODS

Prof. Klaus Richter and Andreas Müller
Anyone intending to manage transportation of the future, must examine current developments closely. How do goods flow? How can logistical processes be organized better with the aid of new telematic technologies and handling concepts? Strategies to manage them arise from tests under real conditions and in the laboratory. Today, the reliable and precise functioning of telematic units is just as much a part of logistics as the incorporation of environmental factors.

Research of the technology drivers, navigation, positioning and communication, are the trend. In their role as first movers, internationally operating logistics providers are currently establishing central IT platforms through which they know the location and condition of their vehicles and their subcontractors’ vehicles at any time. The logical extension of such projects is to continuously record and analyze information on cargo space and freight and thus to always be available as information providers with answers to customers’ questions about the freight with which they have been entrusted. New telematic technologies are steadily making these demands of customers and insurers, which are nothing new, reality. For research, however, these telematic developments are just the beginning of development road maps of the future.

Therefore, under the auspices of the Ministry of State Development and Transportation, Saxony-Anhalt launched the state initiative “Applied Transportation Research/Galileo Transport” in 2008, which led to the establishment of the Saxony-Anhalt Galileo Test Bed. The test bed is intended to support developments and innovations systematically by creating new smart transportation and logistics solutions. Magdeburg’s Fraunhofer IFF is the leading logistics research partner in this newly constituted network. Otto von Guericke University’s Institute of Logistics and Material Handling Systems ILM coordinates the Galileo Test Bed. In addition to the Fraunhofer IFF, the Institut für Automation und Kommunikation e.V. Magdeburg (ifak) and the Halleschen Verkehrs-AG (HAVAG) were involved in the concrete development of the Galileo Test Bed.
Multimodal Development Environments for New Positioning and Monitoring Solutions

In 2010, the telematics platform at the Hanse Terminal in Magdeburg was opened with Magdeburger Hafen GmbH, another collaborative partner. In this real environment, logistics operations can be analyzed in real time and, in the future, also controlled at a handling terminal with innovative telematic technologies. Different radio and imaging systems are integrated for research. They continuously track and identify a wide variety of objects from packages to trucks or cargo. Such an operational test bed is closely tied to practice, especially since Magdeburger Hafen’s trimodal terminal interconnects inland waterways, rails and roads.

These real processes at Magdeburger Hafen GmbH’s Hanse Terminal play an important role at Magdeburg’s Fraunhofer IFF for testing and development purposes. In particular, it can intensively research the links between different transportation systems and material flows. Sufficient data material from handling operations and excellent cooperation with the specialists at the port help. Ultimately, the findings obtained make it possible to organize processes more securely and more effectively.

The heart of the Galileo Test Bed is its development laboratory. The former freight forwarding facility, which has been converted into a specialized radio systems laboratory, is located in Magdeburg’s Port of Science. Unlike similar test beds in Germany that simulate Galileo signals to improve the quality of positioning, sustainable applications are developed here instead, which build upon the availability of such positioning data. The Galileo Test Bed is an applied test bed where GNSS technologies are tested in conjunction with positioning, navigation and communication systems. Contrary to what the name suggests, it is independent from the European Galileo satellite system and any applications for Russian, American or Chinese satellite systems can be tested here as well.

Jointly Developing Transportation of the Future

The test bed’s major advantage is the collaboration of logistics and transportation researchers on the development of new applications. The test bed’s proximity to Otto von Guericke University Magdeburg and the two research organizations, the Fraunhofer IFF and the Institut für Automation und Kommunikation ifak, is also a big plus. While the university is strongly influenced by its logistics program, the Fraunhofer IFF is the
only Fraunhofer Institute in the eastern German states, which specializes in logistics. ifak in turn uniquely combines the research fields of automation and telematics. These are outstanding conditions for joint operative development of transportation of the future.

The applications produced at the Galileo Test Bed are already being implemented in a wide variety of industry and other projects. One is the project MD-E², in which the city of Magdeburg intends to become a model city of energy efficiency and renewable energies by 2020. In 2010, the metropolis on the Elbe and four other winning cities beat out numerous competitors in the nationwide competition “Energy Efficient City”. A total of eleven individual projects supported by the Federal Ministry of Education and Research will be completed in Magdeburg, which are expected to cut CO₂ emissions, exhaust emissions and energy consumption significantly by 2020.

The Fraunhofer IFF is also involved in several projects. In one of them, it is developing and testing new approaches to city logistics incorporating new electric vehicle technologies.

**Swap Bodies for Efficient City Logistics**

They are working on an interchangeable ten cubic meter swap body for 3.5 t delivery trucks. A multitude of modular integrated sensor technologies make it possible to monitor them constantly in a supply chain, regardless of whether they are located on vehicles or being used a autonomous buffer storage at end customers’s facilities in the city. Their sensors register every time the container is opened and a computer logs any change. A special swap body model is additionally equipped with active refrigeration units that assure that the temperature of items is controlled perfectly. Naturally, this is extremely important for shipments of perishable goods, such as meat or milk products, which must be stored in a temperature range of two to seven degrees Celsius.

Unlike heavy duty trucks that make deliveries to one business after another, these small containers can especially be used to distribute goods to businesses in the city optimally and customized to their needs.

This not only benefits the traffic situation in cities tremendously, especially in the sometimes narrow streets of historic city centers. Ten cubic meters is considered the optimal size for the delivery of food to smaller shops in particular. They receive their goods in a closed container that constantly monitors temperature, vibration and moisture without any third party having had access to the shipment. They are delivered electronically regardless of location. This makes schedules more manageable for both the distributors and the recipients of the goods.

Part of the Saxony-Anhalt Galileo Test Bed: The Magdeburger Hafen’s Hanse Terminal. Photo: Dirk Mahler

This logistical principle can also be applied to streamline downtown traffic significantly. Instead of heavy duty vehicles with heavy payloads, which are increasingly encountering opposition in such areas, flexible systems make deliveries to merchants during low-traffic periods, thus helping untangle traffic in problematic downtown areas and also identify energy efficient routes. A system integrated in the vehicles unloads containers without needing a forklift. Drivers that unload one container during their deliveries in urban areas will pick up and return with another as quickly as possible. This eliminates dead-heading. The trucks thus constitute a real opportunity to change city logistics positively in the near future. The introduction of low-emission zones also suggest that restrictions on the use of traditional vehicles will continue to increase.
Electric Delivery Trucks

In response to anticipated restrictions, the swap body concept supplemented with an electric drive is being tested at the Galileo Test Bed and as part of the project MD-E4. The advantages of such a combined system are obvious. Delivery runs in metropolitan areas are ideal for electric vehicles since many stops have to be made but few kilometers are driven in one shift. Typically, forty to seventy kilometers are driven in one shift. Then, the swap body performs an additional job, which is a first in logistics. Instead of functioning solely as a load carrier, it additionally serves as an interchangeable energy storage system that supplies vehicles power. The battery pack integrated in the container frame makes it possible to extend an electric vehicle’s limited range indefinitely and immediately by exchanging containers at terminals or merchants’ facilities. The actors involved in the key research field in the project MD-E4 intend to introduce the slogan “the freight brings its own energy” to energy efficient logistics for cities.

Flexible Delivery

The use of electric vehicle technologies also addresses other issues of city logistics. The reduction of noise connected with the use of electric vehicles is one important factor behind rescheduling delivery runs during low-traffic periods. The 3.5 t delivery trucks and their easily interchangeable bodies can be used to transfer goods in downtown zones almost noiselessly, even at nighttime. Technically, the concept is ideal for moving the delivery of goods to underground garages, garages near shopping centers or supermarkets themselves. These conditions were taken into account when the type of vehicle was selected.

Another benefit of this approach is the swap body’s usability as both a means of transfer and a stock buffer. It no longer has to be unloaded immediately at its destination as is usually the case. This saves twice the time. At a gas station or a supermarket, the container is unloaded when needed. This allows employees at a supermarket, for instance, to concentrate on other jobs during peak hours. Moreover, the truck’s driver does not have to wait for the freight to be unloaded since it has already be accepted electronically. The two-person rule otherwise necessary during the delivery of freight is eliminated.

Cost Effective Interstate Transportation

Naturally, the use of swap bodies in interstate distribution operations holds potential to be significantly more efficient than conventional distribution networks.
The starting point for the transportation of freight is centrally located logistics centers where all shipments are transported to the destination regions on the outskirts of major cities as one complete load in swap bodies – combined in several boxes – on a semi or tractor trailer. The containers are transferred from these trucks to delivery trucks at so-called mini-distribution centers, open areas locatable anywhere. This generates numerous benefits for the operators of such distribution systems. Since only one single logistics center is needed, capital expenditures are correspondingly low. Mini-distribution centers can be erected in available areas such as trucking yards or parking lots. Dynamic structural growth, adjusted to actual need, leads to the opening of new mini-distribution centers or the closing of unused ones. Such a mini-distribution center for the city will also be set up and tested in the project MD-E4.

Work at Magdeburg’s Galileo Test Bed concentrates on knowledge of a container’s location all the time and the generation of information on the status of its contents, including, for instance, unauthorized opening of the lock or the temperature inside the containers. In principle, projects are developed at the Galileo Test Bed with the aim of developing new fields of application for tele-matic technologies and concepts for innovative material handling and transportation systems and approaching potential users. In particular, companies affiliated with transportation will be encouraged to take advantage of these satellite technologies with great commercial potential for them.

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Delivery trucks with swap bodies will soon be electrically powered. The battery is located in the crossbar under the body and is replaced every time it is swapped.

Graphic: Fraunhofer IFF
DRIVING GREEN AND MANAGING SMARTLY

ELECTRIC VEHICLES CAN BECOME A MOBILE COMPONENT OF FUTURE SMART GRIDS

Dr. Przemyslaw Komarnicki, Dr. Thoralf Winkler and Kathleen Hänsch
Wind, sun, water or biomass – the broad reorientation of energy production, including sustainable energy carriers, is necessitating modifications of the grid infrastructure. Old grids will have to be replaced by smart grids. One element, which would especially profit from intensified green power production’s carbon footprint, could also help in the future – the electric car.
Widely visible, large power lines shape the landscape. They connect energy producers with consumers and constitute established grid structures. The power they transport comes chiefly from major power plants that assure industry and private households are supplied with power. For now. While, in 2009, an average of approximately twenty-three percent of Germany’s electrical power came from power plants and approximately fifty-five percent from power plants that use fossil energy carriers, seventeen percent was already being produced from renewable energy carriers and this amount is growing continually (source: Federal Environment Agency). One day, sources such as wind, sun, water and biomass will even cover the majority of Germany’s energy requirements.

Changing Grid Structures

This revolution in energy production entails a number of challenges. One is the smaller sizing of relevant systems and power plants and their wide distribution throughout the entire country. This affects present grids, which were not originally designed for this type of incoming power supply and distribution. Clearly calculable, centralized energy production will thus increasingly be replaced by numerous smaller power producers, which, when they utilize wind and sun, will deliver based on output rather than demand. The influence of weather, seasons and times of day on the production of solar and wind power cannot be eluded. Ensuring a stable supply in the future nonetheless will necessitate compensating such fluctua-
Regulating a varying power output will be one challenge of future grid control. The tremendous growth of renewable energies is confronting grid operators with the challenge of upgrading and modifying their infrastructures to ensure the stability of the grid and the quality of supply in the future, too.

Consequently, new so-called smart grids are being developed. Their job is to intelligently monitor, control and protect the distributed smaller producers, the consumers and the grids, including primary and secondary voltages, which have not been monitored particularly closely until now. Systems will have to be developed to manage these complex processes and establish equilibrium between supply and demand.

Insufficient Storage Systems

One of the main problems that will have to be solved is the currently limited capability to store excess electrical power from sources such as the sun and wind. Since, the capacity of pumped-storage power plants is only minimally expandable, Magdeburg’s Fraunhofer IFF is instead counting on electric vehicle batteries to take over this job in the future.

Transportation Concepts of the Future

Since the end of 2009, experts from the Fraunhofer IFF have been collaborating with regional and national partners from industry, academia and research in the project Harz.EE-mobility.

For one year, a small fleet of electric vehicles drove through the Harz region and Magdeburg to test the electric vehicle concept developed. Photo: Viktoria Kühne

The availability of renewable energy sources such as solar power is irregular and instable. Smart grids will have to compensate. Photo: MEV Verlag
The network is devising a concept for an electric vehicle network, which primarily builds upon supplying energy from renewable sources. The introduction of electric vehicles is generally considered to be the only way to actually reduce CO2 emissions in public transportation, one of the German government’s primary goals.

A year-long field trial with a small fleet of electric vehicles tested the approach’s viability in rural and urban areas. With success. Individuals, who had specially applied to be involved in the project, companies and the engineers themselves drove the retrofitted electric cars through the Harz and Magdeburg regions in order to test them in continuous operation. The engineers primarily collected experiences with the specially erected charging infrastructure, including public charging stations and connections in private households, as well as the special communications and navigation technologies, which they had developed. They interconnect all vehicles and the power infrastructure through an electric vehicle network control center.

Demonstrated Feasibility

The findings demonstrated that this is feasible. The current system is able to meet this challenge. Digital electric vehicle network control centers can manage vehicle charging, while always factoring in the availability of renewable energy. Moreover, stored electricity can always be made available to the grid whenever a vehicle is not in use. Vehicle-to-grid (V2G) or grid-to-vehicle (G2V) are based on the premise that drivers’ mobility is guaranteed in all cases. This means that vehicles must be ready and recharged at a specified time under any circumstances and that no more energy is ever tapped than what the owner has approved beforehand.

Despite all of the positive results, a significant weak point of the concept was also discovered in the course of the one-year field trial: the human vehicle owners. Their willingness to connect their vehicles to the grid when they do not need them and to make “their” energy available voluntarily is not very highly developed. Researchers see more need to develop sustainable business models here, which effectively increase drivers’ motivation to share power. At any rate, drivers themselves will decide what role their cars assume in such a system in the future, too.

Renewable Energies for Electric Vehicles

The Harz region was an ideal test bed for one simple reason. Renewable energies play an important role in the region. Two thirds of the power produced there is recovered from the sun, wind and other alternative sources. Harz.EE-mobility took advantage of this to develop a concept for an electric vehicle network including a functioning power and traffic management system, which, with an eye toward the future, is largely supplied by renewable energy sources. At the same time, it was essential to test the certainty of the grid’s supply under such conditions.

This enabled the developers to closely study the performance of drivers’ vehicles in urban as well as industrial and rural areas. The evaluation of kilometrage and charging cycles played just as important a role as the locations where vehicles were frequently parked and the average times they were parked. Such idle times are important because they can be used not only to charge but also to discharge storage media and thus to return electricity to the grid systematically during peak periods. The idea is simple. Parked cars can be charged. Once they are charged, their batteries can help avert impending energy shortfalls during peak periods. One of the research consortium’s aims was to study whether and how this can be done.

Vehicle Batteries as Temporary Storage Systems

Successfully turning electric cars into mobile temporary energy storage systems with the active collaboration of their users will produce a distributed and flexible storage system for electricity from green but unstable sources such as wind or sun. In the future this will make the vehicles much more than pure means of transportation and energy consumers. As they grow in number – the German government estimates that one million electric vehicles will be on Germany’s roads by 2020 – their batteries will collectively represent a relevant temporary electricity storage medium, which can supply electricity when voltage drops in the grid.

A few numbers suffice to persuade anyone who thinks such ideas are utopian. Quick charging electric vehicles will have an output in the range of twenty to forty kilowatts in the near future. An average household requires approximately ten kilowatts tops but far less than one kilowatt on average. This comparison reveals the reserves lying dormant in vehicle batteries.
Future Technologies Bring New Challenges

Ongoing refinement of the technology for electric cars is making clear that other challenges will await the grid operators soon. While slow battery charging (usually over approximately six to seven hours for a complete charge) has been possible without constraints, the anticipated future rapid charging units will swiftly push grids to their limits. Then, a complete charge with these systems would take only around one hour to a few minutes.

Such a massive collection of power in next to no time will require new control mechanisms that help prevent grid overload. This, in turn, will require functioning communication between the individual levels of the grid, which will enable them to stabilize far more dynamic grids.

Magdeburg’s Fraunhofer IFF research on electric vehicle networks is primarily focused on the analysis of these complex grids. Part of this work entails developing charging stations able to connect with different vehicles and higher systems. The integration of data from driver information systems also appears realistic. In addition, it is developing diverse communication components up through the important digital vehicle network control centers that completely manage transportation and energy flows. The latter can support several providers’ electrical grids, while operating independently from them. A roaming system, resembling the principle familiar from mobile telephony, would most likely be the best solution for vehicle network control centers to manage a variety of grids in differing regions optimally. Then, a control center would function as an electric vehicle coordinator. They would transmit information on free charging stations and ensure that charging operations interact so as not to jeopardize the security of the power supply at vehicles and in the overall system.

Even if all of the researcher’s wide range of visions for electric vehicle networks were implemented, they would only cover a fraction of the smart grids’s functions and challenges and thus the extensive use of renewable energy carriers. Nevertheless, much potential is already identifiable.

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The apparel manufacturer GERRY WEBER relies on the latest RFID technology to localize and monitor its goods. Together with a Magdeburg system integrator, the innovative RFID system from the Fraunhofer IFF was integrated in GERRY WEBER’s transport chain at the logistics provider FIEGE.
RADIO CHIPS IN CLOTHING

Prof. Klaus Richter and Martin Kirch
In April of this year, GERRY WEBER International AG received the coveted RFID Journal Award for the world’s “Best RFID Implementation”. As in past years, the internationally leading professional journal presented the award for the successful use and refinement of RFID technology. This time, the award recognized the development of systems that use RFID labels in textiles. Whether in jackets, pants or coats, combines electronic article surveillance with manufacturers’ care instructions and the electronic product code.

According to the jury from RFID Journal, it conferred the award because the project set a milestone in the use of RFID worldwide. The incorporation of the full product assortment throughout the entire value added chain and the inclusion of the commercial partners are groundbreaking far beyond the textile industry. “We are just at the beginning of what this new system can do for our partners,” says Dr. David Frink, President of GERRY WEBER International AG, satisfied with the honor. With more than 425 HOUSES of GERRY WEBER and over 2,000 shop-in-shops, the concern is the first user in all of Germany to have implemented RFID everywhere in the entire process chain and as electronic article surveillance.

RFID Solutions Are a Trend

Such non-contact solutions are the trend. The 2011 RFID Monitor concluded that more than nine out of ten German companies surveyed intend to pursue them more intensively this year. 31 percent of the potential users are from industry, 15 percent from transportation and 7.37 percent apiece from facility management and public administration.

Magdeburg’s Fraunhofer IFF has been developing technological solutions that implement continuous tracking of goods in transit with RFID for GERRY WEBER’s logistics providers for nearly two year. The starting point for this is the textile labels, which are now being additionally equipped with antennas and microchips.

Continuous Monitoring from China to Germany

Tagged garments begin their travels at two Chinese distribution locations, Shanghai and Hong Kong. The RFID tags are already sewn into the textiles during production.
Later, they cease functioning after multiple washings. Packed in boxes, the textiles are shipped to Germany. An RFID Tunnel enables the logistics provider in China to scan and clearly match every single piece of clothing to a box. Every shipping box is labeled with a barcode, which is read with a handheld scanner before the RFID is scanned in the RFID Tunnel. From this moment on, the data sets created document any changes during shipping and until the retailers’ shelves. One of the logistics partners involved is FIEGE Mega Center Ibbenbüren GmbH. The company is part of FIEGE Stiftung & Co. KG headquartered in Greven, which has 210 locations in eighteen countries. The corporate group has over 130 years of experience in logistics outsourcing and provides services from customer orders, warehousing, shipping and distribution through returns management. That makes it a capable partner for the establishment of new RFID applications.

The System “Tunes” the Electromagnetic Signals

The technological innovation begins with the inner workings of the RFID Tunnel. A UHF RFID scanning system uses the principle of electromagnetic reverberation for UHF RFID applications, which was patented by the Fraunhofer IFF in 2007.

Electromagnetic reverberation originally played a role in EMC test equipment, taking measurements of electromagnetic emissions and immunity relatively easily with a minimum of instrumentation. In such electromagnetic reverberation chambers for EMC measurements, an array of variously aligned metallic reflectors is “tuned” in order to alter the electromagnetic boundary conditions. Continuous alteration of the boundary conditions produces a multitude of modes, which distribute field strength evenly over a defined period. This makes it possible to generate identical field strengths in every possible polarization in the precisely defined read range anywhere in a UHF RFID Gate with a frequency of 868 MHz. Any tagged pieces of clothing located in the predefined area are detectable.

The system reliably reads every thusly tagged object even under the most challenging of conditions. Bulk scanning of transponders, densely packed atop one another in a box, presents major challenges to the scanning equipment used whenever every transponder has to be detected reliably in any direction or position and solely in relation to one box.

Real-time Detection of Missing Items

By already compiling a complete box-by-box inventory in the country of production, GERRY WEBER is enhancing the transparency of its supply chain from its manufacturer’s facilities to its individual warehouses and distribution centers and finally to its stores. Items missing from hand-packed boxes are already detected in the country of production and the globally available inventory is updated in real time. FIEGE Mega Center Ibbenbüren GmbH inspects incoming goods here in Germany. A variance analysis is performed. Whenever there are discrepancies, the boxes are opened to verify and, if necessary, make up for any difference. Afterward, the shipments are combined and handed over to the shipping partner.

Flexible Systems

Other solutions based on the same principle are imaginable in the near future. Boxes of items are not just scanned and documented anywhere. A delivery can be documented even at a store with technological ease. The read infrastructure does not have to be a permanent installation because the system is flexible and easily scalable. Even tent-like receiving stations that perform the same task are conceivable or changing rooms with the appropriate metal shielding could be employed. Items can also be scanned quickly when they are delivered. Even inventories would only take a fraction of the time needed now.

The Fraunhofer IFF sees a bright future for this system, not least because a very large number of other applications other than textile logistics are possible. Even products that have been difficult to track with radio signals, such as bottles filled with liquid, can be identified reliably using the principle developed at the Fraunhofer IFF. When meat is delivered to hotels or from processors, a continuous perishable goods chain can be easily monitored and assured. The potentials are wide ranging and even include an RFID Tunnel for trucks.

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EVERYTHING IN VIEW

AUTONOMOUS POSITIONING AND INDOOR NAVIGATION FOR MOBILE ROBOTS

Dr. Norbert Elkmann, Christoph Walter and Erik Schulenburg
Mobile robots and automatic guided vehicle systems are found in many companies moving from station to station, usually on predefined paths, transporting material and completing simple tasks for us. A new system for reliable positioning and autonomous navigation in buildings is giving them more freedom of movement – and companies more flexibility.

What would manufacturing and logistics companies be without them? Automatic guided vehicle systems (AGV) and mobile wheel-driven systems and robots have evolved into important industrial assistants. As if pulled by invisible strings, they move straight through buildings fully autonomously and transport material, deliver parts to processing machines or take over a variety of other jobs. They thus support humans who perform simple and strenuous activities. Unfortunately, these systems do not move quite as autonomously as they appear to at first glance. A control center radios their assignments to them, after which they then have to follow specific routes with specified stops where, for instance, they pick up material and take it to a destination.

Flexible Only in a Permanently Installed Infrastructure

They rely on set routes and a permanent signal infrastructure, which have to be specially installed for them, to find their bearings in their environment and reliably approach their destinations. AGVs might use guide wires or transponders in the floor or optical guidance with lane lines to orient themselves as they travel to their destinations. Such infrastructure enables these systems to follow their routes reliably and complete their assigned tasks. They are unable to deviate from the specified routes, however. If manufacturing or supply operations are changed or a facility is reorganized, the signal infrastructures often have to be reinstalled and the AGVs’ programming modified.

Much Modification Work when Processes Change

Their lack of flexibility in the field not only reduces their effectiveness but also unnecessarily curtails the efficiency of logistics and manufacturing operations. The latter cannot be reorganized abruptly without considering the permanent infrastructure. Ultimately, if the modifications are more substantial, everything even has to be reinstalled. This may mean having to reinstall transponders or wires, put down new optical lane lines and replan routes. Optical navigation systems that revert to special ceiling markings are much the same. While the application of the markings is less complex, these navigation systems also need a permanent signal infrastructure, which has to be specially installed before the navigation systems are used on transport equipment or robots.

Although other positioning systems such as GPS fundamentally provide an opportunity for flexible modifiable navigation for mobile systems, they are not an alternative in factory buildings because the availability of signals there is unreliable. Consequently, failure rates would be high. Laser scanners on the other hand also fundamentally provide an opportunity for flexible indoor orientation but they only scan the environment just above the floor. What is more, bigger changes in the environment, such as stacked pallets or other obstacles, cause difficulties for navigation using laser scanners because they rely on stationary environment features. All of these solutions also entail high costs for installation and sensor systems, which further restrict their application. Now as before, automatic guided vehicle systems or robots can only identify their positions and perform their assigned tasks within the narrow bounds of defined routes.
New Systems Orient Robots Reliably without Any Signal Infrastructure

A solution just developed at the Fraunhofer Institute for Factory Operation and Automation IFF solves these problems simply but effectively. The system operates based on the principle of visual odometry, i.e. the system optically scans its environment and autonomously extracts specific stationary environment features, e.g. roof structures in manufacturing facilities, and calculates the distance traveled based on the shifting of objects in the camera image. Various commercially available sensors and scanning systems were combined, making it possible to use recorded environment information reliably for orientation with the aid of additionally developed software. It thus has capabilities that conventional solutions do not: It allows autonomous mobile systems to navigate flexibly inside buildings regardless of the infrastructure. In short, it makes robots more autonomous.

The Fraunhofer IFF is presently doing research with a prototype of the navigation system on a mobile robot. All of the system’s components required for indoor positioning are inside a hemispherical dome with a diameter of just under twenty centimeters. It houses a camera, an inertial measurement system that measures and analyzes motion data, a computer and infrared light diodes. All of the components are inexpensively purchased and thus collectively more cost effective than laser scanners or other indoor positioning technologies for instance.

Human-like Orientation

A thusly equipped mobile robot or AGV is able to determine its position inside a building at any time without having to rely on guide paths or ceiling markings, which are technically complex and expensive to lay. Instead, such a system is navigated through all of the relevant areas of a building one time, recording and analyzing significant environment information, e.g. corners or edges ceiling girders, with the camera and the like, and converting it into information usable for positioning. Thus, like a human, it first “looks” at its new environment, “remembering” everything it sees. A specially developed algorithm extracts the optically recorded and subsequently digitized environment structures, which are interpretable as stationary with high probability and thus facilitate orientation.

The new solution surpasses conventional positioning and navigation systems in another way: It handles dynamic environments and thus changes in its environment. To do so, it performs a variance analysis of data every time it is underway in daily operation and draws conclusions about any structural changes in the environment. Thus, its positioning remains precise even when conditions have changed.

Additional markers made of reflecting material can be applied to points on walls to enhance the reliability of positioning, thus making even difficult sections of a route easy to handle. A small number of encodable identification markers suffice to achieve the desired effect. To this end, a pattern of points has been developed, which integrated infrared sensors detect even in darkness. The patterns have their own unique structures, thus ensuring that the system is able to determine its position in space as well as distances reliably and accurately.
Visual odometry: Robots equipped with this system can find their way around buildings on their own even without additional signal infrastructures.

Photo: Peter Förster
The efficient use of resources is crucially important to companies. This especially also pertains to the resource of “knowledge”. However, digital knowledge management requires know-how and a structured approach. So-called wikis, digital knowledge platforms, function like information exchanges on which employees exchange ideas in a structured and systematic manner and pass on important expertise.
The demands on companies’ knowledge management are mounting as they are compelled to organize more and more dynamically in response to global competition. Processes are becoming more complex and more segmented and their organization is often distributed. Work requirements and empirical knowledge are no longer communicated face-to-face and verbally. Instead, individual employees retrieve them on their own from digital platforms, in multiple languages and from any location. Since many processes run simultaneously, establishing communication among everyone involved and building upon the individual steps is difficult. This harbors major risks. Direct exchange among employees can fall by the wayside during this development. Thus, large and small companies are facing the challenge of upgrading and organizing their knowledge management to be better geared toward communication.

ProWis: Knowledge Management Oriented Toward and Integrated in Processes

Now that many large companies have taken this path, small and medium-sized enterprises (SMEs) are also recognizing the need for effective employee logistics. However, they frequently lack the know-how they need to efficiently manage their and their employees’ knowledge. Moreover, the importance of efficient knowledge management and the related challenges is often unclear. Therefore, in the project “ProWis: Knowledge Management Oriented Toward and Integrated in Processes in SMEs” and the subsequent study “Knowledge Management in SMEs”, the Fraunhofer Institute IFF in Magdeburg and the Fraunhofer Institute IPK in Berlin developed guidelines and methods for action, which are intended to help SMEs implement efficient knowledge management.

ProWis was launched in 2005 as a project supported by the Federal Ministry of Economics and Technology in order to provide manufacturing SMEs the assistance they need. It focused on SMEs with up to 250 employees. Fifteen companies from the sectors of machinery, automotive and electronics manufacturing participated in the three-year project. All of the participants in the project were required to already have existing process specifications.
Three Fields of Action Make Knowledge Management a Success

At the start of the project, a detailed analysis of the basic conditions and the status quo had to be performed in the individual companies. The basis for this was a method of business process-oriented knowledge management (GPO-WM) developed at the Fraunhofer IPK. The method, based on a workshop, aims to assess the systematic handling of knowledge as part of a specific business process. Both strengths and potentials for improvement are identified and solutions for potential deficits are devised together with employees.

The internally developed survey and an interview procedure were employed in ProWis to analyze different domains of knowledge, e.g. knowledge about products, customers or markets, and the four core knowledge management activities of “production, documentation, distribution and application”. This revealed how the companies treat their reserves of internal knowledge. The results of the analysis made it possible to define three significant fields of action for effective knowledge management: 1. Inconsistent and inadequate data archiving and information storage, 2. Interaction among individual units (knowledge exchange) and 3. Collection of experience from projects.

Greatest Challenge: Handling Knowledge

The results of the analysis of the companies involved in the ProWis project, which related to the importance and challenges of knowledge management in SMEs, were published during the project as part of the study “Knowledge Management in SMEs”. In addition to structural and economic challenges, the respondents specifically assessed problems handling knowledge and various types of knowledge as critical. Of the twenty-two current challenges analyzed, “knowledge as a critical factor” emerged as the third largest problem.

Optimizing the challenges in each of the domains requires methods that record processes for the first time, describe them exactly and make them comprehensible for everyone involved. The actual design and implementation of efficient knowledge management are contingent on these conditions.

Wikis for Process-oriented Knowledge Logistics

Workshops on collecting experience or standardizing information flows and storage are ideal for the effective management of corporate knowledge. The installation of special Internet platforms called wikis has proven to be a helpful support for such actions. Such an application enables all of the users involved to actively edit, link and delete contents, i.e. information that is digitally stored and used collectively, or even add new entries. Ultimately, wikis very systematically improve direct collaboration and near-real time documentation of corporate processes.

Above all, wikis support process-oriented knowledge management. Since all of the users can access available information centrally, they are able to collectively formulate concepts, plan and execute projects and compile documentation even when they are far away. The merits of a wiki are self evident: Everyone involved in a project is aware of its status or changes to it in near-real time and the higher density of documentation increases transparency especially in cross-unit projects. The greater transparency also enables employees to optimize the scheduling of their own hours of work. Internal communication improved by implementing and employing a wiki makes more empirical knowledge available as it were. This makes knowledge logistics important and effective.
Enhance Usability of Corporate Wikis

Installations of wiki also revealed however that conventional wikis are suitable for use in companies only to a limited extent. In order to modify them for SMEs’ requirements, the research project “ICKE 2.0“, supported by the Federal Ministry of Education and Research, was launched at the Fraunhofer IFF in 2008. In cooperation with the Fraunhofer Institute ISST in Berlin and CosmoCode GmbH in Berlin, Fraunhofer experts successfully developed essential tools during the two-year project period, which make conventional wikis suitable for companies.

The usability of wiki applications in a corporate context was systematically optimized at three companies that had already participated in ProWis project. The aim was to create detailed maps of structures, such as projects or processes. Specific wiki training courses were also held to better familiarize employees with wikis and enable them to work with them properly. The outcome of the project ICKE 2.0 is available to the public online and can be downloaded from www.ickewiki.de free of charge.

Modular Solutions in the ProWis Shop

Effective process-oriented knowledge management presupposes that companies are able to optimally adjust their knowledge logistics to change processes on their own. The ProWis Shop developed by the Fraunhofer IFF during the ProWis project serves this purpose. A large number of field-tested solutions, aids and reports on experience are available to interested companies online on www.prowis.net in order to enable them to establish the transparency necessary for effective knowledge management.

Based on the principle of do-it-yourselfers who select the tools right for them from the abundant range of products at a hardware store, every company can select “its” knowledge management solutions in the ProWis Shop and implement them for its own uses. They additionally transfer knowledge at the same time content is being collectively compiled, verified and improved. The ProWis Shop will open with a new look for all companies in the fall of 2011.

Companies Verify the Merits of Efficient Knowledge Logistics

Participants in the ProWis project have confirmed the sustainability of the projects ProWis and ICKE 2.0 and the efficiency of systematically implemented knowledge management solutions. “Intensive communication with the other ProWis participants has made us aware that we are in excellent company with many other SMEs with ‘everyday problems‘,” according to Bernd Molter from Kristronics GmbH in Harrislee. “Some processes, especially our bidding, have been reorganized and now proceed in a much more structured fashion than before. Many other processes are still waiting on their ‘redesign‘ because of day-to-day business – but the ProWis project taught us how to tackle such things expeditiously.”

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Introduction to a wiki.

Thus, effective knowledge logistics is not hocus pocus. With the requisite basic knowledge, it is relatively easy to implement. Once implemented, it can quickly become a crucial competitive edge. The measures and methods developed in the projects ProWis and ICKE 2.0 are valuable aids that manufacturing SMEs will be able to use in the future to improve knowledge management systematically and to develop new solutions on their own.
DIGITAL LOGBOOKS WITH GPS AND RFID

SATELLITE PART TRACKING IN OUTDOOR STORAGE FACILITIES

Tobias Kutzler
The organization of outdoor storage facilities is made difficult by the lack of clarity, relative uncertainty about the real stock on hand and time-consuming inventory taking. New technologies such as the GPS digital part tracking system developed by the Fraunhofer IFF will simplify this significantly in the future.

The Needle in the Haystack

Industrial outdoor storage facilities have a problem from time to time: They can be quite expansive. This often makes it difficult to locate even especially large parts stored there, as odd as that may sound at first, or to estimate the actual stock on hand realistically. Searches for individual parts can consume valuable time and resources. Ultimately, parts are often identified based on simple visual markings. If these are poorly positioned or hidden however, heavy parts weighing several tons may have to be moved. Unfortunately, quick “rearrangement” of items to clarify identities far too often proves to be an irritating mistaken search.

Relative Inventory

More importantly, logisticians usually only have unverified information on inventory at their disposal for this kind of storage operation. They frequently still work with simple, manually compiled documents and tables. In principle, such written documentation allows the assumption that a part was manufactured or delivered at a specific time or placed in a specific spot in a storage facility or picked up at another time. The work required to keep such documents constantly up to date can quickly take on substantial dimensions at a large storage facility. Format changes when numbers are entered manually and inaccuracies when storage locations are specified make finding a part again difficult. If one wants to know exactly however, one has to go look for oneself. When the item sought cannot be found, a complete inventory is necessary.

More Work Means More Costs

The challenges of keeping inventory manually are primarily the relative imprecision and the sometimes extreme delays entailed by verification. The risk of “non-movers” and “remainders”, i.e. hard to find parts, is sizeable. More and more information must be processed and updated as storage facilities are used to the limits of their capacity.

At the right place at the right time? Efficient management of outdoor storage facilities saves much time and money. Photo: Dirk Mahler

This is the real problem: If the glut of information is so extreme that information is only available with a time lag, then the actual inventory and the tables and documents no longer correspond and finding a part requires considerable work.

Inventories have to be taken even when “lost” parts are not being sought. In many companies, the current inventory has to be reported routinely and especially at year’s end. Depending on the size of the warehouse, this can last several days. Since especially large parts are also particularly valuable and thus constitute fixed capital, companies are interested in the actual inventory on an almost daily basis. However, this is virtually impossible under the aforementioned circumstances.
Virtually everyone in management has faced this challenge. The Logistics experts at Magdeburg’s Fraunhofer Institute also confronted this problem when they collaborated with the wind turbine manufacturer ENERCON. Ultimately, both took this as an opportunity to collectively reflect on a practicable and cost-effective solution to the problem. The outcome was a digital nameplate supplemented by a system with an automatic satellite GPS tracking system for the outdoor storage facility.

**Digital Nameplates**

The specialists at the Fraunhofer IFF built upon their experiences with proven indoor tracking solutions for efficient warehouse organization. This served as the basis to develop an easy-to-use outdoor tracking system for outdoor storage facilities, specifically for large parts measuring three meters and larger. All of the parts were tagged with RFID chips to simplify their identification. On the one hand, the parts can always be identified individually. On the other hand, the chips are used to connect with the tracking systems. These tracking systems are equipped with a GPS receiver and transmit their new locations in certain intervals or changes of location. Then, the system also indirectly knows a part’s whereabouts through the link established with the RFID chip. This produced an entirely new logistics solution for outdoor storage facilities. It has made it possible to locate all of the tagged items in an outdoor storage facility, precisely determine their location and position and additionally identify them individually with all of the necessary and available data.

**Motion Sensors Report Relocation**

The technology is easy to use and install and is based on commercially available, autonomous positioning systems. The palm-sized units have a GPS receiver, a GSM modem, a motion sensor, a battery and, optionally, an internal compass. It uses cellular radio not only to transmit the position of the item to which it has been attached but also to determine its exact orientation as required. The unit’s battery ensures that parts can be tracked even when stored for periods of several weeks.

Thus, all storage, transfer and retrieval operations are tracked with the aid of integrated motion sensors. As soon as a part is moved, the tracking systems are activated and transmit the part’s current position once it has been deposited. This makes it possible to plan and monitor optimal inventory virtually, while maximizing the utilization of the available space. Managers now know where every part is located in real time and to the exact millimeter. They are connected with their stock any time they want to be and can view the exact overall immediate state of a storage facility virtually on a monitor in seconds. A storage facility can now be inventoried in just a few minutes rather than several hours as was usually the case.

**Complete Part History on the Chip**

Easily written and read by a handheld unit, RFID chips store all of the data relevant to particular parts. Model, material, place of production – any information desired can be stored on a part digitally and added at any time. Current data can even be added at a construction site, e.g. when a part is repaired there, or the group of parts to which it belongs whenever this ought to be recorded. Chips thus becomes digital logbooks that record the entire history of parts from production.
Storage Location

Digital tracking systems generate considerable benefits for outdoor storage facility logistics. The status of the complete inventory is automatically available as dynamic live information and any detail about a part can be retrieved immediately. In addition, the system’s software provides support for optimal storage planning. It proposes the most efficient inventory management possible and is thus a valuable tool for routine decision making. Nevertheless, storage locations are still freely defined. People still decide where new items are to be stored. The system notes when its decisions are not followed. It immediately adjusts to the new storage situation and, building upon this, computes the next efficient options.

Transparent Inventory Management

This establishes optimal transparency in inventory management. The digital visualization of its actual inventory enables every manufacturing unit at ENERCON’s Magdeburg facility to access any relevant information rapidly and obtain the necessary overview. Consequently, overlapping procedures are combined more closely. Naturally, the system also supports stock reductions or adjustments of stock to just-in-sequence manufacturing.

From the Storage Location into the Building

Outdoor storage facilities are just the beginning, though. A multitude of parts are additionally stored in buildings. Until now, movements of parts from an outdoor storage facility into a building could not be tracked automatically. The Fraunhofer IFF is collaborating with ENERCON to cover this transition, too. Existing indoor tracking and newly developed outdoor tracking solutions are being combined. The seamless transition from tracking systems with GPS receivers to other tracking systems or vice versa will notify warehouse management systems of an item’s current position at any time, regardless of whether it is in a building or an outdoor storage facility.

Software Proposes the Optimal

through installation. This capability of the technology does more than just tremendously support quality assurance. It also becomes an interesting “add-on”, which manufacturers can additionally deliver to their customers. If a part has to be repaired years later, all of the important information is automatically available then and there.

RFID chips can store a part’s complete history. Photo: Dirk Mahler

The company obtains an exact overview of its complete inventory in seconds. This can even include every individual item’s location and orientation. Photo: Dirk Mahler
From Storage to the Road

The solution does not stop at the edge of the company’s premises. Positioning and communications solutions such as GPS and cellular radio, which do not require any permanent infrastructure, make the system usable outside the company’s premises.

It has interesting benefits for monitoring the transport of large parts and construction and work equipment. Among other things, more effective batteries have to be installed if lengthier transports are to be monitored.

The integrated shock sensors register influences on an item during transport. They are localized immediately and promptly transmitted to a control center by GSM. Thus not only whether, how often and where a part has been moved but also any forces active during transport are detected. Since the system transmits its data in very short intervals, the entire transport procedure is documented, including any adverse affects on a part. The sensor system would therefore be an important step toward complete active monitoring of transports. The system has another benefit.

Its flexibility and independence from any infrastructure, e.g. antennas, also enables it to track objects in rugged and undeveloped terrain. Construction equipment, cranes, vehicles could all be tracked off-road easily.

Less Work and More Information

The automated solution is far more convenient than and superior to conventional approaches. Newly acquired and current information enables logisticians to focus more on optimizing a storage facility. The reduction in work not only cuts storage costs but also makes the workload more efficient. Complete storage of all storage operations in the system or on a digital nameplate delivers an inexpensive part history, which can cover all stages from production, storage and different transports to a construction site.

ENERCON is utilizing the logistics support system for outdoor storage facilities at its Magdeburg facility with great success. Its flexibility, simplicity and ruggedness make the system attractive for many other domains. Ultimately, not only logistics but also other corporate units such as quality assurance will benefit from it considerably.

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Monitoring transports is the key to attaining more transparency and security. The logistics experts at the Fraunhofer IFF develop the right systems solutions for such tasks. Photo: Dirk Mahler

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The word LEGO quickly evokes visions of colorful plastic blocks. Houses, vehicles, imaginative landscapes or little figures are made from many different elements. The fun has long since left the playroom. Special block sets can now fulfill many engineering dreams. Even intelligent robotic systems can be built. Many young people from all over the world take on this demanding challenge every year at the international FIRST LEGO League. Students from Magdeburg’s Werner von Siemens High School also compete and have even established themselves among the world’s top LEGO inventors.
Since 2004, the researchers at the Fraunhofer IFF in Magdeburg have been supporting a special competition. The FIRST LEGO League FLL is a global program intended to introduce young people to research and technology in a competitive environment. They have fun, compete in teams and solve complex technical problems. They concentrate on devising creative and clever solutions that actually function and are demonstrably practicable. Every year, the competition has a different theme such as nanotechnology, medical engineering or food safety.

**Fair Competition**

In different elimination rounds, the young ten to sixteen-year old researchers solve problems that demand team spirit, broad knowledge and a lot of technical know-how. They use LEGO robot building sets available in stores to plan, design and test small machines or robots. These contain programmable elements, electric motors, sensors, gears, axles, blocks, etc. After much practice, they can construct small robot or even other technical systems. It is essential to proceed cautiously because a robot not only has to function but also subsequently take on others in tournaments. They compete against one another in different disciplines in which they have to solve different and, in part, very complex problems under time pressure. The robots are however not the only element of competition faced by the young developers. They also always have to implement a special research task, always geared toward the theme of that year’s competition. In this “freestyle event”, they are free to decide how to interpret specified theme and come up with a technical solution. No limits are set on their creativity and this has produced some surprises throughout the tournament’s history.

*The young inventors find the ideal environment and ample support at the Fraunhofer IFF to develop new ideas. Photos: Dirk Mahler*
Although Error Force One only placed in the middle at the 2010 international FLL Open European Championship in Delft, Holland ...

Along with other schools in Magdeburg, Werner von Siemens High School also fields a team for the FLL. The school bears the name of the inventor, engineer and later entrepreneur Werner von Siemens (1816 – 1892) for good reason. The school’s mission is namely to support young people with talent in mathematics and the natural sciences. Many of the students attending, who decide to pursue degrees afterward, ultimately select an engineering program. Thus, excellent young researchers are cultivated early and simultaneously given the skills to be high achievers in future academic programs or jobs.

The Fraunhofer Institute for Factory Operation and Automation IFF shares these goals. Well aware that covering research and industry’s need for engineers today and especially tomorrow requires intense effort, the Fraunhofer IFF has been working with young talent for some time. The institute has therefore been sponsoring the always enthusiastic young inventors from the high school for seven years.

The Next Generation Arrives

The Magic Creators now have a successor, Error Force One. The team from Werner von Siemens High School has already been extremely successful in Germany. Since its formation a good three years ago, the team has regularly won the regional tournament in Saxony-Anhalt’s capital and eventually mounted the winners’ podium at the German Northeastern Semifinals in 2009. Among the twenty-four winning teams from Germany, Switzerland, Austria, the Czech Republic, Poland and Hungary, Error Force One placed tenth in the Central European Finals and thus qualified for the international FLL Open European Championship in Istanbul. While they fell short of first place in the overall ranking there, the team from Magdeburg nevertheless earned a lasting reputation among the world’s best LEGO engineers.

Rapid Success

This team effort began with the Magic Creators. A less than successful start, technical problems and perhaps a bit of stage fright landed the young researchers last place and a consolation prize the first time they entered the FLL tournament. The young people quickly learned from their experiences though and took an outstanding second place at the German FLL Finals the following year. They also won the SAP award for best programming. That spurred them on. In 2007, they packed their bags to compete in the FIRST LEGO League World Championships in Atlanta, Georgia, USA. Ninety-four teams from all over the world had qualified. The boys and girls took home first prize in the category of robot reliability. In the end, they ranked thirteenth overall worldwide – a very good showing, given the strong competition.

The age limit of sixteen ultimately ended the Magic Creators’ promising track record. Nonetheless, they have remained loyal to engineering. Most of them have decided on careers in engineering and are pursuing degrees at Harz University of Applied Science and Otto von Guericke University Magdeburg, among others. This validates early involvement in such projects. They shape young people’s personalities and foster ambition.
Great Results

The theme of the 2010 FLL was “Body Forward”. Everything revolved around the themes of the “Human Body” and “Medicine”. Here too, the students from Magdeburg were again successful in the elimination rounds with their project on diabetes. The team developed a software called InsulAPP, which diabetics can use on a cell phone to calculate German bread units for over 10,000 foods. This solution with great practical relevance won over the jury, which awarded the Siemens High School students the prize for the best presentation of research. At times, the team also excelled against the competition significantly in the competition of actual robot performance in which robots have to complete an obstacle course with difficult tasks in exactly two and a half minutes.

With an overall rank of sixth at the European Finals, the students established an outstanding basis for the following FLL Open European Championship, which were held in Delft, Holland one year later. Sixty-seven very strong teams from all over the world assembled there to compete for the top international prize for LEGO inventors. Although the students from Magdeburg also put in a good showing, it was not enough to be frontrunners. Their final overall ranking well in the middle did not discourage the young engineers at all. On the contrary, their repeated participation in the international finals was itself recognition that they had finally established themselves among the world’s best FLL teams. The team intends to used its acquired experience to fully go on the offensive next year. One day for sure, they want to be the best in the world.

Vital for Young Engineers

The FIRST LEGO League is also vital to Magdeburg’s Fraunhofer IFF’s recruitment of young engineers, even if not for the institute itself. It is more important that the girls and boys wind up having fun with engineering itself and learn how to work like researchers. Dean Kamen, the initiator of the American LEGO League puts it so: “We need to show kids that it’s more fun to design and create a video game than to play one.” The short time in which an assigned task must be completed additionally forces them to take a concentrated approach. They only have a few weekends to work. Experts from the Fraunhofer IFF support them in this phase in particular. They supply tips on working as researchers and provide rooms and infrastructure. While developing its solution on its own, the FLL team learns how real product development proceeds. It has to make do with the resources provided and keep the tight schedule. The students thus learn how to approach research and engineering problems professionally at an early stage.

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... many participants from all over the world were still interested in their tournament entries. Photos: Private
playful problem solving
management games for advanced training

Annegret Brandau and Dr. Tobias Reggelin
PLAYFUL PROBLEM SOLVING
MANAGEMENT GAMES FOR ADVANCED TRAINING

Annegret Brandau and Dr. Tobias Reggelin
ULF is more than just a name. ULF is a plan. ULF means “Logistics-driven Company Management”. It is based on a training program that enables a company’s executives to think outside of their own boxes for once by using real management games. It abstractly raises logisticians’ awareness of their own operations and teaches them methods to improve them.

Companies intent on being successful have to optimize continually. Globalization and volatile economic developments are not only forcing them to reevaluate supplier and customer relationships regularly, to rethink and to adjust to constantly changing basic conditions. They also have to routinely examine their own processes. Poor communication flows, inefficient procedures or obsolete information management can quickly entail hidden costs. It is essential to identify such points and improve them in the company’s interest.

Teaching Methods Rather Than Supplying Pat Answers

Companies quickly lose their objectivity, the distance to themselves, which is particularly necessary to revise internal operations or optimize overlooked processes. This becomes especially evident when employees have to abstract, analyze and, ideally, optimize their own operations themselves. Moreover, companies often lack the necessary know-how and thus quickly reach their limits in these points.

Calling in outside consultants to optimize corporate processes is therefore often expedient. Successful process optimizers are always dependent on the assistance and collaboration of a company’s employees. Without them, even the best solutions for more efficiently organized processes are doomed to failure. Integrating employees in problem solving is therefore important. After all, they are the ones truly taking action. Instead of being given pat answers, they ought to arrive at correct solution themselves. Effective methods must therefore impart knowledge that is lacking. This motivates participants to learn independently and, in the end, their active involvement produces effective results. This is where the management games developed by the Fraunhofer IFF’s logistics experts come into play.

Fraunhofer IFF Management Games Are a Worldwide Success

Since the mid 1990s, the Fraunhofer IFF has been supplying such educational methods for different forms of advanced training. Its experts have traveled the world to provide such consultation, working in Russia or in Mexico, the USA and China. They are also sought after partners for academic programs at Otto von Guericke University Magdeburg. Their seminars are used for more than just continuing education, method development or training.

Logistics management games foster better understanding of process chains. Photo: Dirk Mahler
Since they are intended to eliminate barriers to acceptance, facilitate discussion and strengthen willingness to change, these seminars are often also helpful in the challenging starting phase of a project.

The different management games, which to the uninitiated look like a set of building blocks for grown ups, rely primarily on learning through play and working with advanced creativity techniques. Frontal teaching and presentations with transparencies, modern killers of creative thought, are dispensed with. Instead, management games directly and authentically demonstrate to employees the knowledge needed for their purposes and practical methods and skills for self-optimization.

ULF Alters Traditional Thought Structures

Despite all the gaming elements, the method is based on research, extremely efficient and always oriented toward real corporate operations. The management game “ULF: Logistics-driven Corporate Management”, for instance, simulates a manufacturing company and its ties to the buyer and supplier market. The game starts with a company strictly organized in an order center, sales, purchasing, parts manufacturing, pre-assembly and final assembly. The players occupy the individual stations. Information and material flows are also strictly demarcated from one another and set up with a structure.

Especially in the first round of the game, players experience the procedural difficulties caused by such functionalistic thinking. Then, employing creativity techniques, they collectively develop solutions and immediately implement and test them in the modular game. In the process, the players grasp the causal relationships in their company and see the consequences of their decisions. The great advantage of this procedure is that it is an abstract simulation. The decisions players make are visible immediately but fortunately have no real consequences. At the end of a seminar, players have learned more than just complex and current management strategies. They have also experienced the importance of changing their perspectives, i.e. from function to process-oriented, and views, i.e. from worm’s-eye to bird’s eye.

Logistics Tools for IT Specialists

Staff at Airbus in Hamburg also played the ULF management game in early 2011. Whereas manufacturing and logistics experts often receive advanced training in these seminars, this was the first time IT specialists were trained. One intention of the project was for the twelve participants to think outside of their own boxes. Ultimately, they were supposed to acquire experience transferring manufacturing concepts to IT operations. The group of players matched the company’s international makeup. Among others, experts from Germany, Great Britain and France took part. This enabled them to communicate straightforwardly – not by phone or email as they normally would in everyday business at the company – for two days, to identify problems collectively and to develop solutions.

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Since August of 2011, Holger Seidel, Manager of the Logistics and Factory Systems Business Unit at the Fraunhofer IFF in Magdeburg, has been the new Vice President of the state of Saxony-Anhalt’s Logistics Advisory Council at the Ministry of State Development and Transportation. Jobst Paul, the Deutsche Bahn AG’s Corporate Representative in Saxony-Anhalt, was elected president, thus replacing Bernd Enders (Kühne + Nagel AG & Co. KG).

After graduating with a degree in industrial engineering from Otto von Guericke University in Magdeburg, Holger Seidel first worked as an engineer in the production organization unit at SKET-Schwermaschinenbau GmbH Magdeburg until he was appointed an assistant professor in the Department of Factory Planning and Logistics at Otto von Guericke University. The logistician has worked at Magdeburg’s Fraunhofer IFF since 1992. His specializations include production planning and control, factory planning, cooperation and service research, knowledge management and logistics management.

The logistics expert has authored numerous publications on factory planning and logistics. He is the spokesman for the Saxony-Anhalt Regional Chapter of the German Logistics Association and a member of the Magdeburg CIC’s Transportation Committee, the State Commission of Transportation and Logistics Experts, the economic advisory council of the Saxony-Anhalt State Association and the extended executive board of the REFA Center of Productivity Management and Maintenance Expertise in Magdeburg.

In May of 2011, Otto von Guericke University Magdeburg awarded an honorary doctorate to Bernd Liepert, a Member of the Fraunhofer IFF’s Advisory Board. The mathematician is a Member of the Board of KUKA AG and in charge of technology and development for the entire KUKA group.

Bernd Liepert’s career began when he started at the company in 1990. He was instrumental in turning KUKA AG’s into one of the world’s leading manufacturers of industrial robots and robot controllers. Under his leadership, an entire new robot controller was created, which is based on conventional computer systems and the Windows operating system. This innovation quickly proved to be revolutionary. Whereas robot programming used to require explicit expert knowledge, this could now be done much faster and, above all, more easily. Henceforward, robots increasingly became a permanent fixture of automated production.

Today, Bernd Liepert is one of the forces driving the further development of robot applications for people’s everyday lives. They will soon be supporting us in many domains, for instance at home, on the job or in healthcare. To this end, he is also de-
the ambitious logistician to the USA, Italy and Thailand. He earned
his Master’s in Engineering Management while attending Rose-
Hulman Institute of Technology in Terre Haute, Indiana, USA on an
International Fellowship. Tobias Reggelin was awarded the Associ-
ation of German Engineers’ Young Engineer Award for his Diplom
thesis and placed third among the recipients of Detecon Interna-
tional’s Mobile Award.

After graduation, the native of Magdeburg quickly realized that
he wouldn’t necessarily have to travel far to pursue his career. He
found exactly the “close relationship between research and indus-
try” important to him right here at Otto von Guericke University
and Magdeburg’s Fraunhofer Institute. Although he had other very
good offers, he started his job as a young researcher at the Insti-
tute of Logistics and Material Handling Systems ILM and the Fraun-
hofer Institute IFF in December 2003. He had already collaborated
on a number of projects at the latter as undergraduate. The con-
crete subject of his dissertation took form there. As a specialist in
the optimization of corporate logistics operations, Tobias Reggelin
wrote his dissertation on a new approach to analyzing supply
chain systems faster.

The thirty-three year old, newly minted doctor of engineering
management balances work with sports, playing field hockey
games, entering the Vasaloppet, a 90 kilometer cross-country
race in Sweden, or mountain biking across the Alps from
Germany to Italy. Additionally, he has been an active volunteer
supporter of a hockey team in Magdeburg and the Saxony-Anhalt
Hockey Association for many years.

A LOGISTICIAN WITH COMPETI-
TIVE AMBITIONS

Creativity and endurance are two traits that can be ascribed to
Tobias Reggelin with utter certainty. The passionate athlete
rarely runs out of steam – a trump he was able to play while
he was completing his dissertation. “That wasn’t easy,” he
recollects. “In my dissertation, I developed a completely new
approach to modeling and simulating supply chain systems.
That was a tremendous amount of work and demanding. Ev-
ey now and then, I had to pull myself together in order to
continue working with all my strength.”

Today, he can look at the outcome of his dissertation with
pride. He successfully defended his dissertation entitled “Me-
soscopic Modeling and Simulation of Supply Chain Systems”
with summa cum laude.

He was already thinking of earning his doctorate as an under-
graduate majoring in engineering management and logistics
at Otto von Guericke University Magdeburg. During this peri-
od, international exchange programs and internships brought

Dr. Tobias Reggelin. Photo: Stephan Reggelin

Photo: Peter Förster

Pending on intense collaboration between industry and re-
search. KUKA is collaborating closely with Otto von Guericke
University and the Fraunhofer IFF in the project ViERforES,
among others. At the Saxony-Anhalt Galileo Test Bed, for in-
stance, the partners are testing new forms of communication
between robots and transport systems. It is testing new solu-
tions for safe human-robot interaction together with the
Fraunhofer IFF. The family man also actively supports the de-
velopment of young researchers. In cooperation with Otto von
Guericke University, he would like to establish Magdeburg as
the permanent venue for the RoboCup tournament.
**FRAUNHOFER IFF PROVIDES VOCATIONAL TRAINING**

The Fraunhofer IFF is an interesting employer and not just for young researchers. It also trains media design and management professionals “on the side”. Ina Dähre and Jenny Dittbrenner started their vocational internships at the institute in 2008 and finished successfully in the summer of 2011.

Twenty-six year old Jenny Dittbrenner from Magdeburg had already acquired three years of experience as a student assistant in the Fraunhofer IFF’s library before she began her vocational training as an office communications manager. Now that she has completed the program, she will be supporting the Virtual Engineering Business Unit as a full-time project assistant.

Twenty-three year old Ina Dähre from Niederndodeleben near Magdeburg came to the Fraunhofer IFF by conventionally applying for the position. The young digital and print media designer will also continue applying her creative talent at the institute by starting a job in its graphic design unit.

**“JUGEND FORSCHT” WINNERS FROM SAXONY-ANHALT ALSO WIN AT THE NATIONALS**

Being young does not mean that one cannot be inventive. Six of the ten young winners of the Saxony-Anhalt State Finals were also among the winners of the 46th National “Jugend forscht” Competition. Twenty-nine of the competitors had previously presented nineteen research projects, some of which were very impressive, at the 2011 state competition held at the Fraunhofer IFF in Magdeburg from March 30 to 31.

In the end, eighteen year old Konrad Kürbis from Hettstedt was also one of the winners at the nationals. He studied the significance of water-filled vehicle tracks in the soil as complex habitats for amphibians. For one year, he systematically analyzed especially small pools of water left on the edges of fields and meadows by large farm equipment at certain times of the year. He was able to prove that insignificant and hitherto unresearched puddles often become valuable microbiotopes and home to various species of amphibians and replace natural pools and watering holes that often no longer exist. After impressing the jurors in Saxony-Anhalt with his work, he took second place in the discipline of biology at the nationals in Kiel.

He was not Saxony-Anhalt’s only representative to win a prize at the finals in Kiel from May 19 to 22. Fifteen year old Michael Laue from Bitterfeld also won over the jury in the discipline of chemistry. He developed his own method of producing electrically conductive glass for dye-sensitized solar cells, for which he won a special award.
Tom Stiehler, 16, and Anton Anders, 18, from Gräfenhainichen won a special award in the discipline of engineering. Their development simplifies the operation of microwave ovens. Their invention enables the appliances to use a barcode reader to automatically scan and then autonomously follow instructions for the preparation of microwaveable food.

Benjamin Hilprecht, 14, from Stassfurt won a special award in the discipline of mathematics/computer science. He used a Bluetooth interface to develop a local social network that allows the exchange of news and information to cell phones at no cost.

The 46th National Competition’s award in the discipline of physics went to sixteen year old Robert Schittko, also from Gräfenhainichen. He designed a multispectral camera that makes light waves visible to the human eye.

The Fraunhofer IFF in Magdeburg hosted the Saxony-Anhalt Jugend forscht Finals for the fourth time and has established itself as the venue for the state competition. Institute staff is delighted at the many young researchers and would like to continue providing support in the future.
The introduction of electric vehicles is one response to the issue of how to organize green transportation concepts in the future. Together with electricity produced from renewable sources, they will sustainably contribute to conserving the environment. The Fraunhofer IFF is researching new smart grids that will compensate both the voltage variations and the additional loads expected from the growing number of electric vehicles.
With its Hanse Terminal, Magdeburger Hafen GmbH one of the partners in the Saxony-Anhalt Galileo-Test Bed.

At it, engineers from the Fraunhofer IFF and Otto von Guericke University Magdeburg are researching and developing new technologies that continuously track and monitor shipments.
School and college students and researchers from all over the country gather at the annual RoboCup tournament in Germany to let robots from a wide range of categories compete against one another in various competitions. The competitions focus on the robots’ flexible, learning and collective performance as well as their autonomous scene recognition and strategic response. Winners at this competition of several days have to push themselves and their engineering to the limit.
### EFFICIENT ENERGY CONCEPTS FOR THE FUTURE

Meet up with researchers from the Fraunhofer Institute for Factory Operation and Automation at these events. Come talk with us!

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<td>September 29, 2011</td>
<td>November 22 – 24, 2011</td>
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### EFFICIENT ENERGY CONCEPTS FOR THE FUTURE

Sustainability means preparing for tomorrow’s challenges today.

Whether in urban design, factory operation or transportation planning – efficient energy use is becoming a factor crucial to success. You need good partners for this.

Develop your ideas together with us.

Meet up with researchers from the Fraunhofer Institute for Factory Operation and Automation at these events. Come talk with us!!

<table>
<thead>
<tr>
<th>Event</th>
<th>Dates</th>
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<tbody>
<tr>
<td>August 22 – 26, 2011</td>
<td>August 29, 2011</td>
<td>Magdeburg</td>
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<td>&quot;Learning in the context of very high-dimensional data&quot; Seminar</td>
<td>September 7, 2011</td>
<td>Buchs, Switzerland</td>
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<td>Dagstuhl</td>
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<td>3rd Central German Logistics Forum</td>
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<td>Leipzig</td>
<td>First International Congress on Cocoa, Coffee and Tea CoCoTea 2011</td>
<td>November 11 – 13, 2011</td>
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<td>August 31 – September 2, 2011</td>
<td>September 15 – 16, 2011</td>
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<td>Joint International IMEKO TC1+TC7+TC13 Symposium Jena</td>
<td>September 19 – 21, 2011</td>
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<td>Taisima</td>
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What is THE WAY TO RESOURCE EFFICIENT PLANTS? Plant engineers and operators are equally interested in this issue. New technologies and creative solutions open great opportunities for more resource and energy efficiency when operating industrial plants. Join the discussion with Germany’s industry and research experts on visions, new methods ad practical experience. Take advantage of the potentials!

www.tagung-anlagenbau.de