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CLEVER HELPERS
Digital Assistance System for Maintenance in Plant Construction

DIGITAL TRANSFORMATION IN AUTOMOTIVE MANUFACTURING
More Transparency in Supply Chain and Manufacturing Operations

FROM THEORY TO PRACTICE
Innovations for Digital Construction Sites

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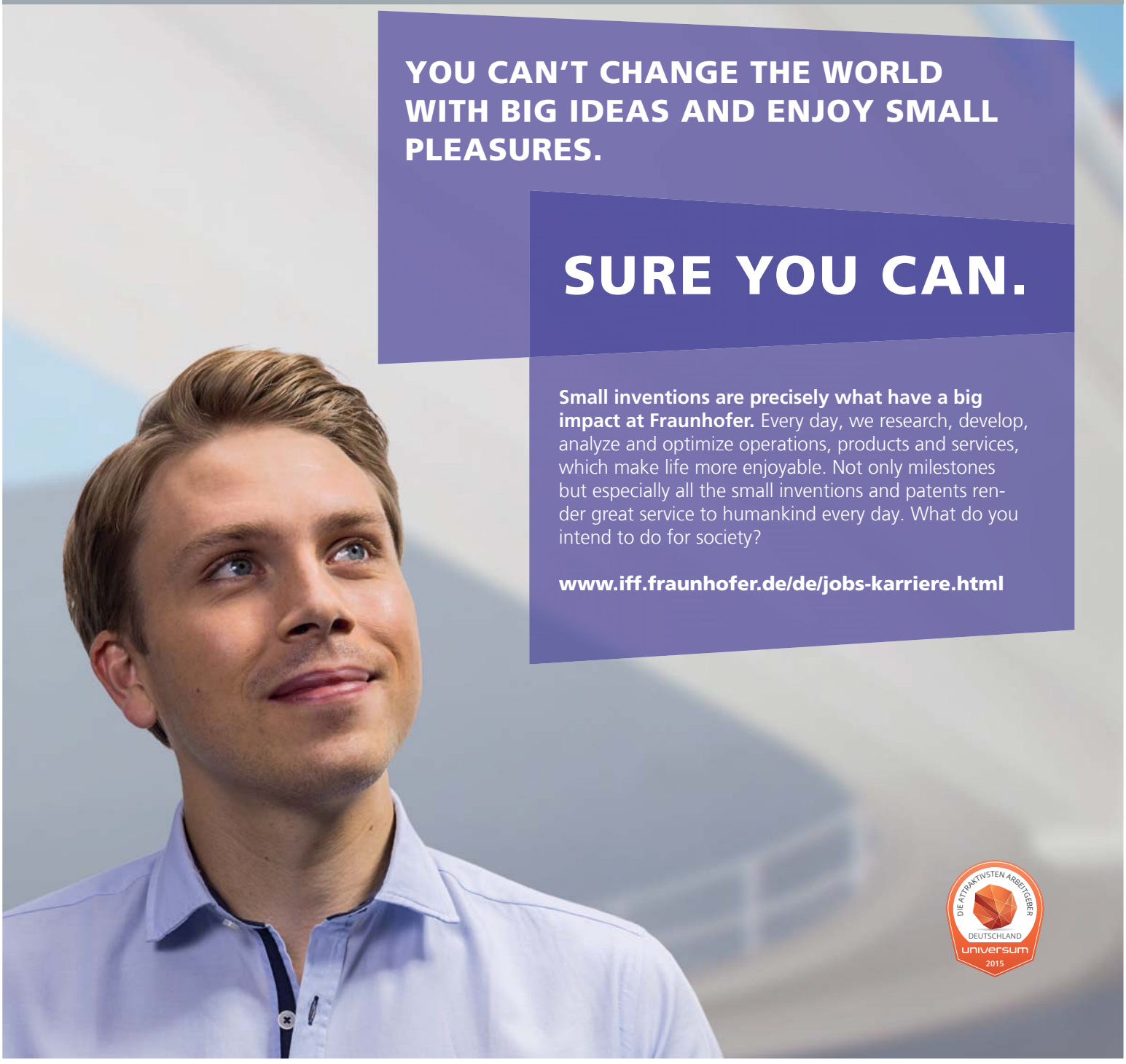
FRAUNHOFER INSTITUTE FOR FACTORY OPERATION AND AUTOMATION IFF, MAGDEBURG



» Returning to the pre-digital ages is not an option. «

Prof. Michael Schenk, Director of the Fraunhofer Institute for Factory Operation and Automation IFF in Magdeburg. Photo: Fraunhofer IFF, Viktoria Kühne

Editorial

Dear Readers,

It is certainly no longer a secret that digital transformation is changing our world forever. This is already perceptible in many domains of life right now. It is successively pervading business and everyday life. Digital transformation is not an end unto itself. It is an outcome of technological progress, which we intend to exploit. Thanks to digital transformation, we are witnessing hitherto undreamed of opportunities in the private sphere, at work, and in the interconnectivity of people and machines. It is not only interconnecting data but also combining ideas and creating new visions.

As it seems, however, we are just setting out on a long path, not knowing where it is going to take us exactly one day. The capabilities of digital transformation are enormous. The related challenges and open questions are still confronting many actors with big problems, though.

Returning to the pre-digital age is not an option, though. Even though some obstacles remain to be overcome, the benefits of digital technologies clearly prevail. That is why we ought to take the offensive and seize the opportunities that lie before us. Skeptics and cowards have never ever won any important prize. In this issue's interview with him about the future of work, acatech President Dieter Spath also stresses that Germany specifically owes its good economic and employment situation to automation. That is why he quite rightly demands that Germany ought to take the lead in digital transformation, instead of exercising undue caution. Those who have a hand in creating get to dictate the rules, too. And this has to be in the interest of the German economy and nation.

This issue of our IFFocus primarily focuses on the question of how digital transformation is being used purposefully and profitably in plant construction and operation as well as logistics. Both industries are changing radically. Businesses have to decide whether they intend to continue on the path to digital transformation or not. The BVL recently conducted a survey of its members. The alarming finding was that approximately eighty percent of the companies surveyed hardly operate digitally at all or not at all. Many do not even see any need whatsoever to transform digitally. They are thus gambling with their own viability and their employees' future.

Plant builders and process manufacturers are already several steps ahead. Many plant builders have long been using digital technologies. They usually only use them selectively, though, or fail to exhaust their capabilities. Such companies are now facing the challenge of turning their local solutions into system solutions, employing available digital tools company-wide, and advancing interconnectivity beyond corporate boundaries. Only this will enable digital transformation to reach its full potential.

In this edition of IFFocus, we present a few examples of such solutions and technologies on which the Fraunhofer IFF is presently working, for instance, a mobile augmented reality assistance system for maintenance in plant operation, a forecasting tool for automated equipment and plant condition monitoring, and a system, which ensures high transparency and accuracy in vehicle assembly.

I wish you interesting and pleasurable reading!

Your Michael Schenk

A Digital Assistance System for Maintenance in Plant Construction

Bulk chemical companies' plants are gigantic. Thirty meters in height, length and width, they fill entire buildings at times. Without question, repair and maintenance are challenges. Plant builder and operator Pergande Group not only wants to offer its clients plants themselves but also suitable business models for operation, servicing and maintenance. The CPPSprocessAssist digital assistance system developed by researchers at the Fraunhofer IFF will help.

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From Theory to Practice: Innovations for Digital Construction Sites

Process plants are now designed almost entirely in 3D on computers – down to the last washer. Construction sites reveal an entirely different picture, however. Plant builders are still working with paper lists and clipboards. Digital solutions exist, though.

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Digital Transformation in Automotive Manufacturing

The Fraunhofer IFF's project at Mercedes Benz's Daimler factory in Ludwigsfelde is making the automotive manufacturer's supply chain and manufacturing operations more transparent.

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Research and Development

Sharp Minds

The Smart Pallet

Researchers at the Fraunhofer IFF have equipped a pallet with affordable state-of-the-art technology, thus creating an Internet of things pallet. It makes continuous process monitoring possible, even in open pallet pools.

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Sharp Minds

Doctorates, awards and collaborative research partnerships: Learn more here about the people and the research networks at the Fraunhofer IFF.

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Readying Saxony-Anhalt's Businesses for Industrie 4.0: A New Research Center in Magdeburg

The capital's Port of Science has acquired a capable addition with the REFA State Chapter's Training Center for Smart Work Systems LiA. The center for industrial research, development and consulting is intended to help Saxony-Anhalt's businesses transition to the digitized future. It will especially offer one-source solutions for work organization and complete service packages for businesses, service providers and governments. LiA will do this by collaborating closely with Otto von Guericke University Magdeburg and the Fraunhofer IFF.

The motivation is the progressing digital transformation of business and the growing importance of Industrie 4.0 technologies. This is confronting many small and medium-sized businesses in Saxony-Anhalt with growing technical, workforce and scheduling challenges. The new Training Center for Smart Work Systems LiA will help businesses in Central Germany make the necessary modifications, select ready-to-use, select customized operational solutions together with them, and help them prepare and oversee their implementation. The focus is on new systems, technologies and methods for smart work systems, e.g. the integration of digital technologies in training, manufacturing or supply chains or the integration of smart automated assistance systems that help employees. (mar) ■

Dr. Uwe Gründler, President of the Saxony-Anhalt State Chapter of REFA (m.), signing the LiA collaboration agreement with Prof. Jens Strackeljan, President of Otto von Guericke University Magdeburg (l.), and Prof. Gerhard Müller, Deputy Director of the Fraunhofer IFF (r.). Photo: REFA

Robotation Academy Foshan

Foshan/Magdeburg. The Fraunhofer IFF Industrial Cooperation Project started in Foshan, China on May 31, 2018. The Robotation Academy Foshan, supported by a collaborative partnership between the city of Foshan and the Deutsche Messe AG, had opened in October of 2017. German companies are presenting their Industrie 4.0 solutions to the Chinese market in a permanent exhibition at the academy. Conferences, training courses and other events are also being held. German and Chinese companies will be able to present their products, e.g. automated solutions, and dialogue about them. The Fraunhofer IFF will also be organizing future events at the academy, for instance, on robotics. As one of the Robotation Academy's partners, the institute is additionally offering its Industrie 4.0 Check-Up for companies there and advising the academy on the establishment of an Industrie-4.0 project center. Experts from the Fraunhofer IFF will offer a variety of training courses and train local advisers for the Industrie 4.0 Check-Up. "Through its presence in Foshan, the Fraunhofer IFF will also be helping German companies that are developing or expanding their Chinese market," says Kay Matzner, Head of International Projects at the Fraunhofer IFF. The Fraunhofer IFF is pursuing its active involvement in the project in order to establish itself sustainably as strong partner for the Robotation Academy Foshan and the city of Foshan for a long time to come. (sti) ■

25 Years of Innovation: Fraunhofer IFF Celebrates an Anniversary

The Fraunhofer IFF celebrated its twenty-fifth anniversary this past year with a series of events and anniversary festivities on September 14. The institute was spun off from the former Otto von Guericke Technical University in 1992. Despite the challenging situation arising from profound changes in the East German economy, it quickly evolved into one of Saxony-Anhalt's most important research organizations for industry. After opening with thirty highly dedicated employees, the institute now has approximately 190 researchers that work with companies and research partners all over the world. The Fraunhofer IFF has become a source of innovation and inspiration for the regional economy and is especially helping businesses transform digitally. Its main research specializations are digital transformation and business interconnectivity, increased resource efficiency in manufacturing, sustainable energy use and conversion, and smart work system development.

Saxony-Anhalt's Minister-President Reiner Haseloff congratulated the research institute on its anniversary and stressed its importance for the state saying, "the Fraunhofer-Gesellschaft is an intrinsic part of our state's research-friendly and forward-looking spirit. Science and research are the key to a broad knowledge-based economic system. Only with it, will we be successful in the 21st century and secure our prosperity."

Director of the Fraunhofer IFF Michael Schenk, expressed his gratitude at the anniversary celebration before 250 guests from government industry and research for the faith that has been placed in the institute from the start. "Twenty-five years of innovation! I can only sincerely thank all the project partners that have challenged us with their projects and implemented unconventional ideas together with us. It's very clear to us that businesses need smart technologies more than ever to manufacture efficiently, sustainably and interconnectedly. That is why we at the Fraunhofer IFF will continue to be a reliable partner and help our clients transition to smart manufacturing. We will continue pursuing cutting-edge research and developing custom solutions for business and industry."

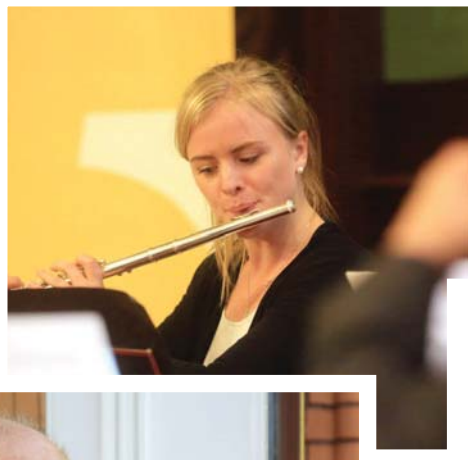
The groundwork for the research institute's future milestones has been laid. The Fraunhofer IFF is responding to the ongoing digital transformation of business and the ensuing changes for the world of work with extensive investments. For instance, € 2,2 million in funds from the state of Saxony-Anhalt and the European Union went into extensively upgrading the Elbedome at the Virtual Development and Training Centre VDTC. Future-proof technology will place one of the largest 360-degree visualization systems for VR applications in Europe at the disposal of researchers and industry partners even for future challenges such as the development of future work systems. What is more, the institute is using federal and state funds to build a new center for cognitive autonomous work systems in Magdeburg's Port of Science. Among other things, flexible and partly self-learning assistance systems for the manufacturing and service sectors will be developed in the addition to the VDTC in the future. (mar) ■

Minister of Agriculture Armin Willingmann congratulating the Fraunhofer IFF at the twenty-fifth anniversary festivities. Photo: Fraunhofer IFF, Viktoria Kühne

Anniversary ceremony with 250 guests form government, business and research. Photo: Fraunhofer IFF, Viktoria Kühne

The starting team of the Fraunhofer IFF in 1992 in front of its first building, which the institute temporarily occupied at that time. Photo: Fraunhofer IFF

25 Years of IFF



Photos: Fraunhofer IFF, Viktoria Kühne

Hub for the Digital Business Transformation in Saxony-Anhalt

One of the European Union's key objectives is the digital transformation of European industry. The Digital Innovation Hubs initiative launched by the EU commission in 2016 is part of this. Every year, € 100 million from the EU framework program for research Horizon 2020 will be invested in regional Digital Innovation Hubs, i.e. facilities that advance digital innovations, throughout Europe. The EU thus intends to facilitate regional and transnational collaboration on digital transformation, themed European partnerships, and experience sharing that benefits every stakeholder.

Such a Digital Innovation Hub is also being established in Saxony-Anhalt with the Fraunhofer IFF's Virtual Development and Training Centre VDTC. Christian Blobner, Head of International Research Networks at the Fraunhofer IFF, stresses the importance of this for regional business. " The VDTC has long been the center of excellence in digital transformation for small and medium-sized businesses in Saxony-Anhalt. Being named a Digital Innovation Hub now gives businesses greater opportunities to draw on a transnational European support infrastructural as they convert to digital processes. That additionally gives them greater European visibility and, not least, advances businesses' internationalization."

Facilitating Structural Change

The target group is specifically SMBs since they are still having altogether more difficulty with digital transformation, according to Blobner. "This is where the underlying idea of the Digital Innovation Hub initiative comes in. Start-ups, established businesses and research organizations will collaborate to create economic and technical ecosystems in which SMBs in particular will be able to find support when they are dealing with structural digital transformation."

The Fraunhofer IFF's VDTC acts as a central hub and point of contact for businesses in this ecosystem. This enables companies to dialogue about issues and effective solutions for digitally transforming their operations even beyond the borders of Saxony-Anhalt and Germany. In return, the Digital Innovation Hub's network enables businesses from other states and countries to draw on the expertise of the Fraunhofer IFF's digital transformation experts. Since the research institute is also collaborating on digital transformation very closely with the Mittelstand 4.0 Center of Excellence initiative and other networks in Saxony-Anhalt, an important hub for digital business interconnectivity in Saxony-Anhalt and Europe is emerging in Magdeburg. (mar) ■

Christian Blobner, Head of International Research Networks. Photo: Fraunhofer IFF, Dirk Mahler

The Fraunhofer IFF's VDTC in Magdeburg's Port of Science. Photo: Armin Okulla

New Mittelstand 4.0 Center of Excellence Magdeburg Is Helping SMBs with Digital Transformation

United start in 2017 (l to r.): Dr. Stefan Voigt, Assistant Manager of the Mittelstand 4.0 Center of Excellence Magdeburg, Prof. Thomas Leich, Manager of the 4.0 Center of Excellence Magdeburg, Iris Gleicke, Parliamentary State Secretary at the Federal Ministry for Economic Affairs and Energy, and Dr. Jürgen Ude, State Secretary in Saxony-Anhalt Ministry of Economic Affairs, Research and Digital Transformation. Photo: Fraunhofer IFF, Viktoria Kühne

For many people, small and medium-sized businesses and the digital transformation of business still appear to be two puzzle pieces that do not quite want to fit together. The failure of digitally operating automotive suppliers, tradespeople or farmers to really catch on despite progressive digital transformation no longer has anything to do with businesses' lack of readiness. If you ask industry insiders, SMBs' awareness of this issue has grown tremendously. What is often lacking, however, is knowledge about how businesses can convert their operations effectively, which solutions are the right ones, and what has to be observed.

That is why the Federal Ministry of Economic Affairs and Energy's Digital Mittelstand initiative is establishing so-called Mittelstand 4.0 Centers of Excellence all over Germany. They provide businesses integrating and employing digital solutions support and assistance to optimize their business operations and to interconnect and develop new fields of business

A Mittelstand 4.0 Center of Excellence commenced work in Magdeburg, too, in 2017. It has its eye on the machinery and equipment manufacturing, transportation and logistics, chemicals and biobased economy, healthcare and medicine, and food and agriculture sectors, which are especially important to Saxony-Anhalt. Businesses find capable and experienced contacts there, who provide them comprehensive assistance in many issues of digital transformation, especially the priority fields of digital business models, digital interconnectivity and standardization, safety and security, and usability and acceptance.

Among other things, the Mittelstand 4.0 Center of Excellence Magdeburg offers free informational services as such as presentations, workshops, guidelines and mobile company consulting. Added to this are exciting new formats such as convoy support or a digital transformation escape room. Most importantly, everything is matched to businesses' individual level of digital transformation.

Great Demand

The range of services is very popular. "Demand is huge and coming from every part of Saxony-Anhalt. We're very pleased!," says Prof. Thomas Leich, manager of the Center of Excellence. "We hope therefore to further expand our services and to be able to respond to every inquiry as quickly as possible."

The Mittelstand 4.0 Center of Excellence Magdeburg is being supported by the Fraunhofer Institute for Factory Operation and Automation IFF, Otto von Guericke University Magdeburg, ifak - Institut für Automation und Kommunikation e.V., and the Zentrum für Sozialforschung Halle e.V. at Martin Luther University Halle-Wittenberg. It also collaborates closely with the Saxony-Anhalt Wirtschaft 4.0 partner network. (mar) ■

Fraunhofer IFF Is Partnering with Latvia

The Fraunhofer IFF is supporting the Transport and Telecommunication Institute in Riga, Latvia in the Alliance project funded by the European Union's Horizon 2020 program. The research organizations are working together with a third partner, the University of Thessaly in Greece, to strengthen Latvia's research and technological capability to develop viable transportation systems. The focus is on establishing a common base of knowledge on sustainable intermodal models and applied solutions for organizing main transportation hubs. Among other things, this is intended to lay the foundations for high quality teaching and research in this field in the Baltic EU member state.

To do this, the partners are relying on sharing expertise in research and technology and establishing regional and international networks for future collaboration. "The Alliance project not only serves to share knowledge. It also facilitates the formation of pan-European networks and is an element of Baltic member state's integration in the EU," says Evelyn Fischer, research scientist in the Fraunhofer IFF's International Business Development Unit, describing the primary objectives.

On the one hand, the project partners expect impacts that boost the Latvian partner's academic knowledge and educational capacities. On the other hand, the research will deliver best practices transferable to the Latvian economy, thus facilitating further development of regional government and business structures. To this end, the Alliance project will offer an educational and training program to established and young researchers, which concentrates on the three pillars of organization and governance, operation and services, and service quality and customer satisfaction.

The Fraunhofer IFF will especially be working on network development and sustainability. What is more, a plan is being developed in Magdeburg to convert developed courses into an e-learning program that will subsequently be available on a public open source e-learning platform for free. (sti) ■

Find more information on the Alliance project website **www.alliance-project.eu**

alliance

Girls' Day

More women in research! The Fraunhofer-Gesellschaft aspires to increase the number of female researchers and executives in its ranks. The Fraunhofer IFF also opened its doors for female school students in the fifth grade and above once again on April 26, 2018 to encourage their interest in science and engineering professions.

Seventeen twelve-to-fifteen-year-old students took the opportunity to learn about the institute and female research scientists' work routines at the Fraunhofer. The entire day, the potential future researchers were able to conduct experiments with different sensor technologies such as a pressure sensitive seat cushion or to learn how to program a small robot's controller. A Science Talk gavethe students an opportunity to ask questions about professions and career opportunities at Fraunhofer. (mar) ■

Girls' Day
Mädchen-Zukunftstag

New Smart Industry Park, Smart Assets Industry Working Group

Industry working groups are a proven method for regularly bringing industry companies together in workshops, sharing views on technologic trends, challenges and best practices, and providing access to current research findings. Ideally, such groups can solve problems or forge longstanding collaborative research and development partnerships. The Fraunhofer IFF's semiannual industry working groups are no exception. The Collaboration in Plant Design and the Laser Scanning and VR in Plant Design Industry Working Groups both meet regularly. They are established forums for sharing professional experience among plant builders and operators, plant engineers, maintenance technicians and industrial park operators. These two formats, which have been successful for years, are now growing in number. The institute established the new Smart Industry Park, Smart Assets industry working group in 2018.

The Smart Industry Park, Smart Assets Industry Working Group will explicitly tackle the challenges of digital transformation for industrial parks. Its rationale is the progressive digital transformation and increasing integration of digital process chains in process plant design. Chemical and industrial park operators expect additional business, structural, logistical and safety capabilities from digital transformation – wholly in the spirit of Industrie 4.0. Together with companies, the Fraunhofer IFF's experts therefore intend to identify resultant capabilities and opportunities for transforming industrial parks into smart parks. What actions will facilitate the development of smart and sustainable industrial sites and what will be the value added for companies based in industrial parks?

Interested companies and researchers are invited to join the Fraunhofer IFF's Smart Industry Park, Smart Assets Industry Working Group. (mar) ■

Photo: LaCozza – Fotolia.com

Find information on scheduled events, registration and contacts on **www.iak-anlagenbau.de/de/iak-smart-assets**

2017 Science Days

Photos: Fraunhofer IFF, Viktoria Kühne

The Future of Work

Interview with Prof. Dieter Spath,

President of acatech

Digital transformation is a new element pervading business and everyday life, which will change it just like the introduction of the steam engine or the triumphant spread of the Internet did in their day. Digital transformation will also profoundly transform our worlds of work just like these prior technical revolutions did. Will certain professions possibly no longer exist soon? How will job profiles and the requirements on employees change? How must companies adapt? We asked acatech president Dieter Spath about this.

Interviewed by René Maresch.

Mr. Spath, how will we work in the future? Not only young people are asking this question. How will digital transformation change the future world of work?

Work organization and people's jobs are both changing. Digital assistants will help individuals control increasingly complex processes. Conversely, simple, repetitive jobs will wane. This will make other skills important: Broad knowledge, readiness to learn, networked thinking and team skills, for instance. Work is becoming more independent and varied and new job profiles are emerging.

Are there differences in industries or job profiles? Which will be affected more, which possibly less?

Machines are performing more and more jobs, and not only in industrial manufacturing. The service industry and government are also being reinterpreted. In the future, smart interconnected systems will, for instance, take over wherever forms are now completed by hand, digitized, printed and processed, . Many jobs will cease to exist, especially in clerical work. At the same time, more autonomous, more qualified and better paid jobs will be created. I see opportunities in this. Germany must become more productive, if only because of demographic change. Moreover, the work situation can improve for many workers, for instance, in nursing care.

What demands does digital transformation impose on future basic and advanced training? For what else will people have to prepare?

Attention is being focused on workers with their judgment, creativity and experience. Basic and advanced training have to keep pace. Specializations such as IT skills, even data evaluation and analysis, cross-functional process know-how and management, and soft skills are important. After all, we will be working in increasingly flexible, interdisciplinary and often intercultural teams.

Constant new learning and continuous training will not only lead to breaks in employment histories. They will also demand entirely different time and financial resources. What role will companies have to play here in the future?

Your question has a cultural dimension. Breaks in employment histories or failed business ideas tend to have negative connotations here in Germany. That's totally different in the USA from whom we could learn. The failure of an idea is incredibly educational and opens opportunities for successful innovation. We will also have fewer linear employment histories in the future. Companies will have to support this development. Human resource development means more than training for a narrowly circumscribed job. It has to foster personal development. Whoever offers this prospect will attract "smart" talents from all over the world.

To what extent will these changes also affect work structures?

Digital transformation is making new forms of work possible, which we only capitalize on and understand rudimentarily. Employees starting their workday in the morning, taking a break from it at noon to care for their children, and ending it in the evening by working at home is routine in some jobs. Flexible times are not limited to knowledge workers. Factory shifts can also be staffed in self-organization. In the KapaflexCy model project, for instance, staff and shift managers are using an app to arrange shifts. This also creates flexibility that benefits both – the smartphone beats the time clock. Companies are setting up experimentation zones for new types of work while they still earn money in established structures. This approach is called ambidexterity.

» Digital transformation is making new forms of work possible, which we only capitalize on and understand rudimentarily. «

Prof. Dieter Spath, President of acatech
Photo: acatech, C. Rieken

What trends for research on future work do you see that are not everyon sees yet but will be important to companies in the future?

Our skill development study revealed the risk of a double digital divide between highly skilled and low-skilled workers and between large and small businesses. Preventing this divide is a key mission for research organizations and businesses. acatech has developed an Industrie 4.0 maturity model and guide, which help smaller businesses in particular. Right now, acatech is joining in the SmartAI-work consortium lead managed by the Fraunhofer IAO. We are studying applied capabilities of artificial intelligence in clerical work and opportunities for smaller companies to take advantage of these capabilities. A bathroom manufacturer from the Stuttgart area brought a plotter print of its operations to the first meeting. We are discussing the capabilities of AI concretely.

Digital transformation harbors opportunities and risks. The risks are predominantly being emphasized at present. What is your response to the skeptics?

In the 1970s, the Spiegel published a cover showing a robot firing a worker. This scenario never materialized. Germany has a good employment situation precisely because we have opted for modernization. We ought to take the lead in technological developments. Only this will enable us to shape them in people's interest. One of our Germany's distinctive features, by the way, is the collective advancement of Industrie 4.0 and artificial intelligence by research organizations, businesses, unions and government in our country. The Industrial Internet Consortium in the USA is an organization wholly driven by industry. So, it's in our hands.

BRIEF BIOGRAPHY

acatech President Dieter Spath

Human factors engineer Dieter Spath has been president of acatech National Academy of Science and Engineering since February of 2017.

He has also been cochair of the newly established learning systems platform since May of 2017.

Dieter Spath heads the Fraunhofer Institute for Industrial Engineering IAO and studies the impacts of the processes of digital transformation on work.

As the former CEO of Wittenstein SE, he acquired experience with digital transformation in SMEs.

A Digital Assistance System

for Maintenance in Plant Construction

Shut down plants quickly cost a pretty penny. The digital assistance system CPPSprocessAssist will provide assistance with the servicing and maintenance of such plants in the future.

Bulk chemical companies' plants are gigantic. Thirty meters in height, length and width, they fill entire buildings at times. Without question, repair and maintenance are challenges. That is why plant builder and operator Pergande Group not only wants to offer its clients plants themselves but also suitable business models for operation, servicing and maintenance in the future that are all based on digital transformation. "In the course of Industrie 4.0, we intend to create value added and prevent plant shutdowns," says Prof. Mirko Peglow, Technical Manager of the Pergande Group. This will yield a classic win-win situation. Clients will profit from higher plant reliability and the plant builder will be able to bring in ten to twenty percent more revenue.

Preventing Shutdowns, Retaining Knowledge, Simplifying Documentation

Researchers at the Fraunhofer IFF are establishing the technological basis for this with their digital assistance system CPPSprocessAssist. It is being developed hand in hand with seven consortium partners: four implementation partners, i.e. four manufacturers, two software companies and GESA Automation GmbH.

"There are three motivations for the assistance system," says Dr. Nico Zobel, manager of the Process Manufacturing 4.0 Unit at the Fraunhofer IFF. On the one hand, it is essential to correct malfunctions rapidly because the longer a plant is shut down, the more it costs a company, e.g. in the bulk chemical industry. This can also make delivery schedules a problem. A lot of time passes whenever a maintenance technician has to gather necessary information together laboriously first, i.e. go to different offices, consult different databases, and search for records containing necessary information. The second motivation is that many companies are having to get by with fewer and fewer employees and work more and more in order to remain competitive. Experienced employees frequently take knowledge with them when they retire. "Our system makes it possible to enter individuals' knowledge in a knowledge database, thus retaining it for a company," explains Zobel. The third reason why such an assistance system is expedient is that manufacturers such as chemical companies have to comply and demonstrate compliance with numerous standards. When necessary, a company must be able to demonstrate compliance with standards and provide proof of performance of requisite inspections both to customers and government agencies, especially whenever safety is an issue. One simple example is the required inspection of emergency showers, which has to be documented because the operator must be able to provide proof that it performed the inspection in the event of a damage claim.

Information from Manuals and the Like

The researchers from the Fraunhofer IFF use information from three sources for their assistance system. One is plant documentation. Documentation exists for and records information on every component on every plant, every pump, and every instrument. Just as with a car, finding the right information in a manual takes time. Much information accumulates in the control center or on a computer in an employee's office as well. That is why the researchers give every component a unique equipment identifier, e.g. a QR code, to which relevant data and documents can be assigned. Rather than running from office to office and rummaging through physical and digital files as in the past, employees simply need to scan the QR code to view all relevant information promptly.

Linked to Plant Control

Not all relevant information can be found in manuals and computer files, though. Is the temperature too high or the pressure too low? Sensors installed in plants record these values and send their data to the plant control where they are stored. In other words, all sorts of error messages converge in the plant control. Anyone wanting to know what was wrong with a faulty component will find the relevant information. The researchers incorporate these data in their assistance system, too. The appropriate technicians view temperature and pressure curves of a malfunctioning plant directly in the assistance system. All relevant information is at hand with one click.

Employees' Experiential Knowledge

What has to be done then? How can a faulty component be gotten running again? Employee knowledge used to be sought for this. Plants are growing more and more complex, though, and numerous faults only occur rarely. The assistance system provides help here. Old hands among staff can enter their experiential knowledge about particular malfunctions, thus making it accessible to their colleagues. The assistance system gives a younger colleague standing before a plant successive recommended actions to repair it based on the experiential knowledge entered: "Check component XY." "Is the temperature higher than YZ?" "Is the pressure sensor showing low pressure?." "Rather than doing the thinking for maintenance technicians, we want to assist them expediently and interactively," says Zobel summarizing.

The researchers at the Fraunhofer IFF are combining all three approaches in their assistance system. At present, employees can access the system on a tablet. The researchers intend to use the system on augmented reality glasses as well in the future. Employees will

The digital assistance system concretely shows a maintenance technician the possible location of a malfunction in a plant and identifies the cause. The system can also be used with augmented reality glasses, an option for future use scenarios. Wearers see elements marked as malfunctioning projected on the real plant. They can view virtual assistance system control panels and plant information and make entries in the system. Photo: Fraunhofer IFF, Viktoria Kühne [M]

look through them at their real surroundings, e.g. the machine. The system projects computer generated information on this, such as sensor data or repair instructions, directly on the relevant plant components.

The researchers are developing the system in three stages, creating a prototype with increased functions in each. The first prototype contains information from plant design and has already been tested at different partners' facilities. The second prototype also implements recommended actions. Experienced maintenance technicians at a company are tasked with documenting their experiential knowledge. The third prototype will incorporate plant control. It will be finished at the end of 2018. Then, quantitative information will be accessible, too: How much time and money does the system save? "Such quantitative information will be tested in representative test scenarios and will be a key result. We are currently developing the test scenarios," says Zobel.

Assistance with Gas Pressure Regulator Servicing

The researchers at the Fraunhofer IFF are not only collaborating with the Pergande Group but also with other companies that build gas plants, including CeH4 technologies GmbH. Along with their construction, service for gas plants is also important. The company rents out mobile gas pressure regulators, among other items. They ensure the supply of natural gas to system operators, public utilities and industrial companies, even when stationary plants are being remodeled. The plants are housed in containers that are transported to the particular site of use. "We have equipped such a container with QR codes and the first assistance system prototype for the testing phase," says Thalke Ehlers, project manager at CeH4 technologies GmbH.

"There is an additional challenge here, however. Since a mobile container is used at different, usually distributed, sites, we need reliable mobile Internet access." Once this is established, the system can employ its features fully. "Then, for instance, we will be able to track every plant component, measure and adjust pressure parameters, provide complete documentation, and enter additional service or repair reports in the system, thus always having this information on hand," explains Thalke Ehlers. The benefits are obvious to her. "Among other things, the assistance system rapidly acquires information whenever a plant malfunctions or is shutdown, expedites corrections of malfunctions through online/offline assistance and communication between assemblers and operators, and simplifies experience sharing among employees. This also boosts efficiency further. This holds just as true for a plant as a service."

Pergande Group employees are currently testing the first assistance system prototype just in a small, manageable plant at this point. The system has been supplied with data by

In the future, Prof. Mirko Peglow, Technical Manager of the Pergande Group (m.), not only intends to sell his clients plants but also new digital business models for operation, servicing and maintenance.

» RATHER THAN DOING THE THINKING FOR MAINTENANCE TECHNICIANS, WE WANT TO ASSIST THEM EXPEDIENTLY AND INTERACTIVELY. «

Digital assistance on a tablet. The affected component of a malfunctioning plant is projected on an image of the real plant on a tablet by means of AR assistance. Technicians can view temperature and pressure curves, for instance, overlay parts virtually or display instructions. They have all relevant information at hand with one click.
Photos: Fraunhofer IFF, Viktoria Kühne

employees and is now being tested and optimized. "The assistance system functions and provides genuine value added. We can say that much already," says Technical Manager Mirko Peglow, pleased. The company's employees intend to transfer the system to a more complex plant in a second stage. Peglow hopes to be able to offer his clients the assistance system by the end of 2018. Giant bulk chemical plants will have to wait another two to three years, however. In the long term, plants will not only monitor themselves but also order needed replacement parts autonomously. The partners still have a bit of development work before of them before then, though. (ack)

Video: Mixed reality maintenance assistance

Link to the video:
https://youtu.be/5laTfCfZI_8

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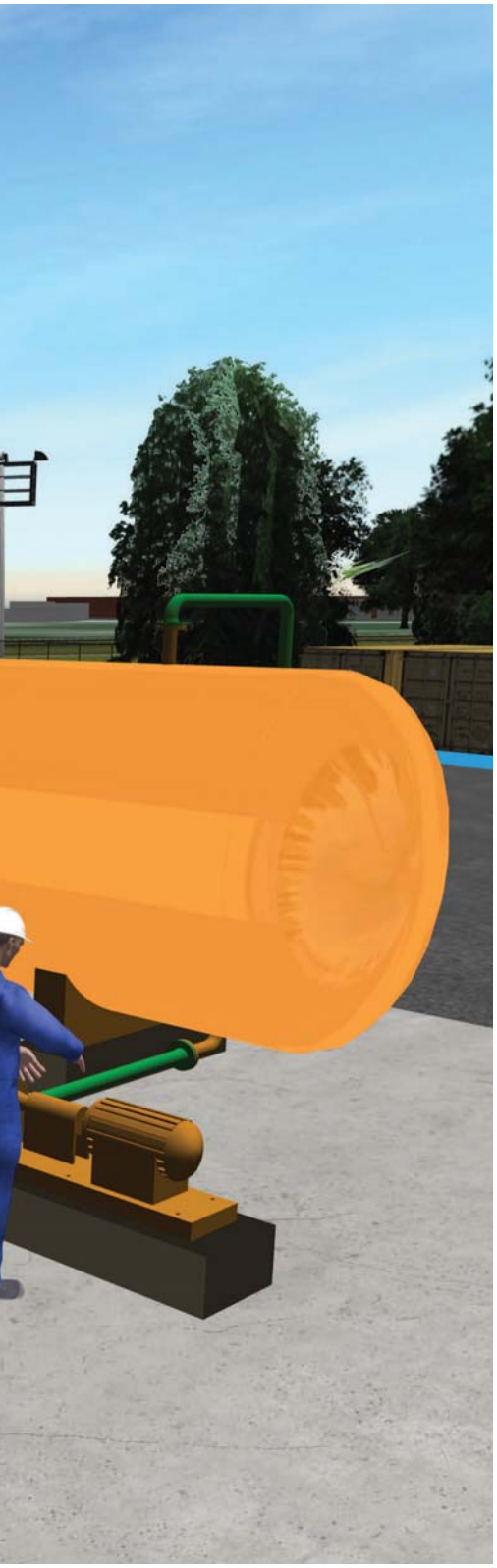
From Theory to Practice:

Innovations for Digital Construction Sites

"Process plants are now designed almost entirely in 3D on computers – down to the last washer. Construction sites reveal an entirely different picture, however. Plant builders are still working with paper lists and clipboards," says Andrea Urbansky, succinctly summing up the situation at the center of the activities of the initiative Industrie 4.0: Digital Construction Site.



The objective of Cosmo Consult TIC GmbH and the Fraunhofer Institute for Factory Operation and Automation IFF's joint project is to make tradespeople's and assemblers' work at construction sites easier, safer and more efficient by utilizing digital technologies. An integrated chain from digital engineering to digital construction constitutes a plus economically. A VDMA study ascertained that twenty to thirty percent of the total costs of a major process manufacturing plant project are incurred at the construction site. As much as one quarter of these costs can be saved in the future if digital methods are transported to construction sites rather than remaining in factory buildings," explains Andrea Urbansky, who is working with a team of other research scientists at the Fraunhofer IFF on the vision of the digital construction site. Digital technologies additionally make it possible to document correct completion of all jobs in a plant project transparently for the purpose of compliance.

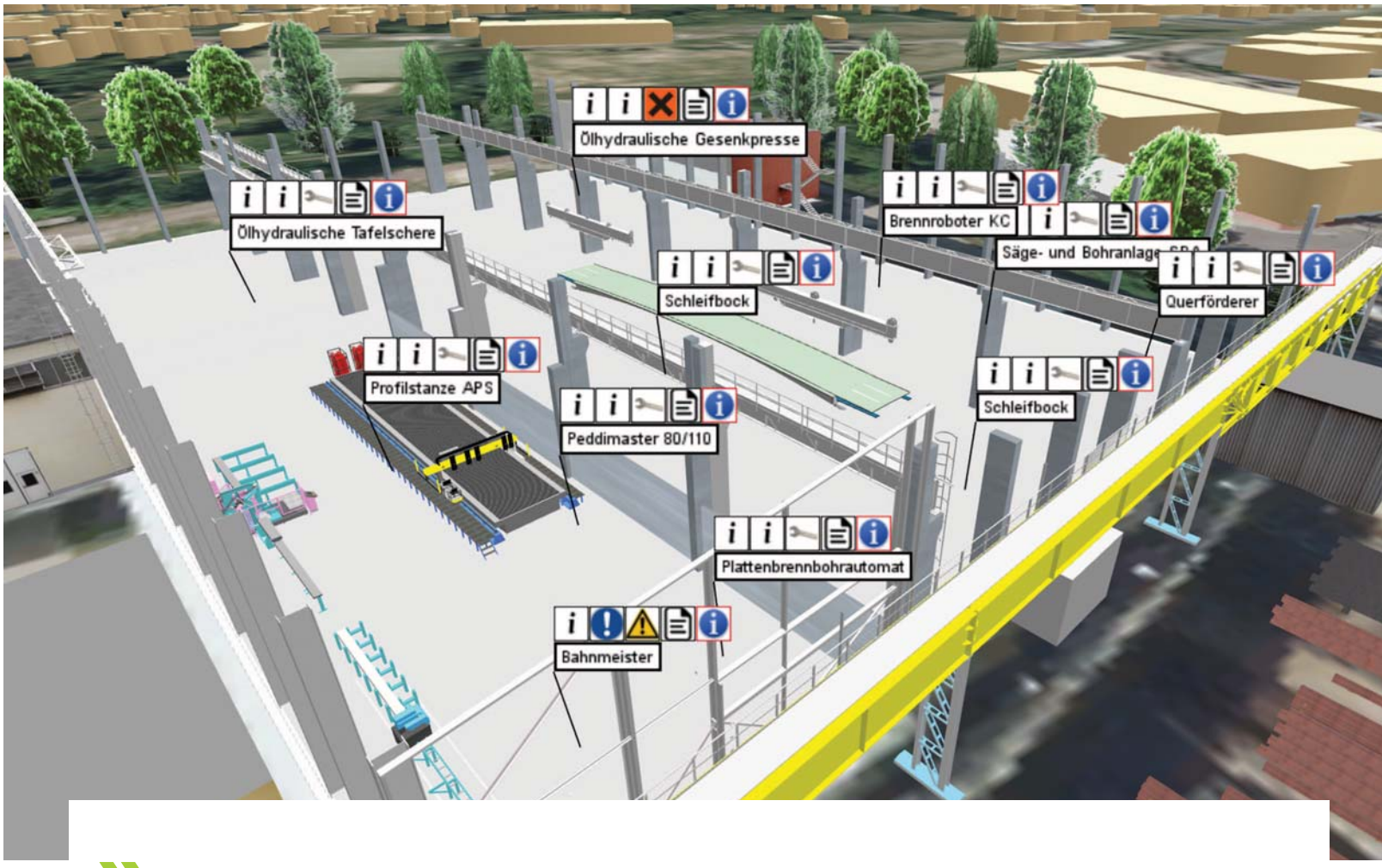
The Fraunhofer IFF's analysis of a survey of fifty site managers, businesspeople and professionals of all stripes identified domains with the greatest demand and the greatest capability: "Communication among everyone involved, smooth flows of information, real-time feedback on activities, and digital documentation of the progress of construction crystallized as key control mechanisms," explains the engineer. "A process plant construction site can take on enormous dimensions. Every plant is unique and virtually every component is one of a kind. The shutdown, disassembly, cleaning, inspection, repair and reassembly of an entire chemical plant or refinery for several weeks for TÜV inspections required by law every few years can conceivably involve two years of preliminary planning and work of 4,500 assemblers.

Such figures make it easy to understand the complexity of communication among tradespeople, assemblers and other contractors whose jobs at a construction site intermesh as in a gigantic gear. Naturally, every job has to be completed with utmost diligence and great efficiency in order to ensure a plant's reliability while minimizing shutdown times. Research, technology and industry entities are researching, developing and piloting innovative IT and assistance systems on the applied research initiative's open collaboration platform together with the partners Bosch, Telent, Microsoft and Dräger, which will enable smooth communication, high reliability and great efficiency for medium-sized plant builders.

Field-Tested Technology for Digital Construction Sites

The initiative has completed different subprojects together with regional companies in which individual products and services were designed and field tested. Each is a standalone module for digital construction sites. One of the clients involved in the project is Stahlbau Magdeburg GmbH. A sensor-assisted part tracking system is intended to create greater transparency, thus minimizing downtimes and shutdowns caused by missing materials or tools. The experts used a site

A site information systems coupled to a plant project's digital design tools supplies information on the plant, its components and each job package centrally in the model to everyone involved. An app on workers' endpoints provides detailed information on components and assigned work as well as options for digital feedback at the construction site.

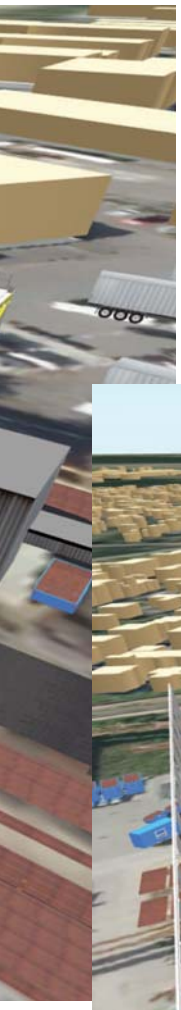


» THE EXPERTS USED A SITE INFORMATION SYSTEM DEVELOPED BY THE FRAUNHOFER IFF TO MAP THE 70,000 SQUARE METER COMPANY PREMISES ALONG WITH EVERY BUILDING DIGITALLY. «

information system developed by the Fraunhofer IFF to map the 70,000 square meter company premises along with every building digitally. Every part and every tool is visualized, tracked one-to-one and virtualized on the computer. This makes job completion transparent. Project progress is monitored and documented.

Another module is a cloud-capable contractor portal developed in the project and ready for the market. Total Raffinerie Mitteldeutschland used this solution to register in periodic maintenance contractors and provide them safety training in order to organize the maintenance and inspection cycle efficiently and consistently.

"Up to fifty percent of all work during a process plant's maintenance and inspection cycle is done on flanged connections," explains Andrea Urbansky. This is why the initiative is focusing on this factor during servicing and upgrading in particular. "An incorrectly tightened and leaky flange can result in major hazards and accidents for individuals, non-acceptance of the plant, and thus loss of production." Connections required for proof of compliance are documented on paper or by an attached seal. This procedure is as labor and time consuming as visual quality inspection of critical pipelines by "flange inspectors". Automated documentation by autonomously communicating tools and parts can replace manual data entry, which is sometimes done several weeks later, and visits by an inspector.



Stahlbau Magdeburg's employees can view the entire factory premises in a virtual site information system. Machines or tools can be tracked quickly and important information retrieved. Even availability and maintenance schedules are displayed. Images: Fraunhofer IFF/Stahlbau Magdeburg

Transitioning to Smart Chemical Parks

After process plants, the initiative will focus on chemical and business parks in the future. The state of Saxony-Anhalt is supporting these projects. "The chemical industry is booming in this dynamic business region and has big investments and a corresponding amount of plant upgrades, excellently qualified employees and effective forms of organization to show for it," says Andrea Urbansky. "The five largest chemical parks in Germany are located in our state." The research scientist is aware of digital innovations' great capability to continue consolidating this competitive edge and to make the vision of smart industrial parks reality. Stable conditions for the medium sized businesses and contractors involved would have to be established in advance by making technologies, research and development, and capital accessible – and the most important commodity of all at digital construction sites, information. (chr)

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“MEASURED AND FELT”

HOW DATA ANALYSIS COMBINED WITH EMPLOYEES' EXPERIENCE ENABLES PRECISE FORECASTS

GETEC-Heizkraftwerk-Fürstenwalde. Photo: Getec, Andreas Lander

Temperatures, pressures, mass flows – distributed control systems employ sensors to collect extensive operating data continuously to control and monitor process plants. Process manufacturing is highly automated and the number of readings recorded is correspondingly large. "Companies only actually use approximately three percent of these equipment data," says Dr. Nico Zobel, Manager of the Prozessindustrie 4.0 Unit at the Fraunhofer Institute for Factory Operation and Automation IFF, knowingly. Archived figures and data from production processes can be valuable capital for companies and can cut expenditures, enhance quality and boost cost effectiveness in plants.

"The analysis of already available data can contribute substantially to operating a particular plant cost effectively without requiring equipment modifications," explains Nico Zobel. Depending on the project, only several days or a few weeks of preprocessing and analyzing available data would have to be invested at the start to establish the basis for permanent use. "Digital analysis tools are a part of advanced Industrie 4.0 that any business can easily use. Cost and benefit can be assessed in advance so that expenditures on analysis systems are proportionate to anticipated improvements," says the engineer in Magdeburg.

Predictive Maintenance Forecast Model

The Fraunhofer IFF develops different systems and digital tools for process manufacturers, which utilize available data. Custom-developed algorithms can be employed to forecast malfunctions during plant components' operation. The distinctive feature is the use and combination of employees' experiential knowledge with the pure base of data along with standard data analyses. The institute compiles a list of questions that is used to acquire experiential knowledge. "Interviewees such as plant operators in a control center are selected based on a project's objectives. They are familiar with equipment's performance, know the value range of good or poor conditions, witness when motors run loud or vibrate heavily. We convert this sometimes very vague information into mathematics," says Dr. Zobel, describing the procedure. The researchers work with probabilities whenever different employees supply different information. Several rules, e.g. for temperature, pressure and volume, are combined to obtain precise results. Neither condition monitoring nor data analysis are anything new, explains the plant expert. "Combining both methods when the base of data is insufficient is new, though. Whenever there are

A combustor recovers energy. flame behavior can be used to read how combustion is proceeding. Neural networks can train sensors to detect optimal combustion. Photo: Fraunhofer IFF, Dirk Mahler

» DIGITAL ANALYSIS TOOLS ARE PART OF ADVANCED INDUSTRIE 4.0 SOLUTIONS THAT ANY BUSINESS CAN EASILY USE NOW. «

not enough cases to forecast malfunctions with sufficient reliability using standard data analysis, we add empirical data to the data."

Condition Monitoring

The Fraunhofer IFF's experts developed a model that automatically monitors the condition of a pulverized lignite burner for GETEC heat & power GmbH, which runs boiler plants all over Germany. "The variability of this natural product's properties has to be factored into combustion," explains Daniel Matzke, the engineer overseeing the project for GETEC. "Pulverized lignite also contains ash, which, rather than fully incinerating in the process, causes heavier or less heavy slagging of the boiler depending on its composition." The burner is shut down for cleaning. On the one hand, this means a loss of service for the operator. On the other hand, the client has to procure power from another provider during this time. "Prolonging the time between shutdowns between two cleanings is cost effective," says Matzke.

Available sensor readings normally cannot be used to measure the amount of slag produced during the process. Optical sensors monitor combustion to optimize cleaning intervals. The researchers from the Fraunhofer IFF correlate these readings with operating data afterward. "We can use flame behavior to read how combustion is proceeding. Neural networks can be used to train the sensor to recognize optimal combustion." The system "knows" what condition to produce and reports deviations. Although it is regulated entirely without any action by the operator, it can be adjusted "manually" anytime.

Soft Sensing

The Fraunhofer IFF also has a solution on hand that tests product quality in process manufacturing operations. The use of soft sensors reduces complex laboratory analyses or even replaces them entirely. This system correlates historical operating data with measured product qualities. The analyses and computed correlations are the basis for obtaining information on product quality from currently acquired data during manufacturing operations. The delay of laboratory

Experiential knowledge always plays a crucial role in plant maintenance. Fraunhofer researchers convert this knowledge into mathematical models. Photo: Fraunhofer IFF, Dirk Mahler

testing is eliminated. This has numerous benefits. "Without soft sensors, defective products may only be detected once a complete lot has been manufactured. This system notifies and enables employees to inspect flaws at an early stage," says Zobel. This reduces both expenditures for process analytics and prevents rejects.

The Fraunhofer IFF has developed different models for implementing soft sensing in industry such as at the butadiene plant at DOW Olefinverbund Schkopau GmbH. "The Fraunhofer IFF compared one year's operating data and documented product and plant conditions for a statistical analysis," explains Martin Ringelhan, the company's quality coordinator at it plant in Böhlen overseeing the project. "Based on the model developed, we can use plant load to identify a product's current composition." According to the engineer, the learning system is able to process the growing quantity of data. "The accuracy is steadily getting better" A daily analysis allows prompt responses to diminished product quality. This minimizes conventional butadiene sampling. Ringelhan sees this as more than just an economic plus. "This not only saves us costs. It also enhances our employees' safety." (chr)

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Digital Transformation in Automotive Manufacturing

The Fraunhofer IFF's project at Mercedes Benz's Daimler factory in Ludwigsfelde is making the automotive manufacturer's supply chain and manufacturing operations more transparent.

Automotive manufacturing and supply chains are under particular pressure to optimize. The range of modules in assembly is growing steadily as vehicles are increasingly being custom built to customers' specifications. While the range of models is growing, costs may not. Of course, it is essential that process chains function reliably, supplier parts are flawless, and, finally, the right part is delivered to the assembly line right before assembly and then installed correctly.

Manufacturers have been testing and implementing new solutions for the final point in particular in recent years. For instance, more than just conventional barcodes identifiable by scanners are now found on storage boxes in assembly plant warehouses. Data glasses that use augmented reality to assist workers are being experimented with in picking, i.e. the retrieval of parts for line assembly.

RFID in Supply Chains and Manufacturing

Correct installation of parts must be recorded in work-in-progress documentation. They include safety-related parts that have to be scanned manually with barcode scanners before installation in a vehicle. Radio frequency identification or RFID tags attached to parts are a solution for greater process reliability and efficiency "We have demonstrated this in both feasibility studies and wireless tests conducted jointly with Mercedes Benz Vans at their factory in Ludwigsfelde near Berlin," says Marc Kujath, research scientist at the Fraunhofer IFF.

"RFID technology has made crucial advances in recent years," adds his colleague Olaf Poenicke. Along with technical developments of transponder and readers systems, the numbering systems for RFID identification of individual parts have been standardized so that they can be widely used among companies in the industry. Unlike barcode, such tags can now be read in large numbers automatically without contact. "Such bulk reading typically takes place when material is being supplied, i.e. transferred from the supply chain to manufacturing," explains Marc Kujath. The engineering manager and his colleagues at the Fraunhofer IFF worked together with the Intelligent Manufacturing Team at the Daimler factory in Ludwigsfelde on a pilot project that tested the use of RFID in assembly. "A forklift takes pallets from a truck and drives through an RFID gate that reads the entire delivery in seconds fully automatically and all at once," says Marc Kujath, describing the system.

First, a multitude of parts were tested in Ludwigsfelde for their suitability for use with RFID from the supply chain with receiving and sequencing operations to material supply on the assembly line up through installation. They included parts sequenced by the factory's logistics unit for just in sequence supply and parts presorted and delivered by suppliers for specified assembly sequences. Finally, side view mirror and seat modules and five typical supply chain and manufacturing processes were selected for the pilot phase of RFID use. The RFID applications developed in the pilot phase ought to be transferable to the scanning of other parts afterward.

Side view mirrors actually tend to be standard products with little variation. One might think

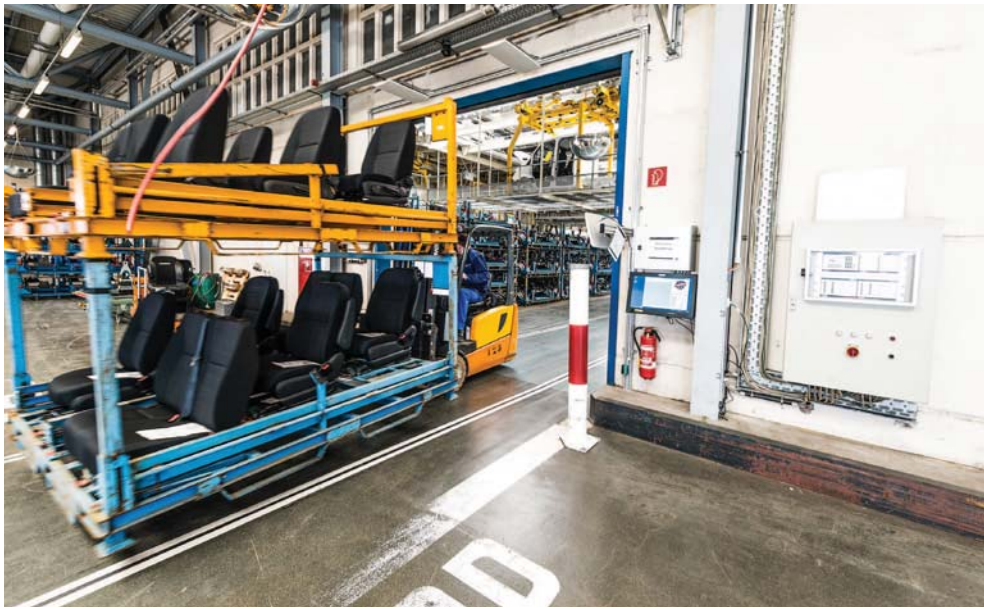
Whiles employees are inspecting vehicles, readers above the test bench are automatically inspecting whether every part with an RFID tag has been installed in the right vehicle

» AS THE PILOT FACTORY FOR PART IDENTIFICATION BY MEANS OF RFID, WE INTEND TO PROBE THIS TECHNOLOGY'S CAPABILITIES, THUS ORGANIZING OUR PROCESSES MORE INTELLIGENTLY AND PASSING OUR EXPERIENCES ON IN OUR GLOBAL VAN MANUFACTURING NETWORK. «

there is virtually no danger of mixing them up but that is a fallacy, particularly in the light commercial vehicle segment. Numerous national regulations result in a wide variety of parts for export, e.g. wide angle mirrors, which are outwardly indistinguishable to warehouse workers. They must be supplied correctly in order to prevent very expensive reworking later.

Fraunhofer Researchers Pick the Right RFID Transponders

Since RFID transponders had not been used in this domain before, the ideal transponders for the conditions in Ludwigsfelde had to be identified first. The researchers did this using the test laboratory at the Saxony-Anhalt Galileo Test Bed in Magdeburg's Port of Science where numerous transponders compliant with VDA standards have been tested and



RFID readers on the gate automatically scan the pallet with seats all at once without contact.

Virtually indistinguishable at first glance: Side view mirrors in a box before final assembly. The reader above the box reads the RFID chips on the mirrors. Every one is identified automatically. Mix-ups are impossible.

evaluated under realistic conditions. "The most important criteria were reliability, good read performance and, naturally, price per transponder," says Martin Kirch, the researcher at the Fraunhofer IFF who performed the tests. The RFID transponders selected are ideal for use from suppliers to final assembly.

Automatic Inspection during Assembly

RFID tags were attached to every single safety-critical part, e.g. every mirror. Like barcode, the tags store a serial number. The major difference is that, whereas barcode merely stores information on the type of mirror, the RFID tag's number includes numerous data such as the vehicle on which the mirror should be mounted. These data are available digitally all the time, even once parts have been installed. "This is a big advantage for

manufacturing," explains Kujath. "For instance, the installation of all the requisite parts can be verified while a front or rear axle is being mounted." Until now, such crucial verification has only been done during final inspection "quite traditionally by individuals performing visual inspections and using checklists on clipboards. A digital checklist is more efficient," he says, summing up. "Less susceptible to errors and more cost effective as well, it frees workers from routine jobs while automatic inspection gives them certainty that they have installed the right part." RFID tags on parts ultimately not only boost process reliability and efficiency but also the manufacturing process's transparency significantly.

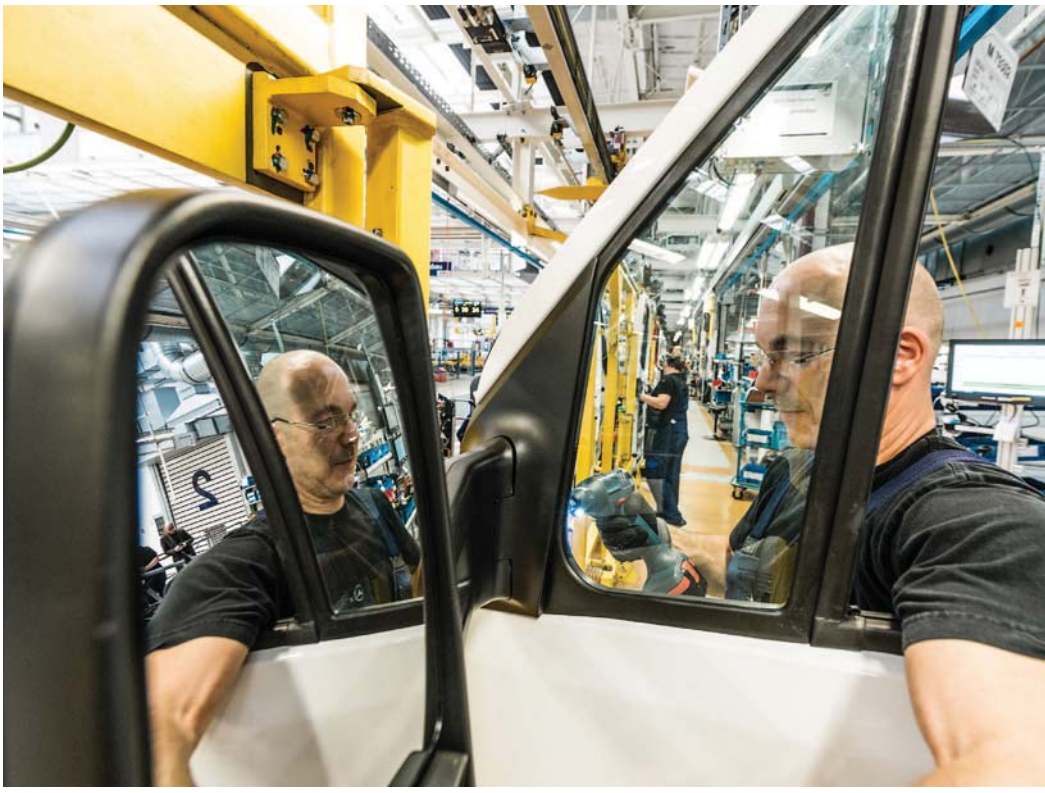
From Technology to Operating Specifications through System Integration

The researchers from the Fraunhofer IFF delivered both the technology and the operating specifications. "This required several steps, which we tackled together with our partner Mercedes-Benz Vans. For instance, we reduced the blind spots in production scheduling. This means that a project manager now knows the locations of snags in the process – and can ask the right questions at the right time. We additionally thought the different roles through. After all, a project manager needs different information than a technician," says Kujath.

Vehicle parts can also conceivably be tracked once a vehicle has been manufactured. RFID part identification can also make new aftersales services possible. At any rate, a variety of positive impacts are expected from the new technology at Mercedes. "As the pilot factory for part identification by means of RFID, we intend to probe this technology's capabilities, thus organizing our processes more intelligently and passing our experiences on in our global van manufacturing network," says Michael Trunschke, project manager at the Ludwigsfeld Sprinter factory.

The researchers in Magdeburg are already thinking about potential future projects similar to this one. After all, many companies face logistical challenges like those at Mercedes-Benz. Whenever Holger Seidel, Manager of the Logistics and Factory Systems Business Unit at the Fraunhofer IFF, has to describe the complexity of present-day supply chains, he likes to apply the metaphor of a big plate of cooked spaghetti. What looks like a knot that cannot possibly be disentangled, is easily disentangled with applied methods. "RFID systems are the crucial key to this because the small RFID chips supply us with all important data. It is actually the introduction of logistics to the world of big data," says the research scientist. This makes every part, whether it be in storage, in transit or in assembly, easily identifiable all the time. Process monitoring and control take on an entirely new quality. Such data management also significantly lowers error rates, which are already in the range of .01 percent.

In principle, the RFID specifications for supply chains and manufacturing made practicable by the Fraunhofer Institute in Magdeburg together with Daimler AG can also be transferred to many other sectors, notes Holger Seidel. He cites the aerospace industry as an example as well as machinery manufacturing and logistics providers with extensive container management. (ms/mar)



Installing side view mirrors on light commercial vehicles is not always easy because of the wide variety of models. Outwardly, the mirrors are virtually indistinguishable. Photos: Fraunhofer IFF, Andres Süß

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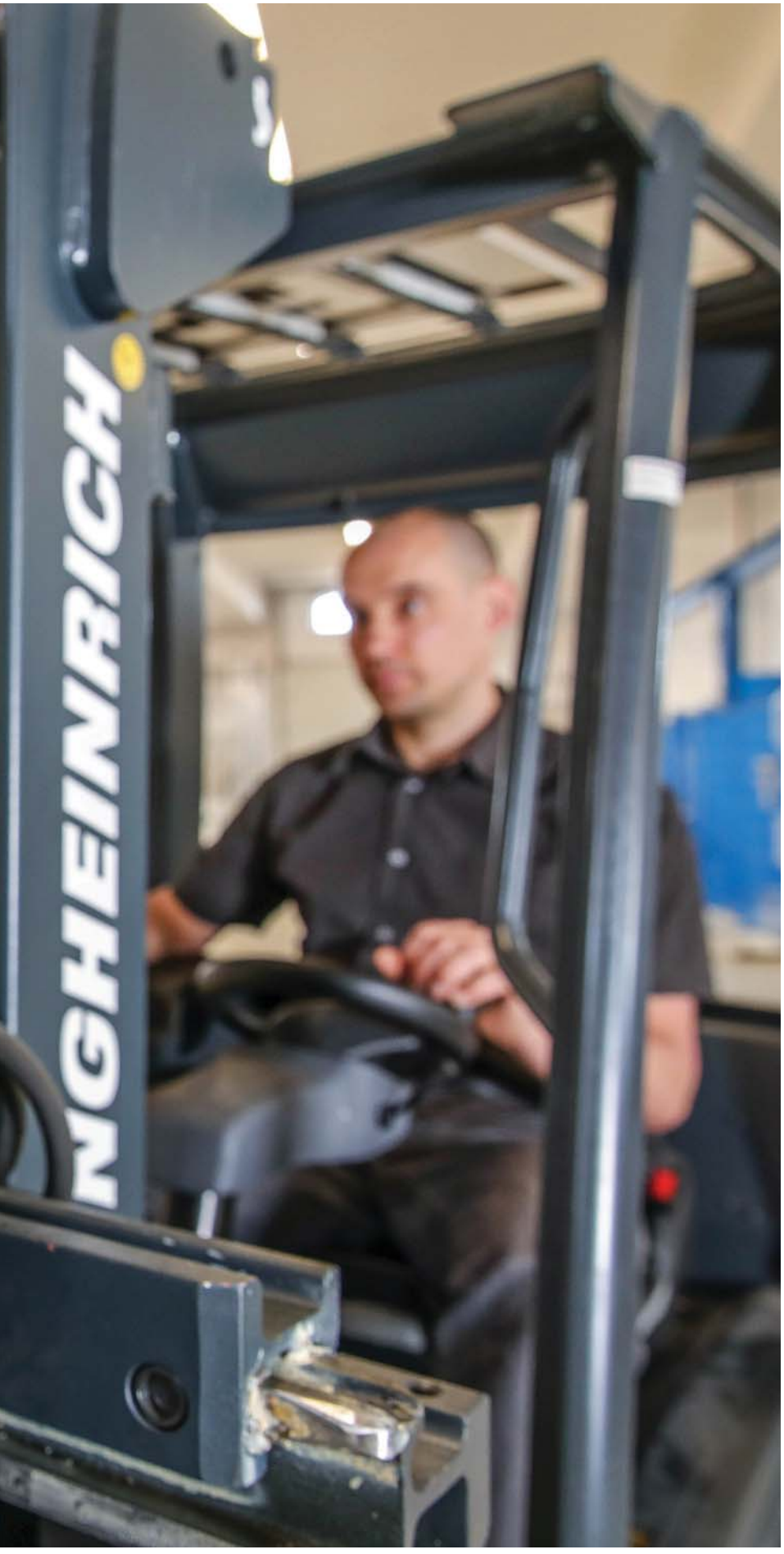
The Smart Pallet

» TRANSPONDERS' CONSTANT RADIO SIGNALS MAKE PALLETS' LOCATION TRACKABLE ALL THE TIME NOW RATHER THAN ONLY WHEN THEY PASS A READER. PALLETS CAN THEREFORE EVEN BE USED IN OPEN POOL MANAGEMENT. «



The Internet of things will make products smarter – at least in theory. Researchers at the Fraunhofer IFF are using pallets to demonstrate this idea's feasibility. Their main development is an electronic device with sensors that actively transmits its data to a control center cost effectively and energy-saving at regular intervals. This makes shipping transparent, even in open pallet pools.

Attention has to be paid to a lot in distribution logistics. Freight such as fresh fish or sensitive medicines stored on pallets can spoil if it stands in the sun too long. Losing track of pallets circulating in the service cycle is not only annoying but also costly in the long run. Although robust plastic pallets with service lives of around fifty uses are significantly more durable than wooden pallets, which often only withstand three uses, they are also more expensive. Logisticians are most concerned with being able to track pallets' location all the time and to check the quality of the products shipped on them whenever necessary.

Always Known: Pallet Location and Product Quality

Researchers at the Fraunhofer IFF are making this possible. "We developed an electronic communications unit, equipped it with sensors, and integrated it in plastic pallets, thus creating the first ever Internet of things pallet," explains Prof. Klaus Richter, Manager of Material Handling Engineering and Systems at the Fraunhofer IFF. The system is currently being tested at pallet manufacturer Cabka.

The pallet's key feature is its active transponder that constantly transmits its data to the control center. It also sends readings, e.g. temperature or current GPS location, from different sensors integrated in the electronic part. The electronic unit promptly transmits a warning to the control center whenever the temperature is too high or a shipment is otherwise imperiled. "This enables the smart pallet to monitor processes, warn of dangers such as high heat, and even report theft," say Richter, summing up.

The groundwork for this project had been laid five years earlier when pallet manufacturer Cabka approached the Fraunhofer IFF to integrate passive transponders in its pallets. "That was the foundation for organizing

closed pool management for companies," recalls Richter. Closed means that pallets remain in a company network and are not passed along to other customers. A reader automatically reads passing transponders and thus has data on the items on a pallet, including quantity and place of origin.

The newly developed active transponder has numerous advantages over its passive predecessor. "Instead of being read passively by a reader, the transponder transmits its data to a control center at regular intervals. This means that infrastructure can be dispensed with in storage facilities, thus rendering readers superfluous. The transponders' continuous radio signals make pallets' location trackable all the time now rather than only when pallets pass a reader. Pallets can therefore even be used in open pool management," says Richter. Open pool management denotes longer, partly unidentified service chains, i.e. cycles in which not all business partners are known from the outset. Data can also be retrieved locally on smartwatches or tablets without going through the control center.

Another advantage is no longer having to hand pallets over in person to clarify ownership. The owner can be identified by the location determined by GPS sensors. Thorsten Lenz, Manager of Development and Projects at Cabka, sees high value added in the new system. "Combining a highly optimized plastic pallet with an energy-saving IoT device finally makes it possible to supply process data relevant to sensitive supply chains in real time. The IoT pallet will generate changes in the control of logistical operations."

Long Range, Energy-Saving Communication

The LoRaWan (Long Range Wide Area Network) communications system related to the Internet of things makes this possible. The Internet of things is intended to help products become smart and communicate autonomously, the product in this case being the pallet. The advantages of the LoRaWan communications system are its effective range of several kilometers and its low power requirement. The wireless link is based on existing cellular towers. The pallet establishes a very brief connection to cellular towers at regular intervals, sends its data, and then terminates the connection.

Although feasible in principle, cellular communication is too expensive and requires a personalized contract as well. Cellular communication also consumes a lot of power. LoRaWan technology, on the other hand, is ideal for the challenges in supply chains. After all, it can be used to transmit location, humidity and temperature data to a control center at low bit rates. This costs four to ten euros per year at present and will become even cheaper in the long run.

The Fraunhofer IFF's researchers main development work involved integrating the sensors and connecting the system with the control center all the time by an appropriate, low-cost and energy-saving communications system. Ensuring that the printed circuit board withstands the harsh stresses on the pallet was another challenge. The researchers ensure this through its installation. There are two alternatives. A printed circuit board is either retrofitted in finished pallets or integrated directly in pallets during manufacture. "An Internet of things printed circuit board integrated directly during manufacture is far better protected than a retrofit," says Richter. Such printed circuit boards are integrated in

Transponders' constant radio signals make pallets' location trackable all the time now rather than only when they pass a reader. Pallets can therefore even be used in open pool management.

As is easy to see on this prototype, printed circuit boards are integrated in hollows in pallets and covered. This has two advantages. Printed circuit boards are well protected against impacts and mechanical stresses and they can be easily removed and reused whenever a pallet has completed its service after approximately fifty runs.
Photos: Fraunhofer IFF, Viktoria Kühne

covered hollows. That has two advantages. On the one hand, printed circuit boards are well protected from impacts and mechanical stresses. A plastic pallet expanding in the sun might cause mechanical stress that could damage a printed circuit board cast with the plastic. On the other hand, a printed circuit board can easily be removed from a hollow and reused once a pallet has completed its service after around fifty runs.

As the project now stands, the wireless module is finished. IoT manufacturer metraTec in Magdeburg is already producing it in small batches. The researchers are now integrating electronics modules in plastic pallets together with Cabka and shipping them throughout Europe. The technology's reliance on cellular towers and thus on the existing cellular network for communication raises the question of where communication connections exist and where not. Although network operators are slowly upgrading this technology for LoRa and retrofitting antennas accordingly, it is still in its infancy. That is why private consortia are filling gaps and simultaneously expanding the network wherever cellular coverage is nonexistent.

A Niche Application? Anything but…

The Internet of things device developed by the researchers at the Fraunhofer IFF is anything but a niche product. Apart from being integrated in pallets, it can also be used for numerous other needs such as tracking equipment in large companies or on airport premises. Their integrated sensors make these devices interesting for quality management, too: Were items shipped properly or was the pallet jostled unduly? Such questions will be answered easily in the future. (ack)

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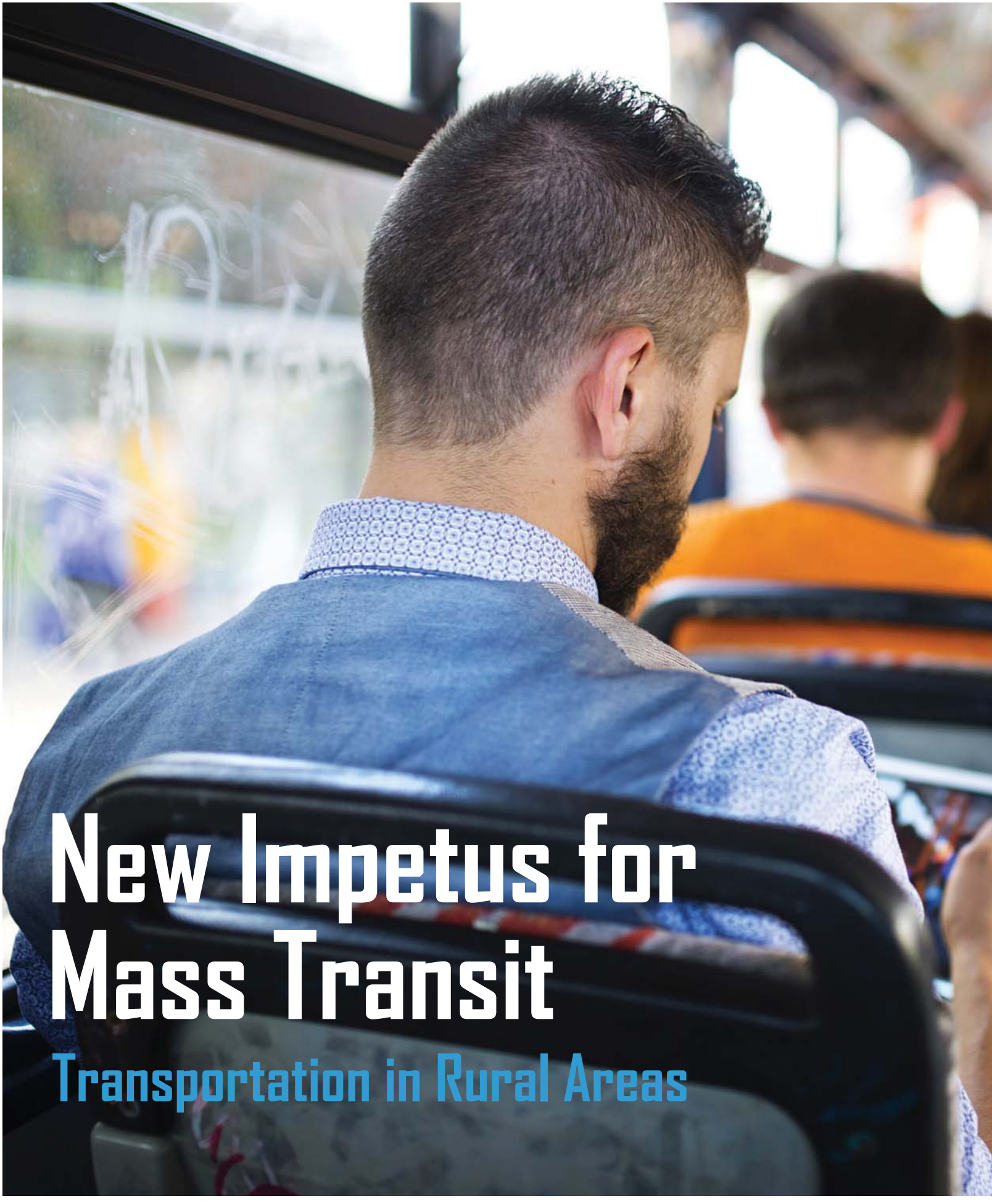

New Impetus for Mass Transit

Transportation in Rural Areas

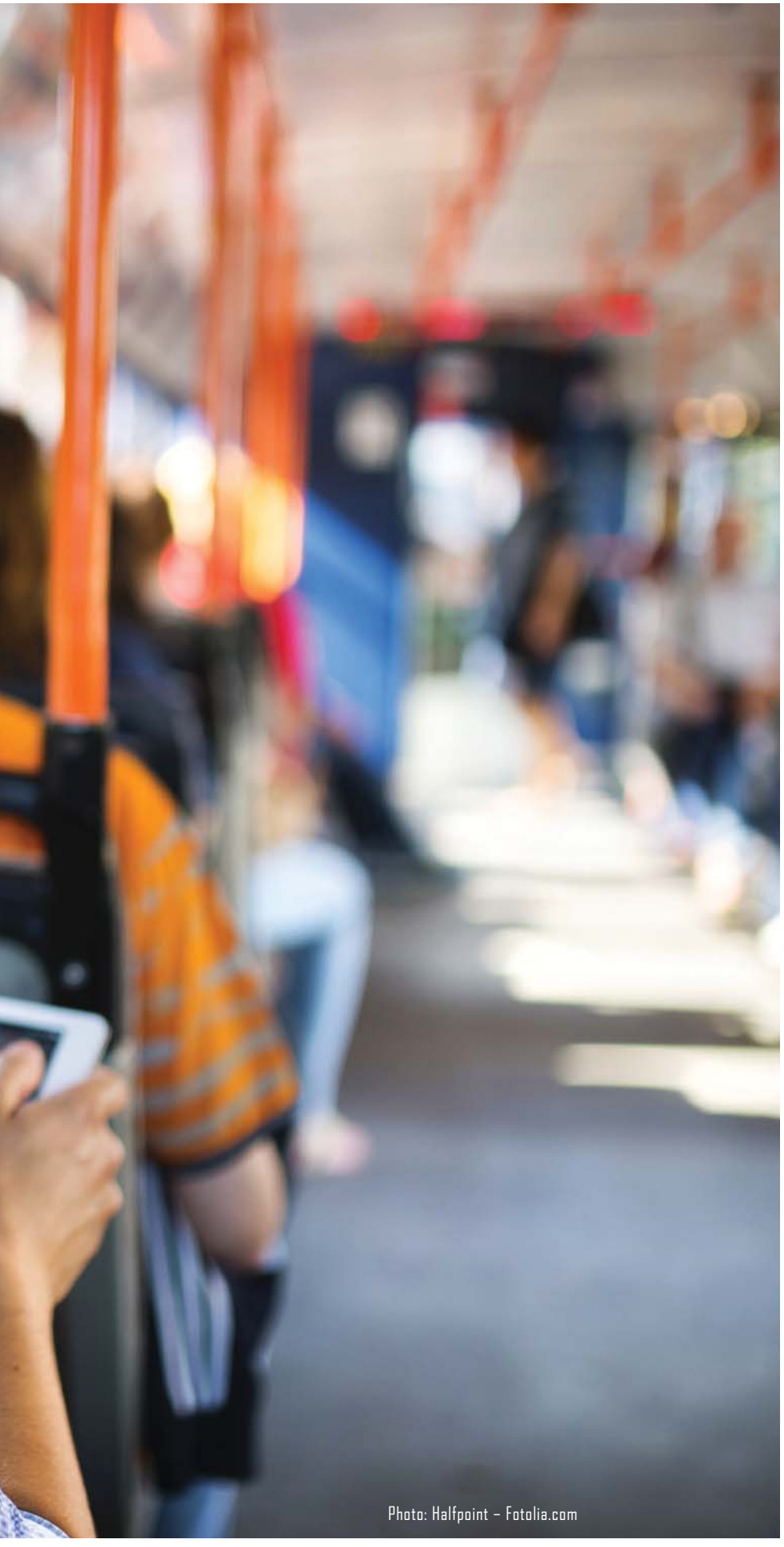

Photo: Halfpoint – Fotolia.com

Buses, commuter trains and subways in larger cities usually run every few minutes. The wait is longer in rural areas. Sometimes, buses only run a few times a day. The project MOVE@ÖV intends to improve transportation in rural areas with new transportation services and more electric vehicles that drive green.

You take off running as fast as you can but you are too late. You only catch sight of the taillights of the bus you wanted to take into town. That is all the more annoying since the bus only stops in your remote village once every few hours. Alternatives do not exist.

Such scenarios are familiar to most people from rural areas. Rural exodus has long since set off a vicious circle. As more and more people move from the country to cities, post offices, banks and the like in villages have increasingly fewer customers. They are merged or closed entirely. In turn, people have to get into cars or buses and drive longer distances for the smallest errands. Rural exodus is not only having an impact on businesses but also becoming noticeable in buses. Their seats are also increasingly remaining empty because of the declining population. Many bus routes are therefore suffering a fate similar to that of businesses. They are no longer profitable and are dropped. That has a direct impact on decisions between bus or car, which fall on cars more and more because routes have been reduced. In other words, the number of passengers riding already slightly used buses is declining further because schedules and routes have been reduced.

Another problem is that people usually drive cars powered with fossil fuel, i.e. gasoline or diesel fuel. Electric cars would be more sustainable. They are also a good addition to buses and trains for individuals traveling to remote destinations. On the downside, electric vehicles still have smaller ranges than vehicles with combustion engines, thus making better planning before departure essential, especially for longer routes. Vehicle batteries have long charging times, too. Running out of power on the road can cause major problems. Even though the conditions for electric vehicles are not ideal, the intention is to promote change conducive to switching from combustion engines to green propulsion systems.

How can these challenges be tackled? First, a plan is needed, which helps passengers as well as mass transit providers and advances the electrification of mass transit and private vehicles. Apart from technological innovations such as autonomous vehicles, service innovations are especially promising. Better interconnectivity of the different elements of transportation, i.e. buses, trains, bikes, cars, remains an important issue. Researchers at the Fraunhofer IFF tackled this issue together with colleagues at the Technische Universität Ilmenau, Nahverkehrsservice Sachsen-Anhalt GmbH (NASA GmbH) and IT provider HaCon Ingenieurgesellschaft mbH. In the MOVE@ÖV project, they developed a plan for new partial services that use electric vehicles, among other things, to improve transportation in rural areas and boost mass transit.

With an E-Bike to the Bus

In the project, the researchers analyzed large quantities of data, interviewed experts, and conducted written surveys with transit companies. One important element of their ideas was linking different means of transportation efficiently while facilitating greater individual use of mass transit services. Surprisingly, the actions that improved rural transportation were often comparatively small. In the project, consideration was given to enabling individuals' transportation in response to one of the main problems, infrequent rural bus ser-

Photo: spql – Fotolia.com

» WE ORIGINALLY THOUGHT THAT PEOPLE DON'T CARE WHY THEY CAN'T FINISH A CERTAIN ROUTE AND ONLY WANT TO KNOW WHETHER ONE BATTERY CHARGE IS SUFFICIENT OR NOT. IT WAS THEREFORE QUITE A DISCOVERY, MORE OR LESS AN AHA! MOMENT, TO LEARN THAT THEY ARE INDEED INTERESTED IN THE REASONS, WHETHER THEY BE LOW TEMPERATURES, THE GRADE OR ANOTHER FACTOR. «

vice or hard-to-reach stops, especially for seniors. One partial solution might be to facilitate the use of bicycles or even electric bicycles. They would at least make people somewhat more mobile to better reach train stations or more remote bus stops, for instance. Customer surveys indicated that combining bicycles/electric bicycles and mass transit lines holds great potential Where can a bike be parked securely, though? And can an electric bicycle be charged near a stop? Users in Saxony-Anhalt will be able to look this up on NASA GmbH's transportation portal in the future. It will display every publicly and commercially operated charging station including their features. Can a bike be stowed securely in a bicycle locker? What does charging cost? NASA GmbH's partners surveyed the current bike charging infrastructure. First, they classified stops based on location, the stops' importance in the route network, and ridership. Then, stop features such as bicycle parking facilities and e-bike charging options were identified and assessed with a point system. The researchers correlated evaluation results with stops' boarding and deboarding numbers to ascertain what can be improved. The data obtained helped map bicycle parking facilities and e-bike charging options in the passenger information system.

Public charging stations for e-bikes can help close connection gaps in mass transit. Photo: jozsitoeroe – Fotolia.com

On-Demand Buses and Shared Taxis as Alternatives

Flexible services such as on-demand buses that passengers order as needed are another element. The have become integral to local mass transit in many regions of Germany. They either supplement buses and trains when demand is low or replace them entirely. Many users still have difficulty accepting this service for two reasons. First, seniors in particular often have inhibitions ordering a bus or shared taxi just for themselves. Second, such flexible and schedule-related services have not been displayed suitably on digital information portals. The project partners HaCon and NASA GmbH addressed this. They developed an option for easily ordering shared taxis and the like on suitably constructed portals.

These partial services have been implemented in pilot applications. The researchers are optimistic that they will soon also simplify real operation of mass transit services in Saxony-Anhalt.

Calculating Electric Vehicle Ranges

Despite such improved mass transit services, private means of transportation still predominate in rural regions. That is precisely why the introduction of electric vehicle networks is important there. Driving green with an electric car, whether one's own or one from a car sharing service, raises the question of whether a planned route can be driven with one battery charge. Low range and long charging times are the biggest obstacles to acceptance of electric vehicles. A study of company car fleets in government agencies demonstrated this. Gas and diesel cars were usually taken first. Employees only reserved electric vehicles when the others were unavailable.

Cars in Germany are driven an average of twelve kilometers per trip. On average, most Germans drive a maximum of around forty-five kilometers per days. Contrary to assumptions, the distances in rural areas are actually not substantially longer. Electric vehicles can usually cover these distances easily. Vehicles do not need a "fill-up" for trips under one hundred kilometers or more. Users' problems are primarily psychological. They fear landing on the berm without power at some point, even on shorter trips, or having to drive a longer dis-

Among other things, the MOVE@ÖV project studied how electric vehicles improve transportation in rural regions and mass transit can be boosted. Photo: Fraunhofer IFF, Viktoria Kühne

figures are problematic because they were measured in laboratories for standardized driving cycles (formerly the NEDC, now the WLTP since 2017), i.e. under standardized ambient conditions. In other words, they are suited for a comparison of two car models' consumption but often have little to do with their real range. The deviations from theoretical values are substantial. "Having to drive up a mountain against the wind in deepest winter can easily halve the range," says Bastian Sander, physicist at the Fraunhofer IFF, putting it in concrete terms. The amount temperature reduces range depends on the particular type of battery. What is more, a vehicle's individual features (geometry, tires, total weight), the road (surface, grade, speed limit) and, not least, the wind affect a vehicle's power requirement significantly.
"We are striving to counter such range anxiety," says Sander. The researchers at the Fraunhofer IFF have developed a route-dependent range calculation system as a partial MOVE@ÖV service. Anyone wanting to know if an electric car will complete a planned trip with one battery charge opens the platform and enters the time of travel, point of departure and destination, and car model. The system finds other information over the Internet. Once the user has entered the date, the system receives the current weather forecast, including outdoor temperature, air pressure, and wind speed and direction, for the selected period from an online weather service. It uses an online map service to compute the grade climbed and types of roads driven on the trip from which it ascertains the car's average speed. How must the car perform? "The system computes rolling resistance, grade resistance, drag, acceleration and energy requirement from this," explains Sander. The user receives information on the feasibility of the planned route with one battery charge under the given conditions. "We intend for this tool to provide clarity and dispel drivers' anxiety about their vehicle possibly running out of power on the road," explains Robert Kummer, another researcher at the Fraunhofer IFF. In the medium term, the researchers intend to incorporate charging stations' distribution. Then, much like booking a flight, users could indicate whether they would accept no, one or more charging stops.

The staff at TU Ilmenau subjected the range calculation system to a usability test. The outcome was surprising. "We originally thought that people don't care why they can't finish a certain route and only want to know whether one battery charge is sufficient or not. It was therefore quite a discovery, more or less an Aha! moment, to learn that they are indeed interested in the reasons, whether they be low temperatures, the grade or another factor," says Sander. Integrating such information in such an information portal is certainly technically feasible. (ack)

tance at short notice and not knowing whether they can make it with an electric car. The researchers at the Fraunhofer IFF are developing a solution for that with their partial service.

Electric Cars' Energy Requirement Varies

Although manufacturers specify a certain, average range for their electric cars, these

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Safely Interacting Humans and Machines

FourByThree EU Project: Fraunhofer IFF Presents Projected Workspace Monitoring

Some two millions robots stood in factories all over the world at the end of 2017. The International Federation of Robotics (IFR) foresees a continually steep growth curve in the coming years. Over three million computer-controlled machines will be performing jobs in industrial manufacturing operations by the end of 2020. Germany, along with South Korea, Japan and Singapore, has one of the highest automation rates. The inevitably rapidly growing number of interactions necessary between humans and machine will necessitate solutions for safe work routines.

The Fraunhofer Institute for Factory Operation and Automation IFF and sixteen partners from all over Europe developed hardware and software solutions for a new generation of robots that safely and efficiently collaborate with humans in the FourByThree project funded by the EU. The research project derives its name from the four most important characteristics of a robot systems – modularity, safety, usability and efficiency – combined with the three major actuators – humans, machines and environment.

The Fraunhofer IFF used its patented projected workspace monitoring system in the project as the basis for developing a technology that enables humans and machines to interact intuitively. The new solution replaces cameras and projectors originally distributed independently in space with sensor units. "Flexible connecting elements combine and synchronize one projector and two cameras in each single module," explains José Saenz, who is managing the project at the Fraunhofer IFF. "The robot control delivers data on arm position and speed to the sensor system, which computes safeguarded areas from them." These are visibly projected around the area where the robot operates and adjusted dynamically to its movements as narrowly as possible and as widely as necessary, in keeping with the separation formula from ISO/TS 15066. The visible boundary does more than show employees the maximum area in which they can safely work. Breaches of projected safeguarded areas, e.g. a hand entering the robot's work area and disrupting the projected beam, are captured by the cameras, prompting the robot to stop its movements immediately.

A "Simple Idea" for a Complex System

A "simple idea" makes this possible, finds Saenz. The projector's light is switched on and off at high frequency. "The human eye does not perceive any flickering but the computer receives one image with light and one without light after another." Safeguarded areas are defined based on the expected out-

The robot control delivers data on arm position and speed to the sensor system, which computes safeguarded areas from them. These are visibly projected around the area were the robot operates and adjusted dynamically to its movements. Photo: Stefan Deutsch

comes computed internally. The system checks the two-dimensional camera images against computer-generated ones. Discrepancies immediately activate a signal. "The result is rapid and reliable processing with minimal response time – ideal conditions for a safety sensor." Complex 3D computations become unnecessary.
The safeguarded areas provide technical and psychological security. "A robot can be frightening," says José Saenz. "It moves differently than a person. It is articulated and very fast in a very different way. That is strange to employees. They project their anthropomorphic view onto the machine but are unable to anticipate its movements."
How a person dealing with a robot feels heavily influences acceptance of collaboration. "Workers can organize their workflows accordingly when they know what space a robot will occupy."

The sensor units also protect tools and workpieces from damage and facilitate operations. Information relevant to worker assistance, for instance, is projected directly into the work environment. Machined parts can be positioned precisely. Virtual and customized buttons enable individuals to control a robot and operations intuitively.

José Saenz considers it important that workers can define their work themselves as far as possible: "Whenever a worker or a robot can perform a job, the individual decides which part he or she wants to do."

Safety in Practice

The projected workspace monitoring system has already passed its field trial with flying colors. The consortium's industry partner defined four pilot scenarios in which the FourByThree technologies had to prove themselves. The Fraunhofer IFF's sensor units won over users in such industrial operations as assembly, workpiece insertion and removal, welding, riveting and deburring. Another feature will also be important to companies. Like most of the solutions developed in the project, the sensor units can be integrated in existing robot systems. "Our solution can be used anywhere machines are used, regardless of a company's size," says Saenz. "Our goal is to license sensor units to industrial companies as a safety certified product." (chr)

Combined sensor unit above a workspace: One projector and two cameras are combined and synchronized in one module. Photos: Fraunhofer IFF, Stefan Deutsch

» WHENEVER A WORKER OR A ROBOT CAN PERFORM A JOB, THE INDIVIDUAL DECIDES WHICH PART HE OR SHE WANTS TO DO. «

Breaches of projected safeguarded areas, e.g. a hand entering the robot's work area and disrupting the projected beam, are captured by the cameras, prompting the robot to stop its movements immediately.

FourByThree

€ 6.9 million in funds, partly from the EU Horizon 2020 framework program for research and innovation were available to the entire European project FourByThree. Consortium partners coordinated by the Spanish research center IK4-TEKNIKER included research organizations, industrial and technology companies, and universities,.

Project partners

Fundacion Tekniker (IK4-TEKN), Eibar, Spain; Deutsches Forschungszentrum fuer kuenstliche Intelligenz GmbH (DFKI), Bremen, Germany; Consiglio Nazionale delle Ricerche (CNR), Rome/Milan, Italy; King‹s College London (KCL), London, Great Britain; Queen Mary University of London (QMUL), London, Great Britain; Zentrum Für Mechatronik Und Automatisierungstechnik Gemeinnützige GmbH; (ZEMA), Saarbrücken, Germany; Deltatron Oy, Helsinki, Finland; Pilz Industrieelektronik SL, Barcelona, Spain; Antproject TVIP SL (Prosumerlab), San Sebastian, Spain; Ingenieria Y Servicios de Automatizacion y Robotica KOMAT SL, Eibar, Spain; EFS-Gesellschaft für Hebe- und Handhabungstechnik mbH, Nordheim, Germany; Alfa Precision Casting SA, Eibar, Spain; Woll Maschinenbau GmbH, Saarbrücken, Germany; Stichting Stodt Praktijkcentrum voor Geavanceerde Technologie (STODT), Hengelo, Netherlands; Ground Truth Robotics (GTR), Bremen, Germany

Video: Projection and camera-based work space monitoring system

Link to the video:
https://youtu.be/tmLiWmVPFM4

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Photo: Fraunhofer IFF, Viktoria Kühne

Plant design and process manufacturing have long been using digital tools in every domain, just not consistently. Comany-wide use of avilable data would generate additional vallue added, for instance, in a helpful maintenance assistance system.

Technicians can retrieve any of a system's parts and condition date virtually in real time. Defects are identified immediately and displayed along with part information and instructions for repairs.

Photo: Fraunhofer IFF, Dirk Mahler

Many conventional manufacturing processes and environments have to be modified for the conditions of Industrie 4.0.

Flexibility and digital transformation will play a major role in sustaining competitiveness in the future.

The Fraunhofer IFF's supply chain experts advise companies that are planning and establishing or reorganizing supply chain and manufacturing systems.

Fraunhofer IFF Congratulates Prof. Gerhard Müller on His Retirement

"Nothing is more certain than change." This simple truth is both a truism and a major challenge for business as well as research. It means recognizing important changes early on, drawing the right conclusions, adapting oneself and one's own objectives, and taking the necessary actions. The Fraunhofer IFF has also been following this maxim since it was established over twenty-five years ago. Prof. Gerhard Müller, Deputy Director of the Fraunhofer IFF until 2017 and in well-deserved retirement since January 1, 2018, always based his actions on this.

One of the "fathers" of the Fraunhofer IFF, Gerhard Müller was instrumental in its establishment and success from the very start. Along with Prof. Eberhardt Gottschalk, the institute's founder and first director, and his successor Professor Michael Schenk, he left a secure job at the Technical University Magdeburg during the transitional period of the early 1990s for the adventure of Fraunhofer. Together, they planned the manufaturing engineering research institute's profile and adapted it for the young state of Saxony-Anhalt's dramatically changing business landscape. At the same time, they created awareness of constant change and the importance of innovation, periodic adaptation and flexibility in the Fraunhofer IFF's DNA. This was one of the guarantors the Fraunhofer IFF's successful development, which is now one of Saxony-Anhalt's most important research organizations.

Having earned his doctorate in 1986, one Gerhard Müller,'s first official jobs at the young Fraunhofer institution was managing the Department of Maintenance and Service Management in 1992. He was made manager of the Division of Planning and Logistics in 1994, by which time the Fraunhofer IFF was an autonomous institute. At the same time he became a member of the Fraunhofer IFF's board of directors. As new business segments were being established in 2001, he became the manager of the Division of Production and Plant Management and was named deputy director. Director Michael Schenk with close ties to Gerhard Müller not only because of the numerous soccer games together recognized him as the institute's important strategist on the occasion of his 60th birthday. Schenk, the forward, fast and noisily at the front, and Müller, the so-called sweeper, who has the overview of the entire playing field. He knows when it turns critical and wards off threats, observed Prof. Schenk lightheartedly.

In his role as chief of staff, as institute founder Prof. Gottschalk once termed it, Gerhard Müller always had a watchful eye on the research institute's development. Side by side

Hammering in the symbolic final nail at the topping out ceremony of the Virtual Devlopment and Training Centre in Magdeburg' Port of Science. Photo: Fraunhofer IFF, Viktoria Kühne

At the colloquium honoring Prof. Eberhard Gottschalk on his seventieth birthday at the Fraunhofer IFF: Prof. Gerhard Müller (l.), Prof. Eberhardt Gottschalk (m.) and Prof. Michael Schenk (r.). Photo: Fraunhofer IFF

"There's no research without new talent," Prof. Müller always liked to say. That is why the development of young future engineers was always particularly important to him. He believed it was never too early to start, just as here, building the "world's biggest fantasy machine" with the Tigerentenclub in 2004. Photo: Anna Mahler

Recognized with the VDI Badge of Honor in 2015. Photo: Christina Schumacher

with Director Schenk, he kept the Fraunhofer IFF on an expansion course. He fought readily and often for "his" institute. For instance, when new research projects for current challenges had to be launched, obstacles had to be surmounted, and partners had to be found to achieve strategic objectives. Whoever he addressed could always expect passion for his cause, clear standpoints, persistence and negotiating skill from him. He combined engineering spirit, technological expertise and pragmatism with visionary ideas like hardly any other.

Many of the Fraunhofer IFF's significant and successful projects bear his signature, whether the idea for Magdeburg's logistics hub, the Saxony-Anhalt Galileo Test Bed, made reality by Prof. Müller and Prof. Schenk together with other partners, or the Virtual Development and Training Centre VDTC, the Fraunhofer IFF's flagship in Magdeburg's Port of Science. Credit for the institute's research specializations in energy and resource efficiency, renewable energy use, electric vehicle networks and smart farming largely goes to Gerhard Müller's efforts. The son of a family of millers deeply rooted in the Altmark, which operated aits own water mill there for four generations, was passionate about this ecological research profile. He was also intensely committed to this outside the Fraunhofer IFF, for instance, in the Saxony-Anhalt Center for Renewable Energies ZERE.

His contributions to engineering on the whole did not go unnoticed outside the Fraunhofer IFF, either. Gerhard Müller was awarded the VDI Medal of Honor in 2007. The Ukrainian National Aerospace University named him honorary professor in 2010. Finally, VDI President Ungeheuer presented him with the VDI Badge of Honor in 2015.

Professor Gerhard Müller was instrumental in shaping the Fraunhofer IFF's fortunes and thus its transformation for twenty-five years. Even many of the institute's future major project are virtually inconceivable without him. He initiated and advanced construction of the institute's new addition for research and development of smart work systems, thus preparing the Fraunhofer IFF well for future challenges. Gerhard Müller finally has enough time now for other personal interests now such as family and grandchildren, of course, and preserving the Müller family's historic abbey mill in Dambeck township. Much that has always distinguished him is being demanded of him again there: substantial technical expertise, visionary thinking and high energy. The Fraunhofer IFF thanks and congratulates Prof. Gerhard Müller on his active retirement! (mar) ■

Dr. Behrendt Receives Appointment at SRH Fernhochschule, The Mobile University

Dr. Fabian Behrendt (2nd from l.) receiving his appointment as professor at SRH Fernhochschule. Photo: SRH Fernhochschule

SRH Fernhochschule, The Mobile University, in Riedlingen, Baden-Württemberg, is adding three professors to its faculty at the beginning of 2018. They will be applying their expertise in the fields of industrial engineering, technology and systems development, and economics and sustainability.

One of them is Dr. Fabian Behrendt, who was who was appointed Professor of Industrial Engineering at SRH Fernhochschule on January 1, 2018. The engineering manager has been an employee of the Fraunhofer IFF since 2012 and manager of the main office of the Fraunhofer-Gesellschaft's Group for Production since 2013. At the same time, Dr. Behrendt has been working as an instructor at Otto von Guericke University Magdeburg. At SRH Fernhochschule, he will primarily be in charge of the modules "Manufacturing and Supply Chain Concepts", "Digital Engineering", "Introduction to Engineering" and "Industrial Operations Management" in the engineering management programs. The Mobile University's students will profit from his teaching and research experience as well as his work in different professional fields. (mar) ■

Twenty-Two New Research Managers for the Fraunhofer-Gesellschaft

The Fraunhofer Academy's "Fraunhofer Research Manager" honors program trains future research managers to organize effective and purposeful sharing of research findings at the interface of research and industry.

Twenty-two research managers completed the third round of this honors program at the end of March. One of them was Dr. Christian Teutsch, who has been working at the Fraunhofer IFF since 2003 and coordinating the Fraunhofer Big Data Alliance's "Production/Industrie 4.0" business area since 2014.

He was one of the eight members of the project group that developed a digital guide with recommendations and tips for developing digital utilization models in a project entitled "Digital Utilization 4.0: From the Idea through Implementation". This work and four other projects on "Cross-Institute Collaboration and Digital Transformation" were presented at the Fraunhofer headquarters in Munich.

Dr. Christian Teutsch and twenty-one other successful graduates of the honors program may now proudly call themselves "research managers". Prof. Georg Rosenfeld, Fraunhofer-Gesellschaft Executive Vice-President for Technology Marketing and Business Models, presented the certificates of completion to the graduates.

The idea of training Fraunhofer talents to be future research mangers in a program was hatched five years ago. Since then, the Fraunhofer Academy has successfully brought three classes through the program. (kor) ■

The Fraunhofer-Gesellschaft's twenty-two new research managers. Dr. Christian Teutsch is first from the left in the front row. Photo: Marc Müller

Fraunhofer Researcher on the euRobotics Board of Directors

José Saenz from the Fraunhofer IFF's Robotic Systems Business Unit has been an elected member of the Board of Directors of the professional association euRobotics since 2017. He is one of twelve members of the euRobotics Research Board of Directors. His term of office is three years. At his side are the twelve members of the Industry Board of Directors, the Secretary General, and the President Dr. Berndt Liepert (KUKA).

Based in Brussels, euRobotics AISBL (Association Internationale Sans But Lucratif) is an international non-profit association for all stakeholders in European robotics. It builds upon the success of the European Robotics Technology Platform (EUROP) and the academic network of EURON, uniting the members of both in one common organization for the entire European robotics community.

One of the association's main missions is to collaborate as a private partner with the European Commission to develop and implement a strategy and a road map for robotics research, technological development and innovation factoring in the framework program Horizon 2020. The association also facilitates intensive dialogue between industry and research on concrete topics in robotics. (mar) ■

José Saenz
Photo: Fraunhofer IFF, Andreas Süß

Managing Knowledge

Ask ask Stefan Voigt about his hobbies and he immediately answers, my two children. Regrettably, the father of two and family man does not have time for much else. The forty-one-year-old with a Diplom degree in business informatics is the assistant manager of the Mittelstand 4.0 Center of Excellence in Magdeburg. His time-consuming job involves helping businesses in Saxony-Anhalt transition to digital transformation. This entails a lot of travel promoting the center of excellence, establishing networks, visiting companies, and organizing consultations, workshops and training programs for companies.

Stefan Voigt is actually an employee of the Fraunhofer IFF and was more or less "loaned out" for this job. He has been working at the institute since 2002, most of the time in the Logistics and Factory Systems Business Unit. He specializes in knowledge management.

"I've always been interested in uniting people, technology and organization. The technical side was particularly fascinating me, a business informatics expert," he says. "That pertained primarily to the development of digital platforms such as wikis, which help render knowledge in businesses transparent and share it effectively as possible. In this respect, digital transformation, specifically digital interconnectivity in companies and the interplay of humans and the digital world, already played a major role in my work very early on."

His expertise also flowed in his doctoral dissertation written on "Development of an Integrated Concept for Documentation in Agile Software Projects". "Generally, it's about using a sound methodology to record important experiences of the individuals involved in a project so optimally that they can be made optimally available to other," he says, explaining the difficult title with a smile.

Stefan Voigt completed his doctoral dissertation in the spring of 2017, just in time to fill the position of assistant manager at the Mittelstand 4.0 Center of Excellence in Magdeburg. For the next three years, he and his team and many partners such as the Fraunhofer IFF and Otto von Guericke University Magdeburg will be helping companies decide which digital solutions they need to transition to "digital companies". He will be focusing on facilitating digital transformation and Work 4.0. Funding for the center of excellence will end in 2020. Then, his career path will lead him back to the Fraunhofer IFF where he will continue helping businesses with the challenges of digital transformation. (mar) ■

Former and current colleagues celebrating the traditional ceremony before the Otto von Guericke monument in Magdeburg with Dr. Stefan Voigt (m.). Photo: Fraunhofer IFF, Christian Blobner

Onto Success with Virtual Learning

There is no getting around Tina Haase at the Fraunhofer IFF when it comes to learning using technology-based learning and assistance systems. The thirty-eight-year-old engineer is a specialist in the development of such systems, which are used, for instance, by companies to train their employees.

Tina Haase has been working at the Fraunhofer IFF since 2002 and on the development of this specific research topic at the institute almost from the start. She now heads the Learning and Experience Sharing Group in the Measurement and Testing Technology Business Unit. This is an integrative topic, she says, that interconnects many technological issues at the Fraunhofer IFF. Her work is multifaceted. "We are working, for instance, on means to introduce new technologies in manufacturing. Among other things, we are seeking solutions that employees genuinely accept and use. After all, only this will enable them to develop their technical capabilities fully at their companies. Afterward, we evaluate the results to ensure that they deliver the promised benefits to companies."

Experience sharing is another important issue for businesses. "Companies lose valuable knowledge whenever experienced employees depart or change jobs. Virtual scenarios have the potential to document this knowledge visually and make it available in the work situation," says the engineer. Close collaboration with the Otto von Guericke University Magdeburg's Departments of Engineering education and Vocational Education ensures the quality of teaching and learning.

She ultimately found her dissertation topic in her work: "Industrie 4.0: Technology-Based Learning and Assistance systems for Maintenance". "The topic was spawned by years of collaboration in an industry project," says Tina Haase. She earned her doctorate, summa cum laude, in 2017. She is already incorporating the contents of her dissertation her current project entitled StahlAssist in which she is developing such assistance systems for reliable and learning-conducive maintenance work in a steel mill. (mar) ■

Dr. Tina Haase receiving her diploma at the Otto von Guericke monument in Magdeburg, a must for newly-made doctors. Photo: Private

VDI Awards Professor Michael Schenk the Grashof Medal

Professor Michael Schenk, Director of the Fraunhofer Institute for Factory Operation and Automation IFF in Magdeburg and of Otto von Guericke University Magdeburg's Institute of Logistics and Material Handling Systems, was awarded the Grashof Medal, the VDI's highest honor, at the 28th German Engineering Day 2017 in Düsseldorf.

VDI President Prof. Udo Ungeheuer thus recognized Prof. Schenk's achievements in German engineering. He personally advanced research organizations' collaboration with manufacturers. Moreover,

he especially furthered the engineering profession, the role of engineers, and young professionals. He held top posts in the VDI for many years, including President of the Saxony-Anhalt State Chapter of the VDI for seven years. Numerous initiatives he promoted further shaped the positive image of engineering in society, said VDI President Ungeheuer.

After Hugo Junkers and Herrmann Gruson, Michael Schenk is just the third native of Saxony-Anhalt to receive the VDI's highest honor. He joins the ranks of other distinguished recipients such as Count Ferdinand von Zeppelin, Carl Bosch and Ferdinand Porsche.

He himself primarily views this recognition both as vicarious acknowledgement of the work of engineers in Saxony-Anhalt and as publicity for the state. "The award signals that we have successfully managed to revitalize engineering and thus the professional workforce in Saxony-Anhalt since 1990. The outstanding engineering programs at Otto von Guericke University and the state's universities of applied science have been instrumental in this," says Prof. Schenk. (mar) ■

Prof. Michael Schenk (r.) being presented the Grashof-Denkmünze by VDI President Prof. Udo Ungeheuer (l.). Photo: VDI, Bildschön

From Doctoral Student to Mentor

Renewable energies are one of Torsten Birth's passions. The researcher at the Fraunhofer IFF is working on demand-driven and energy efficient power-to-X systems for industry and on power systems, i.e. renewable energy storage systems, that will be available to industrial companies on demand. He is constantly advancing these topics outside of work, too. He heads the biomass gasification team in the Fördergesellschaft Erneuerbare Energie e.V.. Unsurprisingly, his doctoral dissertation in chemical process engineering, which he successfully defended in December 2017, is entitled "Treatment of Biogenic and Waste Gases: Analysis of Dry Reforming".

The native of Magdeburg's passion for the natural sciences emerged early on. He decided to earn his high school degree from a high school specializing in natural sciences and engineering. He followed this with a Diplom degree in process engineering at Otto von Guericke University Magdeburg where he seized the opportunity to acquire practical experience as a student assistant in the Fraunhofer IFF's Process and Plant Engineering Business Unit in 2008. Following an internship at the chemical company BASF, he wrote his Diplom thesis on dry reforming at the pharmaceutical company Bayer before returning to the Fraunhofer IFF as a research scientist in 2012.

Torsten Birth is now a recognized specialist in biomass waste recovery research. Among other things, he is collaborating on the "Power-to-Gas" project focused on hydrogen fuel cells that are intended to replace traditional combustion engines, especially in factories, industry and internal supply chains. The power for hydrogen production, in turn, will come from renewable sources.

Having officially received his diploma and doctorate in March 2018, the amateur athlete is now mentoring young researchers as well. He recently initiated an undergraduate colloquium to advise and help young researchers with questions about bachelor's and master's theses in order to share his experience. (kor) ■

Dr. Torsten Birth (m.) enjoying the humorous diploma presentation ceremony at the Old Market in Magdeburg. Photo: Private

Changing of the Guard in Administrative Services Management

Karla Zorn (l.) and her successor as manager of administrative services Fraunhofer IFF, Andreas Knittel (r.). Photo: Fraunhofer IFF, Viktoria Kühne

Karla Zorn also believes that all good things must come to an end. She headed administrative services at the Fraunhofer IFF for over eleven years. The manager of Administrative Services took her well-earned retirement in April of 2018. "Those were always exciting times," she recalls. "Now its time, however, to pass the baton and let a younger generation take charge."

The "younger generation" is Andreas Knittel. The thirty-nine-year-old from Mühlhausen in Thuringia has an MBA and knows the Fraunhofer IFF like the back of his hand. He has been working for the institute in different positions since 2009 and in the Fraunhofer IFF's administrative services since 2015, preparing intensively with Karla Zorn's help for the complex job of managing administrative services. "I'm looking forward to my new work with pleasure and respect," say Andreas Knittel. "Interesting challenges, starting with the planned addition to the institute in Magdeburg's Port of Science through the pending change in institute management, are just around the corner. But we have an excellent team and are thus well prepared."

Director Michael Schenk recognized Karla Zorn's outstanding work as the head of the Fraunhofer IFF's administrative services and thanked her for her work over the past years. "Those were important years in the institute's development during which we grew steadily and were able to establish ourselves further as the leading research organization in Saxony-Anhalt. Credit for this also goes to the work of Ms. Zorn and her team," said Prof. Schenk, while looking ahead with optimism: "I am convinced that we have found an excellent and capable successor in Andreas Knittel, who has already demonstrated his capability repeatedly in the past. We are thus ensuring important continuity for the Fraunhofer IFF in the management of administrative services in the future, too." ■

Director Schenk Inducted into acatech

Fraunhofer IFF Director Michael Schenk was inducted into the circle of acatech members along with twenty-five other researchers. They were elected at the general meeting on October 17, 2017.

Election is both an accolade for their professional accomplishments and an honorary position. Funded by the federal and state governments, the academy advises government and society on technological issues, facilitates decision making about innovation policy, and represents engineering sciences internationally. The academy provides the consulting with which it has been tasked by the federal and state governments independently, scientifically and driven by the common good.

The twenty-six new members from engineering, natural sciences, humanities, economics and social sciences are active at acatech at the interface of research, business and government. They collaborate with experts from business and research in interdisciplinary projects and develop options and recommendations for action for government and society. Projects address topics ranging from the energy supply to digital transformation and Industrie 4.0 through technical communication. (pm) ■

Michael Schenk, Director of the Fraunhofer Institute for Factory Operation and Automation IFF, chairing a discussion session at the 2018 acatech Academy Day in Magdeburg. Photo: acatech, D. Ausserhofer

Upcoming Events

Meet up with researchers from the Fraunhofer Institute for Factory Operation and Automation IFF at these events.

June 11 to 15, 2018
Cebit, Hannover

June 11 to 15, 2018
Achema, Frankfurt am Main

June 19 to 21, 2018
21st IFF Science Days, Magdeburg

June 19 to 22, 2018
Automatica, Munich

October 17 to 19, 2018
International Supply Chain Conference, Berlin

October 19., 2018
Digitalisierung auf dem Hallenboden angekommen!? Erfolgsbilanz zur Prozessoptimierung im Mittelstand
Frankfurt am Main

October 25 to 26, 2018
Smart Process Manufacturing Kongress, Würzburg

November 27 to 29, 2018
SPS IPC Drives, Nürnberg

Publishing Information

IFFocus 1/2018

Publisher: Fraunhofer Institute for Factory Operation and Automation IFF
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ISSN 1862-5320

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Layout: Ina Dähre

Translation: Krister Johnson

Printing: Harzdruckerei GmbH

Photo: Fraunhofer IFF, Andreas Süss

Fraunhofer
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FRAUNHOFER INSTITUTE FOR FACTORY OPERATION AND AUTOMATION IFF, MAGDEBURG

2018 21ST IFF SCIENCE DAYS

JUNE 19 TO 21, 2018

The IFF Science Days in Magdeburg are the Fraunhofer IFF's annual forum for research, business and government experts. Every year, they combine varying conferences on digital engineering, robotics and automation, logistics, and plant design and operation.

In 2018, the Fraunhofer IFF will be hosting the Future Plant Design and Operation Conference and, together with Otto von Guericke University Magdeburg, the Magdeburg Logistics Days.

Take advantage of the IFF Science Days to gain insights into current research and industry projects and best practices from the presentations, workshops and personal dialogue. We look forward to seeing you in Magdeburg on June 19 to 21, 2018.

Program and registration on **www.wissenschaftstage.iff.fraunhofer.de**