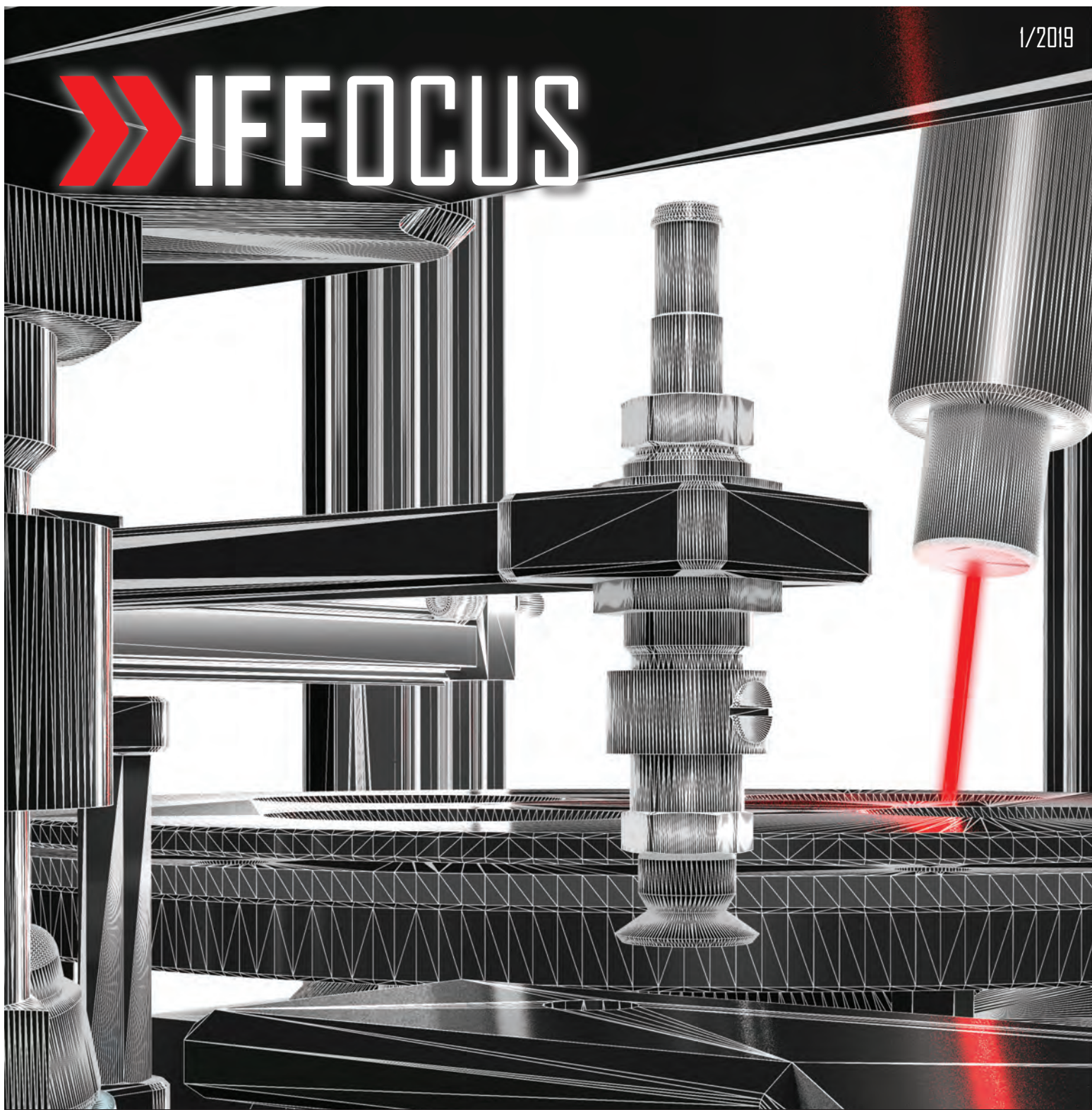


IFFOCUS



THE DIGITAL TWIN

How Digitalization Is Changing How Custom Equipment Manufacturers Work

BURG260

Discovering City History Digitally

INDUSTRIE 4.0 CHECKUP

Helping Navigate the Transition to Industrie 4.0

DIGITAL TWIN

THE FUTURE OF ENGINEERING

22ND LOGISTICS GUEST
LECTURE SERIES

**LOGISTICS AS A
FIELD OF WORK
OF THE FUTURE**

APRIL 11 – MAY 28,
MAGDEBURG



Editorial

Dear Readers,

Do you know just what a digital twin is? If you do, I'd like to congratulate you because that makes you one of a very select minority – for the time being. Even though everyone is talking about the buzzwords digitalization and connectivity or even digital twins now, often surprisingly few people have clear ideas of the significance these elements of digital transformation actually have for them. They know, of course, that the future of business is digital, that digitalization improves businesses and products, that it helps optimize processes, and can generate additional value added and new business models thanks to the data generated. All this is common knowledge today.

What would you answer, though, if I asked you whether you know where your business, institution or college is already working effectively digitally? And not just selectively such as in a manufacturing facility's design unit, but rather process-driven and throughout several business units or even beyond corporate boundaries. How qualified and prepared are you yourself for the digitalization of your work? And do you know how many businesses have actually now arrived in the digitally transformed world?

The KfW studied the cross-industry level of digitalization in small and German Mittelstand businesses for its "2018 Mittelstand Digitalization Report" and did not reach a very good conclusion. Although approximately one third of SMBs reportedly invested in their digitalization in 2017, just as many businesses employ virtually no digital applications. Remarkably, the majority of these investments in digitalization flow into the domains of supplier and customer communication and IT infrastructure. The development of digital products and services, i.e. the creation of innovations, accounts for the lowest percentage. The major actors, OEMs in the manufacturing sector, are also the workhorses of digitalization. A brief formula puts it in

a nutshell: The smaller a business is and the more regional its sales market is, the less interested it will be in digitalization. A widening gap between large and small businesses is looming. Their abstinence from digitalization is imperiling their competitiveness and thus the survival of many small and medium-sized businesses in Germany too.

We actually have the best conditions to be at the top all over the world in this respect. We are excel in outstanding technological developments and willingness to innovate. Germany is the leader in the field of machine learning. Excellent knowledge transfer from research to industry is practiced in Germany by, among others, its colleges and universities. And we with Fraunhofer additionally provide a unique infrastructure that facilitates this process to bring the latest technological developments into industry by the shortest route and thus quite specifically to SMBs.

The good news is that small and medium-sized businesses' willingness to digitalize operations and open their eyes to digital services' capability to add value is growing. Our researchers experience this daily in their projects and collaborative partnerships with many partners such as the "growing connectedly" Mittelstand 4.0 Center of Excellence.



Professor Michael Schenk, Director of the Fraunhofer Institute for Factory Operation and Automation IFF in Magdeburg.

They are putting many small and large digitalization projects into practice, advising and helping businesses transition into digitalization, and sharing their expertise on this nationally and internationally.

We report on such projects in this issue of our IFFocus too. We would like to show what different facets digitalization can now have on a small and on a large scale. Starting with the digital twin, a digital pendant of a product or an entire factory that provides support in every process in its life cycle, to the implementation of a digital knowledge platform as an assistance system in manufacturing up through a digital guide for tourists, which helps explore a city's history in a fun way.

As always, I wish you enjoyable reading!

Your

A handwritten signature in black ink, appearing to read "M. Schenk". The signature is fluid and cursive, written on a white background.

Michael Schenk



The Digital Twin

Everyone from engineering, electrical design, control system development and other units involved in the design of equipment has to collaborate on developing suitable solutions so that the equipment performs its manufacturing task and can be serviced during operation too.

Operators and maintenance technicians are repeatedly confronted by new challenges to maintaining the quality of manufacturing when equipment malfunctions or is being serviced. This is where digital assistance systems come into play. They facilitate scheduling, connect different work areas, and help keep track of everything. They are based on the digital twin.

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Europe's Largest 3D Mixed Reality Laboratory Reopens in Magdeburg's Port of Science

Following its extensive upgrading, Europe's largest 3D mixed reality laboratory, the Elbedome in Magdeburg's Port of Science was officially reopened in the presence of over one hundred guests from research, industry and government on May 24, 2018.

Top Job: Improving Working Life through Digitalization

Recruiting skilled labor for shift work is becoming increasingly difficult – both in regions with full employment and in sparsely populated regions. Researchers at the Fraunhofer IFF are demonstrating how digitalization on just a smaller scale can help make such jobs more attractive.

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Burg2Go: Discovering City History Digitally

The city of Burg near Magdeburg markets itself as the "Green Towered City". Only a few of the stone eyewitnesses to events are open for viewing, though, if at all. An alternative is the Burg2Go app. The interactive companion guides tourists from the Middle Ages into our digital age.



Barley Biodiversity: Innovations for Future Farming

In collaboration with Martin Luthe University Halle-Wittenberg, the Fraunhofer IFF is using spectral technologies to measure the constituents of grain crops right in fields and to forecast growth and yields – for useful plants that have benefits ecologically and economically.

Europe's Largest 3D Mixed Reality Laboratory Reopens in Magdeburg's Port of Science

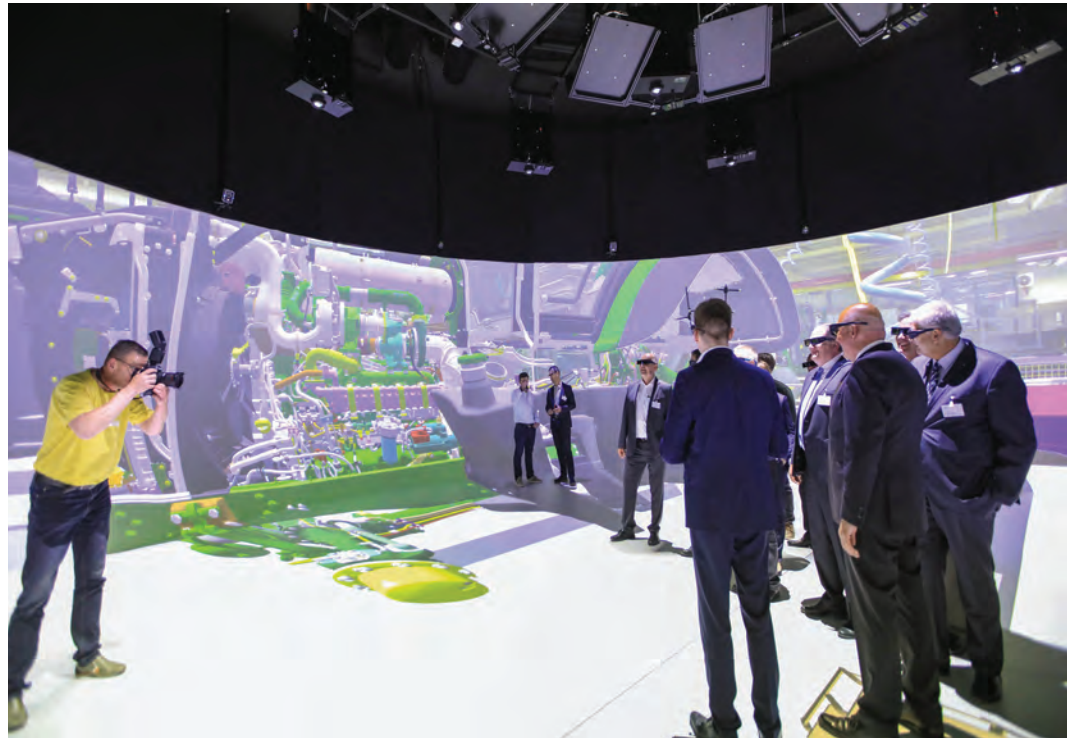
Following its extensive upgrading, Europe's largest 3D mixed reality laboratory, the Elbedome in Magdeburg's Port of Science was officially reopened in the presence of over one hundred guests from research, industry and government on May 24, 2018.

The sole laboratory for virtual simulations is part of the Fraunhofer Institute for Factory Operation and Automation IFF and was built in Magdeburg's Port of Science in 2006. After over ten years of effective use in research and development for numerous businesses and scientific organizations, upgrading the equipment had become necessary. The hemispherical mixed reality laboratory is sixteen meters in diameter and a four meters high. It can present virtual contents in high definition on a 360 degree panorama and floor projection surface of over 400 square meters and even in holograms with the aid of additional augmented reality glasses. These huge dimensions make the system particularly suited for virtual interactive representations of large objects such as machinery, systems, factories and even entire cities at a scale of 1:1.

Groups of as many as twenty people can easily immerse in virtual world simultaneously. The Fraunhofer IFF celebrated the grand reopening with over 100 guests from, research, industry and government and speakers such as Prof. Dr. Dieter Spath, President of acatech, and Dr. Max Lemke, the European Commission's Head of Unit for Technologies and Systems for Digitising Industry.

Millions Invested in Research

The Fraunhofer IFF will again be able to work together with research and industry partners and clients on cutting-edge research issues in its mixed reality laboratory in the future. This will especially include the development of new technologies and applications for Industrie 4.0, the future world of work, and digital business transformation. The laboratory will primarily be open to higher education institutions and public research organizations. Small and medium-sized businesses will also profit, though. The Fraunhofer IFF's researchers in-



Over 100 guests from research, industry and government toured the Elbedome 3D mixed reality laboratory at its opening. Photo: Fraunhofer IFF, Viktoria Kühne

tend to support them with collaborative partnerships, contract research projects, and regional, national and European knowledge transfer.

Altogether € 2.5 million were invested in its modernization. Seventy-five percent came from funds from the European Union. The German government and the state of Saxony-Anhalt each contributed 12.5 percent.

At the reopening of the state-of-the-art simulation laboratory, Minister of Economic Affairs and Science Armin Willingmann remarked, "The modernized Elbedome is a cathedral of virtual reality and thus a landmark in Saxony-Anhalt's research landscape. With it, the Fraunhofer IFF remains nationally and internationally top in the cutting-edge issues of digital engineering and virtual reality. The

modernization funded by the state and federal governments and the EU ensures that 3D applications and the capabilities of Wirtschaft 4.0 will be able to converge here in the future. Our many Mittelstand businesses will especially profit from that too."

Professor Michael Schenk, Director of the Fraunhofer IFF also voiced his satisfaction: "The Fraunhofer IFF's mixed reality laboratory is once again one of the most advanced facilities of its kind in the world. It will help find new solutions to the most important future challenges in store for all of us as business transforms digitally and automation grows." (pm)



Photos: Fraunhofer IFF, Viktoria Kühne

Elbedome Reopening





Photo: Fraunhofer IFF, Andreas Herzog



Hyperspectral images of faded murals in Brandenburg Cathedral. Traces of pigments and fillers made to fluoresce by UV light are mapped with the hyperspectral camera and analyzed.

International Talks on Digital Transformation

The world's top public officials and experts meet on Jeju Island in South Korea every year to discuss Asia's regional, economic and political development. Dialogue about how to secure peace and prosperity and to strengthen security in Asia in the future is paramount.



Acquiring digital expertise will be essential to being able to navigate the digitalized world of work confidently in the future. That is why programming is already taught in middle schools in the USA, pointed out Dr. Yong Suk Lee (2nd from l.) at the panel discussion. Photo: Jeon Hee-Jung

Christian Blobner, Head of International Research Networks at the Fraunhofer IFF, discussed "Industrie 4.0 and New Frameworks for Business" with innovation and technology experts at last year's Jeju Forum. Discussion focused on the issue of Industrie 4.0's potential impacts on future societies and economies in different countries and regions.

"Since national cultures differ, many nations have their own approach to Industrie 4.0," says Christian Blobner. "Although they largely concur on the direction in which technology development is moving, the social focus on the issue differs slightly in each country. Such differences greatly influence how and whether individual technologies are accepted and ultimately used in those countries. Everybody can learn from everybody else in the process, though."

During the discussion, Prof. Yong Suk Lee, Deputy Director of the Stanford Walter H. Shorenstein Asia-Pacific Research Center, stressed that combining data and technologies such as artificial intelligence, machine learning and automation is a core element of Industrie 4.0. The laxer information privacy laws in the USA accommodate this, enabling businesses in the USA to opt very heavily for data-driven business models.

China is also opting for extensive data analysis, especially to advance business models in wireless and e-commerce sectors. The focus in the manufacturing sector is primarily on automation and robotization to boost cost effectiveness.

The data economy in Europe is subject to significantly stricter policies focused especially on the right to protect personal data. The European General Data Protection Regulation (GDPR) ultimately establishes the basic conditions for international parties and their business relations with European partners and customers.

Christian Blobner displayed confidence after the discussion. "Despite the different approaches, there are good ideas for us Europeans to continue working in Korea. The Jeju Forum was a good first step toward establishing contacts and initiating new projects with potential partners there in the future."

Held from June 26 to 28, 2018, the Jeju Forum is East Asia's biggest economic forum. The Industrie 4.0 event was organized by the Friedrich Naumann Foundation for Freedom (FNF) and the Economic Freedom Network (EFN) Asia. (mar)

Strategic Collaboration Is Being Intensified



Prof. Anne Lequy, Magdeburg-Stendal University of Applied Sciences, and Prof. Michael Schenk, Fraunhofer IFF, signing the collaboration agreement. Photo: Viktoria Kühne

The Fraunhofer IFF Magdeburg and Magdeburg-Stendal University of Applied Sciences are intensifying their strategic collaboration in the research and development of future energy system and equipment. A strategic collaboration agreement to this effect was signed on February 4, 2019.

Both parties intend to collaborate closely on researching new and future-proof energy supply infrastructures in the future. Their collaboration will also include sharing Fraunhofer IFF and university staff, jointly using research infrastructures, and combining their training of young professionals for research and industry. Both parties also intend to collaborate closely with regional industry in this field.

Director Michael Schenk stressed that "the Fraunhofer IFF and Magdeburg-Stendal University of Applied Sciences have been collaborating very well in different fields for many years. The now permanent collaboration on future energy systems agreed on is good for the region and local businesses. They will profit from both the research findings and joint training of specialists for this important future market."

"Today's signing of the collaboration agreement is a happy event. We are both sealing our organizations' longstanding good and effective collaboration and strengthening Magdeburg as a center of research. The university is gaining an important strategic partner with the Fraunhofer IFF for international research on state-of-the-art energy designs. Our engineering and industrial design students will especially profit from both organizations' pooled expertise and infrastructure during their applied training," explained Prof. Dr. Anne Lequy, President of Magdeburg-Stendal University of Applied Sciences.

Researchers Are Working on Digitalizing European Ports

Digitalization can help ports and shipping cut costs and organize operations even more efficiently. Thirteen German, Spanish, Italian, Greek, British and Norwegian research organizations, businesses and ports are developing application specifications for the applied use of state-of-the-art digital technologies in port infrastructures under the lead management of the Fraunhofer IFF in the European research project PortForward.

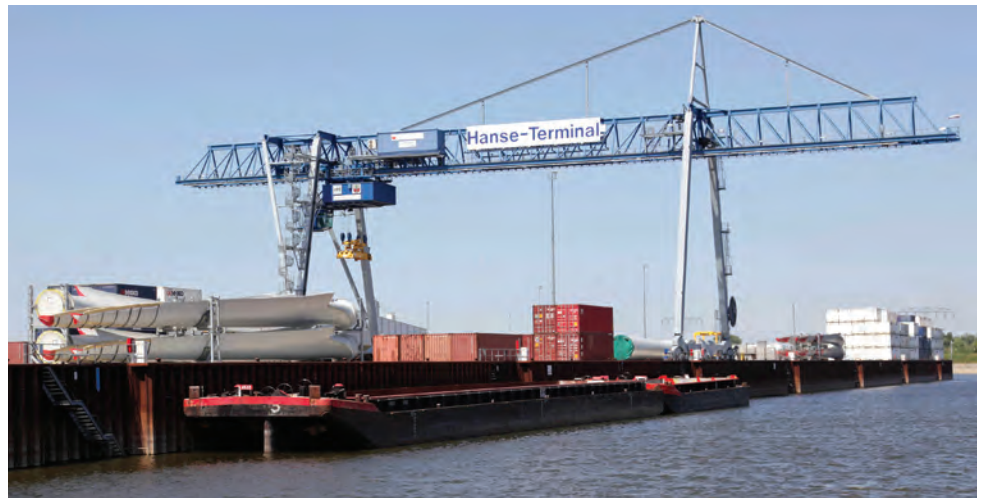
The partners are developing digital solutions intended to organize the operation of small and medium-sized ports in particular more intelligently, more connectedly and more greenly. The project running from 2018 to 2021 is being funded with € 5 million from the European Research Framework Program Horizon 2020.

Ultimately, a modular platform will be delivered, which allows port operators to utilize innovative technologies and services that connect and digitalize infrastructures and operations. It will facilitate the planning and operation of ports to boost their cost effectiveness and eco-efficiency and make them internationally competitive.

Fraunhofer IFF Is Contributing Its Expertise in Digitalization

The Fraunhofer IFF is collaborating closely with Transportwerk Magdeburger Hafen GmbH, operator of the Port of Magdeburg, in this project. The sole inland port among the five ports involved is playing a special role in the research network. Digital solutions primarily intended to facilitate warehousing and logistics on port premises will be developed with it. The Fraunhofer IFF will be contributing its expertise in digital connectivity, sensor systems and the "Internet of Things" for industrial applications.

PortForward will profit from the Fraunhofer IFF's advanced research infrastructures such as the Elbedome, the largest mixed reality laboratory in Europe. Among other things, its 3D visualization system facilitates decision-making for the operation of major infrastructures. The Fraunhofer's own secure cloud infrastructure will also provide services to port operators. (mar)



The Hanse Terminal in the Port of Magdeburg. Photo: Dirk Mahler/Fraunhofer IFF

Spectroscopy for Consumers



Everyone has a modern smartphone in their hands. Many users typically use them for more than communication. Researchers at the Fraunhofer IFF have developed another possible use with their HawkSpex® Mobile technology that enables companies to provide cell phone apps that analyze the widest variety of materials and constituents. Scanning foods for freshness and pesticides, cars for concealed repairs, medicines and luxury goods for authenticity, and much more are conceivable. HawkSpex® Mobile puts all this on consumers' smartphones, turning them into material scanners for a wide range of applications.

The Fraunhofer IFF generated great interest when it presented this technology at the Fraunhofer-Gesellschaft's booth at the 2018 Cebit. A number of companies are currently working on apps for themselves and their customers based on this technology, which has been available for commercial use since the end of 2017. The first releases are expected in early 2019. (pm)

Prof. Udo Seiffert (left), Fraunhofer IFF, explaining HawkSpex® Mobile technology to Thomas Wunsch (second from left), Saxony-Anhalt State Secretary in the Ministry of Economic Affairs, Science and Digitalization at the 2018 Cebit. Photo: Hennig Köhler

Mobile Aerial Scanning for Controlled and Automated Geospatial Data Acquisition



The aerial scanner is mounted on the light aircraft's wing. Pictures: Fraunhofer IFF

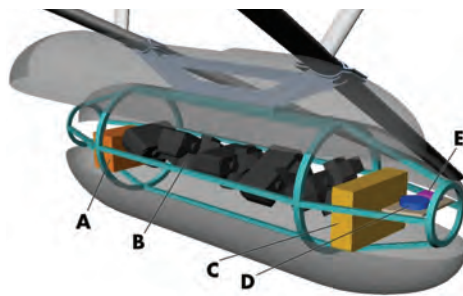
The surface of our earth is measured and mapped in many ways, including photogrammetry, i.e. the scanning and localization of three-dimensional objects such as buildings. In so-called aerial photogrammetry, the measured region is flown over so that several images, e.g. scans of particular objects, are generated from several perspectives. This generates three-dimensional data that can be processed into three-dimensional images of buildings, of instance.

GEO-METRIK-Ingenieurgesellschaft mbH in Stendal produces such images, combining advanced methods and analyses methods for terrestrial and digital aerial photogrammetry to do so. The firm employs multicopters to acquire data from 3D scans of individual structures and entire properties. Recording data with such unmanned aerial vehicles (UAV) consumes too much labor and money, though, when areas are larger. Since longer approaches, a larger number of required start and landing sites, limited flight times, and the restricted altitude of 100 meters maximum render the use of UAVs to scan larger areas inefficient, other options such as satellite images or special survey aircraft have to be reverted to.

These options also have drawbacks because of potentially obsolete aerial photography, insufficient accuracy, high costs and poor availability of survey aircraft.

That is why GEO-METRIK-Ingenieurgesellschaft mbH in Stendal developed a portable aerial scanner together with researchers from the Fraunhofer IFF, which acquires geospatial data controlled and automated. The scanner can be mounted on standard small aircraft. This makes survey aircraft unnecessary. A special mount makes the portable digital camera system quick and easy to use. Software controls and monitors it. The software gives pilots their flight path. An algorithm monitors the image data scanned in the area of use in-flight. Pilots receive visual feedback in real time. Using such digital systems to record and analyze data makes it possible to automate many processes. Time-consuming postprocessing to identify and extract relevant image data is minimized. Along with additional image data, data sets are created, which do not have to be laboriously combined manually, but are already integrated.

The solution developed in this project makes it possible to charter small aircraft near the area of use to acquire and process geospatial data. Essential flexibility is retained and high capital expenditures and maintenance costs for survey aircraft are eliminated. (mar)



A: battery, B: cameras, C: controller, D: GPS antenna, E: IMU

Developing Future Smart Work Systems

A new research team named KASys (Cognitive Work Systems in Human-Centric Manufacturing Environments) has started its work at the Fraunhofer IFF. In this research project, emerging research scientists are developing intelligent assistance systems and manufacturing work areas shared by humans and robots.



Smart work systems such as the assistive robot ANIE are being developed at the Fraunhofer IFF. Photo: Fraunhofer IFF

As they develop a systemically integrated, technological design for cognitive work systems, Prof. Norbert Elkmann's team is primarily devoting itself to four key activities while factoring in the changed basic conditions of future work areas where humans and autonomous machines will collaborate.

Four Key Activities

First, a so-called "condition interpreter" detects an individual's concrete work situation and ascertains which work step will follow next. A "logistics planner" will control the material supply to the work area dynamically as needed rather than synchronously. The material stream must factor in the worker's

Research for the Energy Transition: Making Businesses Part of Energy Grids

individual work situation and respond to changes in the work system. The research team is focusing on simulation-based forecasts of short-term material supply scheduling and control on time, at cost and to quality. By coupling the real material stream and information flow with their digital twin, the researchers intend to test future changes in supply chain scheduling and control in advance in simulations and implement them.

Another key activity is the development of a “digital human model” because of the frequent impracticality of using sensors to prevent human and robot contact. The digital body model resolves this problem. It enables machines to assess the potential dangers of their autonomously planned actions for humans and to respond appropriately. The researchers will use this innovation to keep robotic assistance systems from injuring people.

The fourth element of the future smart work system is the “autonomy planner”, a method that analyzes the respective current context of the work situation and the primary objectives and derives autonomous actions for the assistive robot involved from that. Such actions can either apply to worker assistance or automated work steps. The autonomy planner also distinguishes between cognitive and physical assistance.

Establishing a Cutting-Edge Research Unit

The research team’s structural objective is to establish a new and internationally recognized cutting-edge research unit on cognitive work systems based in Magdeburg. The team is the first step and promising trailblazer in this direction. It will develop the first sustainable solutions for the aforementioned key activities, thus contributing to defining the work and networking of the Center of Cognitive Autonomous Work System Excellence that is being established at the Fraunhofer IFF. (mar)

The planned abolishment of coal power in Germany will make distributed renewable energy sources significantly more important in the coming years. It will also mean having to step up efforts to upgrade energy grids even more. New smart grids and technologies are intended to stabilize fluctuations in green power availability and accommodate the many different producers and consumers. Not least, companies generating power themselves from sun and wind or even their own

One of the German partners is Arte Möbel in Magdeburg. The Mittelstand company uses green power it produces itself to manufacture its furniture. In the project, the researchers are establishing a dynamic energy management system at the company. Among other things, it includes an internal energy storage system and a newly developed ICT infrastructure that connects it with the grid operator. The system can be used to forecast energy consumption in manufacturing or energy gen-

benefit from the opportunity for interesting new business models a more than just participants in the electricity market. Arte Möbel, for instance, intends to use the system to sell fully sustainable furniture in the future. Not only the wood but also the power that goes into its manufacture will be green. (mar)



Dr. Pio Lombardi (left) is the international RELflex project’s coordinator and the Fraunhofer IFF’s representative. Together with Timo Hesse (center), CEO of Arte Möbel, and Prof. Przemyslaw Komarnicki (right) from Magdeburg-Stendal University of Applied Sciences, he intends to make the furniture company an active partner in the future grid..



The use of green power from fluctuating renewable resources in manufacturing will also have an impact on the organization of work processes.

Photos: Viktoria Kühne

manufacturing waste will be given a completely new role. Such so-called prosumers will operate actively in the future grid, helping make it more reliable and more stable.

The Fraunhofer IFF in Magdeburg and Magdeburg-Stendal University of Applied Sciences are working together with other German and Polish partners on the requisite technologies in the European project RELflex.

eration by solar panels. This is intended to allow the company to use more renewables specifically to manufacture furniture despite fluctuations in the green power supply or to inject excess power into the grid whenever it is needed there.

The researchers count cutting pollution and energy costs among the ultimate primary objectives. In addition to boosting their profits, businesses will



21st IFF Science Days

2018





Developing Digitally – Growing Connectedly

Prof. Thomas Leich,
Professor and Director of the Mittelstand 4.0
Center of Excellence Magdeburg

Growing connectedly – in Saxony-Anhalt and beyond. With this goal, the Mittelstand 4.0 Center of Excellence Magdeburg is helping Mittelstand businesses use innovative digital solutions to optimize their operations, connect businesses and develop new lines of business. The Mittelstand 4.0 Center of Excellence Magdeburg is part of Mittelstand Digital with which the Federal Ministry for Economic Affairs and Energy is facilitating digitalization in small and medium-sized businesses and trades. The initiative provides small and medium-sized businesses free information about the opportunities and challenges of digitalization.

René Maresch conducted the interview.

Professor Leich, businesses' need for assistance programs for digitalization and Industrie 4.0 appears substantial. At the same time, the number of providers of such services is growing. Why should businesses call on you explicitly?

We support our businesses as a center of excellence. We simply listen in the first step and then develop the next digital steps jointly. All our programs are free and available to every Mittelstand business. We have a broad network of regional and national partners and are happy to visit businesses even right on site. At all times, the focus is on Mittelstand businesses with their very individual projects.

Does each business have distinctive goals?

Businesses' challenges are often diverse and only comparable to a limited extent. For this reason, we offer very different formats at the

center of excellence, which allow every Mittelstand business to pick up at the stage of digital development where they are at the moment. From "mobile business consultations" to diverse training programs up through implementation projects – there is something for every taste. Everyone can develop a taste for digitalization in our opinion; they just have to try it.

Surely the amount businesses need to invest in digitalization varies widely. What role does this play in businesses?

Companies do not always need five-figure expenditures to digitalize. Investing time and courage, tackling the issue, and examining which digital targets really advance your business are far more important. Not every trend being discussed in the media is a panacea. We ought to look at and learn from others' success stories. Businesses therefore ought to invest primarily in dialogue with others to "grow connectedly", as we always like to say.

Where can businesses learn about this connectivity idea at your center of excellence?

They can learn about that at every one of our events. Our workshops in particular are ideal for discussing one's own plans and ideas with other businesses and obtaining feedback. Formats such as "start-ups versus established businesses" are actually wholly dependent on sharing experiences.

You also manage a company yourself. What have your own experiences been?

The trust factor plays a crucial role particularly when issues are new. Even I seek advice, primarily from close confidants and experts. Businesses ought to continue following this approach. Courage for new issues is part of this and then you seek a partner you trust and tackle the issue together.



» AT ALL TIMES, THE FOCUS IS ON MITTELSTAND BUSINESSES WITH THEIR VERY INDIVIDUAL PROJECTS. «

Prof. Thomas Leich, professor and director of the Mittelstand 4.0 Center of Excellence Magdeburg.
Photo: Viktoria Kühne

How do businesses approach you? Is it hard to contact you?

Contacting us is very easy! Interested businesses usually approach us through our website and reach out by email or phone. We offer "hands-on digitalization" in our digital showcases at the Experimental Factory research and transfer center, the Fraunhofer IFF's VDTC, the Denkfabrik in Magdeburg's Port of Science, and Otto von Guericke University's VLBA laboratory. Since everything is close together, we can even present different examples of good practice and issues in one meeting if necessary. We travel with our "growing connectedly" vehicle all over Saxony-Anhalt every week and visit businesses on site. Apart from our website, we also report on current issues on Facebook and Twitter and in our newsletter. Contacting us is the first step toward digitalization – very easy!

You are well connected beyond your different locations yourself as well.

The center of excellence lives from its partners' expertise. We collaborate closely with the Fraunhofer IFF in Magdeburg and the Zentrum für Sozialforschung Halle e. V. in Halle, for instance. They support us with expertise and experience, technology scouting, and employee training. This enables us to offer tremendously high quality state-of-the-art support services for digitalization in businesses. This is surely also one of our work's crucial success factors.



Brief Curriculum Vita

Professor Thomas Leich

Professor Thomas Leich is a businessman, professor and Director of the Mittelstand 4.0 Center of Excellence Magdeburg. He specializes in digital innovations, data-driven systems and adaptable software system development. He is in charge of the Technical Innovation Management master's program at Harz University of Applied Sciences. With the Mittelstand 4.0 Center of Excellence Magdeburg funded by the Federal Ministry for Economic Affairs and Energy, he is primarily helping Mittelstand businesses master the current challenges of digitalization with his team. As the owner of a family business, he never loses sight of the practical side, either.



Combining Sensors and Motors Modeled after Humans

Ulrike Christoforidis



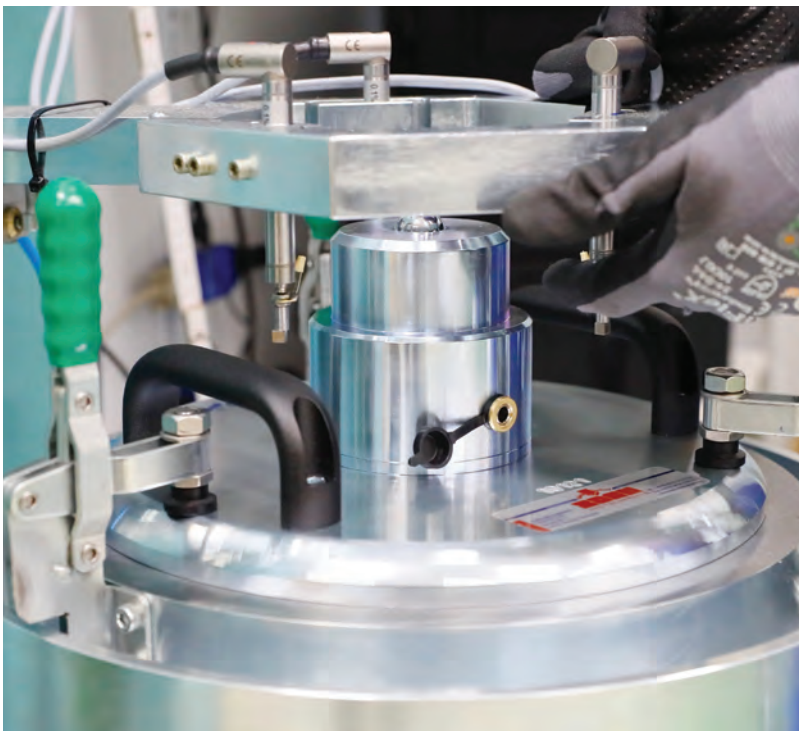
Fraunhofer IFF Is Developing Actuators That Catch Dynamic Objects Precisely

Whether it be a ball in fast-paced team sports or a falling water glass that was too close to the table's edge, a unique combination of sensory and motor capabilities enable people to catch dynamic objects in split seconds. Experiential values tell our brains how heavy a moving object might be, provide information on features and properties, and transmit this information on motor actions to the musculoskeletal system. Automatically tensing musculature prepares limbs to catch appropriately – and adjusts their rigidity to the actual values “measured” during and after catching. The moving objects land gently in our hands and we can even (usually) handle an unexpected weight. Such work can constitute heavy physical labor for workers in the long-term.

Zorn Instruments GmbH & Co. KG turned to the Fraunhofer IFF to employ an automated solution to relieve its employees of such repetitively physically strenuous works steps and to organize operations more effectively as well. The company in Stendal develops and manufactures testing and inspection equipment for select applications. Its ZFG light drop weight tester measures the load-bearing capacity of subsoil in a quick test. The tester releases a weight on a vertical rod, which drops onto a spring-mounted baseplate with sensors, thus applying a force to the ground and delivering readings on subsoil compaction.

ZFGs are calibrated during manufacture, repair and maintenance in a manual tester from Zorn Instruments GmbH that has been approved by the Federal Highway Research Institute. The procedure requires workers to catch drop weights weighing as much as fifteen kilograms in their hands, which have to be lifted back up along the guide rail as high as one meter after they have struck the spring-mounted baseplate. In order to be able to take

One of the Fraunhofer IFF's new developments catches a building industry tester's weights during calibration gently as if by a human hand. The “variable stiffness actuator” ensures readings are flawless and precise – and relieves employees of strenuous physical labor.



Manual tester for fall weight testers at Zorn Instruments. This test procedure requires a worker to handle drop weights weighing as much as fifteen kilograms.
Photos: Zorn Instruments, Danny Kurz

usable measurements, the weight may not drop a second time and vibrations may not be produced by hard impacts when it is caught. The weight must be caught reliably and gently after the first impact. Measurements are taken repeatedly, readings are compared, and settings are readjusted. Again and again. Merely installing a new cup-spring assembly in a light drop weight tester requires prestressing through at least one hundred impacts before actual calibration.

The VaSt Project: Variable Stiffness Actuator for Handling Highly Dynamic Workpieces of Unknown Mass

This is why the Fraunhofer IFF developed a new design in collaboration with Zorn Instruments. This entailed developing technologies and methods for handling highly dynamic workpieces of unknown mass. "The objective of the project begun in March 2017 is to develop a catching device with a one-dimensional actuator that precisely catches the weights in an automated procedure, thus replacing manual handling," explains Holger Althaus, research manager in the Robotics Systems Business Unit of the Fraunhofer Institute in Magdeburg. Use of a robot quickly proved to not be an option at the start of the project. "Apart from the high capital expenditures of approximately € 20,000 to € 25,000, which would normally be far too high for small and medium-sized businesses, suitable robots only have a carrying capacity of five kilograms. We thus needed a simple and reliable alternative to relieve staff of heavy physical labor," adds his colleague and robotics expert Veit Müller.

A linear stiffness actuator with two integrated magnetic grippers that pick up the drop weight was developed for the calibration process to close the "technological gap" for precise handling of highly dynamic payloads. A linear actuator moves the actuator's catching device vertically and parallel to the light drop weight tester's guide rod. The magnetic grippers implemented in the catching device pick up the drop weight lying below and raise it to a specified drop height where it is released and drops onto the light drop weight tester's guide rod. An accelerometer installed in the baseplate delivers data on the mass that has struck and is rebounding right upon impact. "In the meantime, the actuator with the magnetic grippers has traveled to the already computed reversal point of the rebounding drop weight and is pre-positioned there to catch it," says Holger Althaus, describing the subsequent action.

Since there are virtually no more forces of acceleration at that point, the velocity briefly drops toward zero and precisely catching the mass is feasible. Minimal deviations from the pre-computed reversal point cause catching errors, though. If the point is lower, it misses, If it is higher, the harder impact distorts the accelerometer's data.



» Much like a person catching an object reacts to the energy they receive, the actuator also varies its stiffness when catching the weight to do so gently. «

Data delivered by a spring-mounted tactile measuring tip near the magnetic grippers on the catching device are also incorporated in order to prevent that. A control system includes these measurement data to make catching precise. "Much like a person catching an object reacts to the energy they receive, the actuator also varies its stiffness automatically when catching the weight to do so gently," explains Veit Müller. "Using neural networks with the sensors gives us a self-optimizing system."

This project being supported with funds from the state of Saxony-Anhalt and the European Regional Development Funds (ERDF) will conclude at the end of February 2019. Then the variable stiffness actuator will be in use at Zorn Instruments – and protect employees' health.

A light fall weight tester. An accelerometer is installed in the baseplate. It delivers data on the mass of the weight striking the ground to the gripper. It catches the rebounding weight at its computed apex. Photo: Fraunhofer IFF, Uwe Völkner



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Top Job

Improving Working Life through Digitalization

Janine van Ackeren

Recruiting skilled labor for shift work is becoming increasingly difficult – both in regions with full employment and in sparsely populated regions. Researchers at the Fraunhofer IFF are demonstrating how digitalization on just a smaller scale can help make such jobs more attractive.

The private sphere without digitalization is hardly conceivable: We pick up our smartphones countless times a day to check the weather, watch YouTube videos, and read world news or personal messages. Smartphones are our constant companions. Digitalization is becoming increasingly established in businesses and industrial companies too. Yet there are limits to this development: Not every manufacturing process can be automated cost effectively. This is confronting many businesses with major challenges. Skilled labor working strenuous shifts is scarce. This holds just as true in sparsely populated regions of Saxony-Anhalt where many workers are migrating as in Baden-Württemberg with virtually full employment. How can Industrie 4.0 technologies help boost employability? And how can jobs be made more attractive through automation?

Researchers at the Fraunhofer IFF are exploring these questions in the “Top Job” project together with their partners SRH Higher Education GmbH, DEKRA Akademie GmbH, Liebherr-Werk Biberach GmbH and Zorn Instruments GmbH & Co. KG in Saxony-Anhalt. The project is being funded by the Federal Ministry of Education and Research.

Employability

“In a first step, we ascertained workers’ employability and explored how digitalization can improve this,” explains mathematician Stefanie Samtleben from the Fraunhofer IFF. “SRH Fernhochschule selected and developed the methods for this. They incorporated four organizational domains of employability: personal health, work requirements and environment, work organization and management, and employees’ professional skill. The researchers identified all these points in focus group interviews. “We interviewed each employee from the same level, recorded the interviews, and then analyzed them qualitatively,” says Samtleben.

In addition to the focus group interviews, the SRH Fernhochschule developed questionnaires on work-life-health balance. Dekra assessed the extent to which digitalization changes employee skills requirements. They found that digitalization is largely a given for employees in their personal life. Most are also interested in and curious about extending digitalization to working life as well in the future. They do not want to be surveilled,



The ViWIS assistance system merges information from different systems. Workers log on to the portable operational data acquisition system (BDE) on their tablets with their employee card at the start.

though. In their everyday routines, this means employees tend to take advantage of company athletic programs, for instance, when they are not analyzed and information is not divulged.

The Fraunhofer IFF research team conducted a rough value stream survey at the implementation partner’s facilities, thus obtaining an overview of operations that enabled them to examine and assess potential uses of assistance systems. In addition, an Industrie 4.0 CheckUp was performed at Liebherr-Werk Biberach GmbH to ascertain which digitalization actions have been taken in which units and what objectives are being pursued.

Zorn Instruments GmbH embraced many suggestions from these interviews and made changes. They strategically worked through the findings and drafted a mission statement for upper management. The goal is for employees to identify with their company even more.

Liebherr-Werk Biberach GmbH: Virtual Worker Information System

The study at construction equipment manufacturer Liebherr-Werk Biberach GmbH resulted in the Virtual Worker Assistance System or

ViWIS for short. “ViWIS is intended to provide workers assistance and supply relevant data in real time,” says Samtleben, summarizing. Workers previously received information on performing a particular work task on paper, for instance, when manufacturing crane components. The challenge is the labor required to keep circulating documents up-to-date. Revising drawings, standards, etc. is particularly very time consuming. Moreover, Liebherr-Werk Biberach GmbH is striving for paperless manufacturing.

ViWIS merges information from different systems. Workers use their employee card to log on to the portable operational data acquisition system on their tablets. Once they have registered for a job, they can view related 2D drawings, bills of material, setup schedules, standards and 3D views of the workpiece in the ViWIS. Its direct connection with different databases ensures that all approved changes reach workers immediately. They can also view parts three-dimensionally for better understanding. “This increases understanding tremendously, something important especially for inexperienced and non-German-speaking colleagues who still need to be trained. We can clarify a lot there with the clear presentation,” says Samtleben. Workers can sometimes also watch a video on the assem-

Everyone involved can also view parts three-dimensionally to understand them better. The clear presentation facilitates understanding and communication among workers tremendously.



bly sequence. The system even simplifies workflows themselves: Workers have to register every new job in the operational data acquisition system, confirm quantities, enter dimensions in the linked CAQ, and report the job finished upon completion. Instead of having to find a central terminal to report completion, they can now use their tablet to do this right where they are working.

ViWIS also supplies them more information in the work area: For instance, workers can access an intranet on which they can view lunch menus, a factory map and internal messages, among other things. The bill of materials displayed precisely lists the parts required for a specific operation. This enables workers to verify that the right parts are all there and, if necessary, to check the rack bin for missing parts right on their tablets.

The Fraunhofer IFF team has completed the prototype ViWIS app. "It was kept as simple as possible and designed to be easy to use. A desired point ought to be reached with two to three clicks. Select Liebherr employees already assisted us during the design phase. They were able to submit their requests and requirements and provide feedback on the mock-up. This enabled us to incorporate workers' concrete needs in the app," explains Stefanie Samtleben. The IT team is now installing ViWIS and it will be tested in crane production at Liebherr-Werk Biberach GmbH for three



ViWIS makes more information available right in the work area: Menus and a company map can be accessed on the intranet and internal messages can be viewed.



Always current. The direct connection with different databases ensures that all approved changes to parts reach workers immediately.

months. Dekra experts are also involved in this test phase. The first workers approached by Dekra in an awareness workshop are now interested in the following questions: How does the system function? How do users manage with it? What has to be considered when training employees so that they can use the system efficiently? Stefanie Samtleben will also be on site now and again. She will present the final version of the system together with an employee from Liebherr-Werk Biberach GmbH and train others in its use.

Focus group interviews will be conducted again after the three-month test phase. They are intended to reveal the extent to which the assistance system has increased the attractiveness of jobs.



GEFÖRDERT VOM

**Bundesministerium
für Bildung
und Forschung**



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Imagine you have to solve a problem that is utterly new to you under time pressure. What you need now is advice from colleagues and, despite the pressure, the time necessary to make what are hopefully correct decisions.

This is the daily routine when dealing with custom equipment. Everyone from engineering, electrical design, control system development and other units involved in the design of equipment has to collaborate on developing suitable solutions so

that the equipment performs its manufacturing task and can be serviced during operation too. Operators and maintenance technicians are repeatedly confronted by new challenges to maintaining the quality of manufacturing when equipment malfunctions or is being serviced. This is where digital assistance systems come into play. They facilitate scheduling, connect different work areas, and help keep track of everything. This makes them important maintenance tools.

A hand holding a tablet in front of industrial machinery. The background shows a factory setting with various mechanical parts and a 'Fraunhofer' logo on a piece of equipment.

The Digital Twin

Future Engineering

Dr. Simon Adler, Marlene Eisenträger and Sebastian Möser

Digital Data in Manufacturing

Cutting-edge equipment is closely related to Industrie 4.0, a concept invented in Germany, which describes the growing digitalization of manufacturing. And it has many benefits. Advanced industrial facilities not only produce products but also digital data, which are integral to the manufacturing output. The data, in turn, enable analyses for optimization and new business models through data trading with suppliers and customers. Of course, the digital contents have to fit the real circumstances and be managed consistently whenever equipment is modified. These data are also a basis for digital assistance systems. Maintenance technicians can use them during equipment operation to retrieve documents and current and saved condition data on every equipment component. Staff record equipment modifications quickly and right on site with the system and complex reports can simply be generated automatically. This makes the assistance system an essential tool along with hammers and screwdrivers when operating equipment.

When such digital data describe equipment from the first document through current sensor readings they are termed a "digital twin". This is backed by high quality standards for the volume and integrity of digital equipment data. The transition to the digital twin thus necessitates awareness of digital data and their value as well as their consistent use in previously analog processes.

Digital Twins in Custom Equipment Manufacturing

The Fraunhofer IFF researches methods and systems to automate complex processes and develops corresponding solutions from the idea through engineering and automation up through delivery to the client. Such equipment may consist of thousands of sensors and hundreds of electric and pneumatic drives that manufacture reliably in shifts.

Supporting research is pursuing the objective of using digital twins to minimize the intrinsic uncertainty in such projects. The Fraunhofer IFF uses its experience and solutions to help businesses create and utilize their own digital twins.

Digital Transformation Is Changing Ways of Working

This makes it essential to think digitally in projects from the outset. Building before digital data has been compiled is too complex and error-prone. When work is done digitally, on the other hand, the data for later use during operation are already compiled and linked during development. This produces value added for a company by improving data exchange from the beginning. The magic of digital data is the ease with which they can be supplied, verified and searched as needed.

Value added can hardly be expected, though, when established ways of working persist and new capabilities go unutilized. Unlike ad hoc installation of new programs, the transition to working digitally is



Find more information on the Virtual Engineering Business Unit's services on www.iff.fraunhofer.de/ve



a gradual process. Changing the methods of communication in a company by using digital data as the basis for intercommunication, for instance, inevitably changes the work processes too. The following example elucidates what this means.

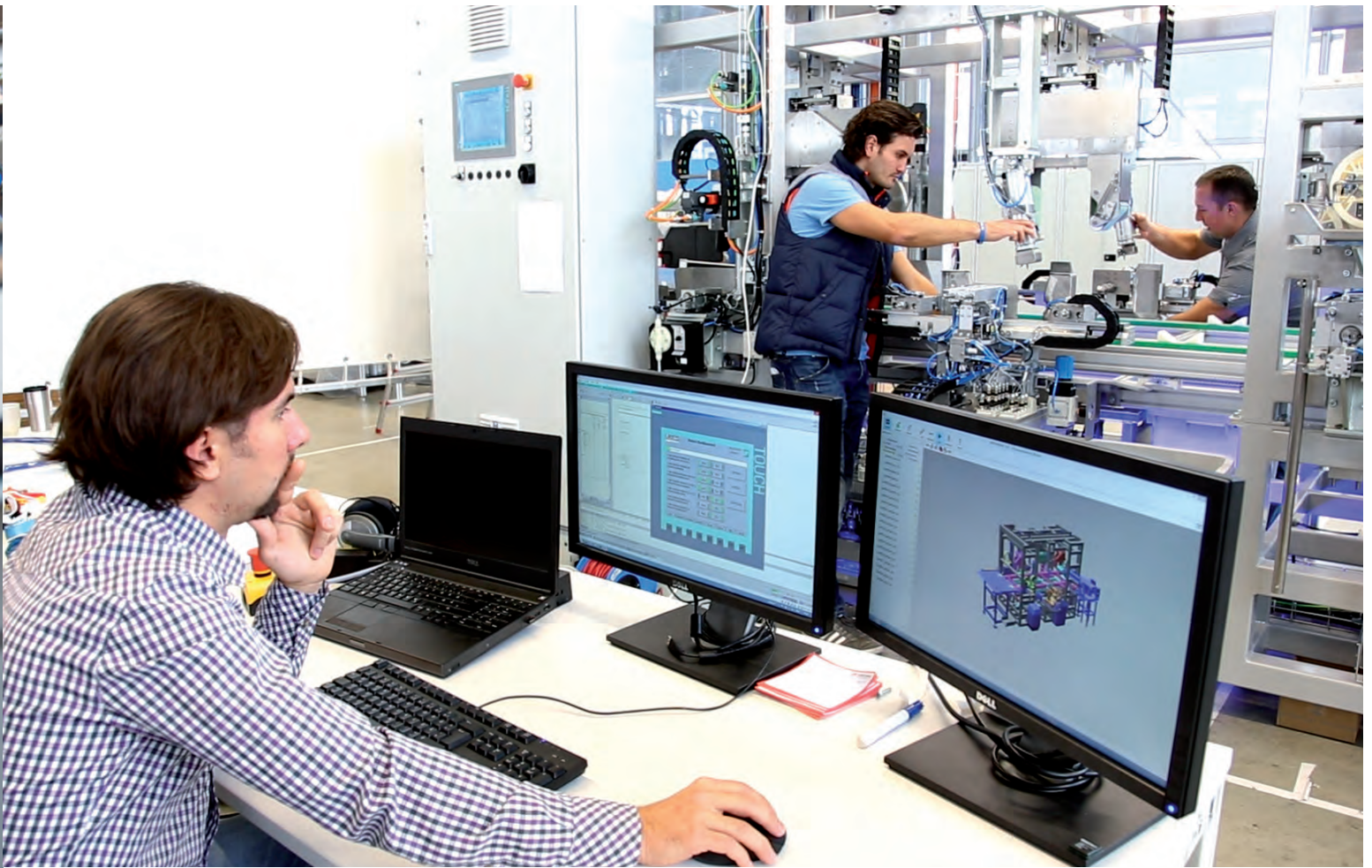
In traditional engineering, engineers and programmers complete their work consecutively. Photos: Fraunhofer IFF, Dirk Mahler

Digital Engineering

In engineering, engineers and programmers traditionally complete their work consecutively. Engineers design equipment in a 3D CAD system. Programmers do not have to specify equipment motions as control code until after assembly. Initial problems and detailed issues frequently arise during commissioning, however. The design engineers are usually already working on their next project by then, thus complicating coordination. Design errors not detected beforehand are extremely expensive.

That is why digital engineering is being researched intensively at the Fraunhofer IFF: A consistent digital work method breaks this dependence. The Fraunhofer IFF's VINCENT development environment also supports the development team. Engineers and programmers work hand in hand in this software dur-

ing development. They collaboratively set the 3D model of the equipment in motion digitally, all the way through its virtual commissioning. This approach makes it easier for programmers to understand the complete equipment and its relationships. Its working principle can be discussed and problems that occur can be resolved at an early stage. All team members are involved in the project then. Parts are not manufactured until the conclusion of joint development and programming. Along with faster commissioning and fewer errors, a virtual copy of the equipment is produced right away. Then the equipment controller controls this digital model parallel to the real equipment during later operation.



System engineers and assemblers use the VINCENT development environment to work hand in hand at the same time.

Using and Operating the Digital Twin

When this method is applied consistently, all relevant data are recorded digitally and related to the equipment from the beginning, thus producing a comprehensive, highly linked knowledge base. The manufacture delivers the necessary documents to the operator digitally along with the equipment. The operator can add experience from operation to the base data and ultimately use the V-ASSIST assistance system to access the collected documents and equipment condition data digitally.

Immediate notification of maintenance technicians whenever equipment malfunctions and their ability to retrieve detailed information is particularly advantageous. V-ASSIST identifies the component of the reported malfunction and displays its documents. Maintenance technicians can access recom-

mended actions and, if need be, get help from colleagues by video chat. They can see the subject of interest in the virtual model and thus provide assistance. Finally, the user documents the troubleshooting with an annotated photo linked with the malfunction message and equipment component in order to be prepared for the next time.

Such scenarios boost equipment availability and help staff handle increasingly complex equipment. The underlying view of the equipment structure makes it possible to link knowledge and equipment. Different experts have different viewpoints and information needs, though. That usually results in parallel information structures that have to be maintained separately with a lot of labor. Here too, digital assistance systems facilitate the merging, documenting, and, above all, updating of equipment modifications on site.

Facilitating Digital Transformation

The aforementioned benefits cannot simply be attained ad hoc, though, because digital transformation primarily means change. It changes people's organization in their world of work. Technology development and process modifications often affect each other. That is challenging for companies and the employees involved. This applies to digital engineering too. It facilitates close collaboration between engineers and programmers. Moreover, it affects electrical design and purchasing and lightens the project management workload by reducing uncertainties during commissioning.

Such changes have to be made together with employees so that processes and technologies are accepted and coordinated. Since the detailed impacts and organization of new op-



Experiences with the Digital Twin

The VINCENT and V-ASSIST software applications are based on methods for efficient digital engineering. These solutions are now helping many industrial companies develop and operate equipment. Motivation for new improvements also comes from individual equipment design projects with a research character in which work is being done to minimize the high uncertainties. Custom equipment with thousands of sensors and hundreds of electric and pneumatic drives has

Find more information on digital engineering with VINCENT on www.vincent.engineering



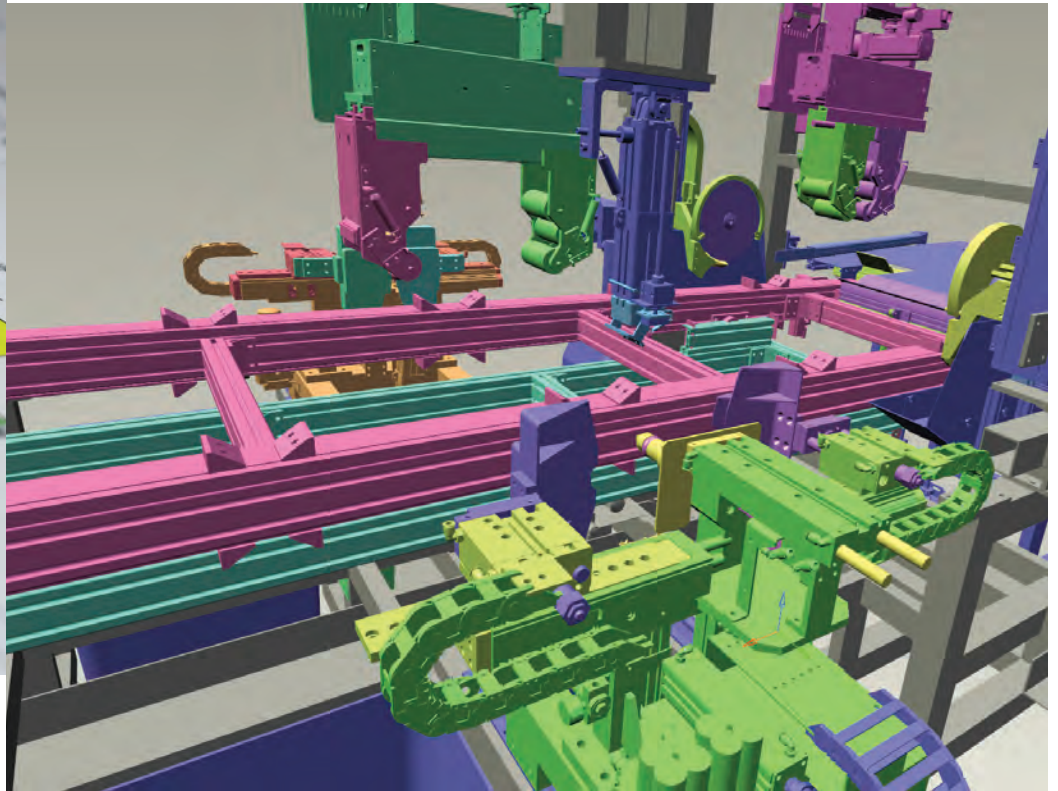
erations frequently are impossible to gauge when starting to develop and implement digital technologies, though, assistance with such change and staff involvement are essential. Business games are ideal for this. The Fraunhofer IFF's INVENT business game demonstrates the digital twin's working principle. Players experience the new technology's impacts on work organization in a simulated project and discuss them. Everyone involved in engineering plans and completes a digital equipment design project in the game. Simu-

lated experiences make it possible to determine the next step in digital transformation with the greatest potential for improvement collectively. Instead of worrying about unforeseeable changes that impede the transition to digital business, players can establish a common understanding of the reorganization needed and new processes.



The Fraunhofer IFF's INVENT business game demonstrates the digital twin's working principle. Players experience the new technology's impact on work organization in a simulated project and discuss the impacts.

Photos: Fraunhofer IFF, Daniela Martin



Thanks to the digital twin, equipment can already be functionally programmed and tested on the computer before being built. Graphic: Fraunhofer IFF

been developed digitally and commissioned virtually. This shortens commissioning significantly and keeps projects' end dates. Improved collaboration during the design phase results in significantly fewer misorders and less damage during assembly and commissioning.

Future Actions

The methods of digital engineering and the interaction with the assistance system are constantly being refined. New methods for using machine learning are being examined in the Fraunhofer Lighthouse Project ML4P, for instance. They are intended to make malfunctions predictable and facilitate troubleshooting. New methods and standards for swapping digital twins among different systems are also being developed. Digital twins

are not confined to equipment, of course, but can also be generated for system networks or factories. Current developments are exploring methods for combining materials supply simulations, digital equipment twins and real equipment with each other as well as with the largest 3D mixed reality laboratory in Europe, the Fraunhofer IFF's Elbedome where teams can view real and virtual equip-

ment in virtual factories. This makes it possible to assess modifications and optimizations all the way through equipment logistics and factory operations at an early stage.



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Burg2Go

Discovering City History Digitally

Kathrain Graubaum

“Hexenturm” and “Witches’ Tower” alternate on the modern stele with additional information in German and English relating to the adjacent tower of Burg’s medieval fortifications. Even more, a QR code guides visitors right into the structure from the days of witch hunts, going down the narrow spiral staircase into the six-meter-deep dungeon at a brisk pace. Some may find it dizzying, even though they are standing outside on the cats’ stairs named for the stone projectiles of the catapults and trebuchets or “cats”, which were carried into the fortified tower over these stairs. Only part of the tower is accessible today.

Whoever want to enjoy their tour’s “realism” even more, though, borrows a tablet with the Burg2Go app from the Burg Tourist Information Center. The tablet with “Burg to go”

takes users on an interactive trip through time through the “Towered City”. 1070-year-old Burg says, “Welcome to the era of digital transformation,” to its visitors.

The idea comes from the municipal government. They had collaborated well with the Fraunhofer Institute for Factory Operation and Automation IFF in Magdeburg when Burg Business Park south of the city was visualized, say Kirsten Backhaus. She is in charge of business and tourism development in the city of Burg. The era of digital transformation provides keys to entirely new approaches, says Kirsten Backhaus. If you are not open to that, you will be left out in the cold, even in terms of tourism marketing for your hometown.

App Opens the Door to City History

The Burg2Go app is such a key. Visitors use it themselves to open virtual doors to historical structures that are open for limited times in the real world or not open to the public for structural reasons. Nicole Mencke and Stefan Leye developed the app. The two research scientists at the Fraunhofer IFF are experts in virtual land-use and structure development. Many of their projects facilitate change processes in cities and their environs. Embedding Burg2Go in a historical context is particularly interesting works say the two Magdeburg researchers.

Burg is just a few kilometers away from the capital of Magdeburg. The two cities’ histories have points of contact. Emperor Otto I,

The city of Burg near Magdeburg markets itself as the “Green Towered City”. Only a few of the stone eyewitnesses to events are open for viewing, though, if at all.

An alternative is the Burg2Go app. The interactive companion guides tourists from the Middle Ages into our digital age.





Maximilian Steib (rechts), director of Tourist-Information Burg, with Nicole Mencke and Stefan Leye from Fraunhofer IFF before a digital info stele inside Tourist-Information.

founder of the Archdiocese of Magdeburg, mentioned the market settlement of Burg for the first time in a foundation charter in 948. The fertile environs between the Ihle and Elbe enabled the settlement's to grow a city. Burg started building fortifications with thirty fortified watchtowers along the city wall in 1213. Part of their well-preserved remains in Burg's old town can be toured – virtually and separately from guided tours too thanks to Burg-2Go.

Interactive Expedition

Nicole Mencke and Stefan Leye were often on site doing research to get a realistic impression of the buildings and to pick out details that they wanted to incorporate in their app, such as tossing coins through a small opening in the Witches' Tower. "This symbolic gesture was a custom in the tradition of medieval indulgences to atone for the innocent women convicted in witchcraft trials," explains Nicole Mencke, "You are given the task of finding the virtual spot where coins were tossed in and hear the ring of coins when you succeed."

Burg2Go is a true companion with which users can interact. The Witches' Tower, for instance, can be turned and viewed 360 degrees outside and inside. It can be opened up and its furnishings and decor viewed. So-called "wayward women" were still walking down the stairs into the prison until 1846. The virtual stairs, on the other hand, are fun for children, families, seniors and history buffs. "Our target group is the gamut of the public and users can explore the city in four eras and tour four to five buildings apiece from the Middle Ages to the twentieth century," says Stefan Leye. "Burg Local Heritage Society and city tour guides contributed much information on history and details," adds Nicole Mencke.



The Witches' Tower can be turned 360 degrees and viewed outside and inside in the app. It can be opened to view its furnishings and decor

The actual innovation of the Fraunhofer IFF's development is the reduction of the vast quantities of data to a significantly lower volume so that "Burg to go" is easy to manage. Downloads with the QR code at the stelae should not overuse cellular data rates.

"People are now accustomed to highly realistic visualization from game apps. The quality should be comparable despite far less data," says Stefan Leye, pointing out another challenge. Rather than the entire city, only twenty-four buildings relevant to a particular era, which can be toured virtually with the Burg2Go app, are visualized realistically and faithfully using current photos. "The other buildings are displayed in black-and white with a lower level of detail. The ground is a dark color so that the twenty-four destinations stand out. Visualizing the buildings' characteristic features was important to us when we created their models. In the process, we couldn't lose track of the number of polygons that produce a detailed model. Building textures were additionally compressed and collected in an image file," explains Stefan Leye.

Tablets Loaned to Tourists

Tourist-Information Director Maximilian Steib has twenty Burg2Go tablets to loan. He gives users a brief explanation of the user interface and a paper map of the old town, which is also displayed in 2D on the app. This enables people to pick the route they want to follow.

Burg2Go has its first summer season behind it. And there is user feedback. A navigation system is at the top of their wish list. "Most would like to be guided through the streets," says Maximilian Steib. That is no problem for the team from the Fraunhofer IFF. The app could be connected with GPS. Then it would determine where people are located and navigate to the point activated on the map, say Stefan Leye and Nicole Mencke.



Nicole Mencke and Stefan Leye were often on site doing research to get a realistic impression of the buildings and to pick out the details they wanted to incorporate in their app.

The municipal government is receptive to optimizing the app. Burg2Go is ultimately supposed to become a city brand. Burg2Go will primarily be introduced to residents now.

"We will recommend the app to schools for classes, for instance, and present it to clubs and associations," says Kirsten Backhaus. The experts from the Fraunhofer IFF also have an idea there: "We could upgrade the app with a virtual scavenger hunt through Burg. Fasci-

nating adventures would be waiting at each of the twenty-four stations, which teach interesting facts in a fun way," says Nicole Mencke, arousing curiosity.



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Barley Biodiversity

Innovations for Future Farming

Spectral Imaging Simplifies the Identification
of Exotics Suitable for Barley Breeding

Ulrike Christoforidis

In collaboration with Martin Luthe University Halle-Wittenberg, the Fraunhofer IFF is using spectral technologies to measure the constituents of grain crops right in fields and to forecast growth and yields – for useful plants that have benefits ecologically and economically.



Markets are demanding higher yield, climatic changes are creating new conditions, and pollution and corresponding legal regulations are necessitating new thinking. Farming is changing radically. Cultivated useful plants are frequently insufficiently resistant to the mounting stresses, e.g. increased droughts, mineral deficiency, pests and pathogens. Exotic relatives of domestic species planted here, however, can contain alleles, i.e. variants of a gene, which regulate adaptation to such biotic and abiotic stresses and produce a new breed of higher yielding and hardier plants.

Remote support has been complicated – until now: Which of the selected wild relatives that primarily thrive in the Fertile Crescent in the Middle East potentially have the traits sought is only revealed in a laboratory. Even this information is only partially reliable in turn since quite a few factors in fields such as soil condition, climatic conditions and fertilizer use affect the outcome in practice.

Noninvasive methods for analyzing suitable lines to provide information on genotypical traits and to allow selection under field conditions are being developed in the Barley Biodiversity research project. The objective is to boost the genetic diversity and yield of cultivated barley species by crossing in exotic wild barley. Along with improving the plants' stress resistance and adaptability, factors such as increased nitrogen efficiency and optimized malting quality are priorities. "Developing solutions to problems that grow out of market demands is particularly interesting to Fraunhofer scientifically," explains Prof. Udo Seiffert, head of the Biosystems Engineering Unit at the Fraunhofer IFF. Together with three other project partners, Martin Luther University in Halle-Wittenberg, the Leibniz Institute of Plant Genetics and Crop Plant Research (IPK) in Gatersleben and SaatZucht Josef Breun GmbH & Co. KG in Herzogenaurach, he went searching with a team from the Fraunhofer IFF for suitable exotic genetic material in 2014: The Pre-Breeding Program for the Selection and Characterization of Stress-Resistant and High Yielding Plant Material is being funded by the Federal Ministry of Education and Research as part of its Innovative Plant Breeding in the Cropping System initiative.



Technology does not always have to be cutting-edge. The research scientists sometimes revert to quite traditional aids such as this old handcart for their research studies. Photo: Olaf Christen



The research scientists use drones for rapid analyses. Although they are less accurate than the slower AgRover on the ground, they deliver a large amount of data in a fraction of the time while flying over test fields. Photo: David Killias

Two Populations for Research

Research is being done on two populations that have been phenotyped and genotyped specifically for the project: The S42IL population consists of forty-nine so-called introgression lines for which wild barley was the "donor" crossed into cultivated barley in order to

transfer specific genes or segments of chromosomes from the exotic to the cultivated barley. Repeated backcrossing with the cultivated plant gradually reduces the share of the donor's genes to the genetic material desired in the step. Like the S42IL population, the second significantly more extensive HEB-25 population was created in Prof. Klaus Pillen's

» The sensors enable us to examine different nutrient statuses and to detect diseases before they become outwardly visible and it is often too late for treatment. «

working group at Martin Luther University in Halle. It includes nearly 1,500 so-called nested association mapping (NAM) lines and is unique worldwide. Never before has a multiparental NAM population been used to research the genetic diversity of a wild cereal species. Twenty-five wild barley plants from the Fertile Crescent were selected for these lines and crossed into the elite barley variety Barke.

Both populations are being grown and subjected to different conditions in field tests: Some plants will experience extreme drought, others will be treated with plant protection products or nitrogen fertilizers, while others will go untreated. Genotypical as well as statistical analyses will provide information on barley traits that can be attributed to specific gene loci or genes. This knowledge can be used to identify those genes exactly, which produce agronomic traits desired for a particular environment.

Yield Forecasting

The Fraunhofer IFF developed special modeling methods that ascertain the plants' constituents and forecast their expected yield at an early stage. The AgRover, an all-terrain vehicle that looks like a cross between a giant go-kart and a small lunar buggy, will drive over the 3,000 barley tracts of land in Halle on a regular basis. The vehicle has cameras and instruments that take spectral optical scans to collect quantitative hyperspectral data.

Commercially available optical sensors measure nitrogen content right in the leaves based on the reflected wavelengths of the biochemical composition – without sampling, without laboratory testing. "Spectral

monitoring detects different varieties as well as growth conditions such as soil, fertilization and plant protection actions," explains Seiffert. Statistical data analysis reveals the agronomic yield and plant quality and allows conclusions: "Which genotype performs particularly advantageously under which conditions?"

The second phase of the project during which a drone will be used to collect multispectral data will begin in the spring of 2018. Unlike hyperspectral scanning, the lower number of points this scanning detects in the spectrum delivers limited information on constituents but these data are delivered in a fraction of the time needed by the ground AgRover.

"The AgRover drives slowly and delivers data in high spatial and spectral resolution, while we cover more area with the drone," says Seiffert. It screens in just twenty minutes, whereas the technology on the vehicle needs two days. "The sensors enable us to examine different nutrient statuses and to detect diseases before they become outwardly visible and it is often too late for treatment." The Fraunhofer IFF has been developing, researching and using such hyperspectral and multispectral systems for ten years, says Prof. Seiffert, Barley is now following grapes and wheat as the focus of research in the Barley Biodiversity project.



Initial Successes

The collaborative project has already been able to tally a number of partial successes two years before the targeted goals will be reached. Genes or markers that improve barley development and barley yield under different conditions have been identified. The research team is able to predict micronutrients such as iron or zinc and the nitrogen or metabolite content very accurately with the aid of the spectral imaging system – with an accuracy of ninety percent at times. Economically, benefits are beginning to emerge too. The crossed in genes have made some lines resistant to phytopathogenic fungi. This cuts the use of plant protection products, benefiting farmers and the environment. Prof. Udo Seiffert sums this up this way: "We provide commercial plant breeders support so that they can breed new lines for the good of all of us."

Find more information on "Applied Crop Research in Germany" in the Federal Ministry of Education and Research's initiative Plant 2030 on www.pflanzenforschung.de



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Helping Navigate the Transition to Industrie 4.0

Janine van Ackeren

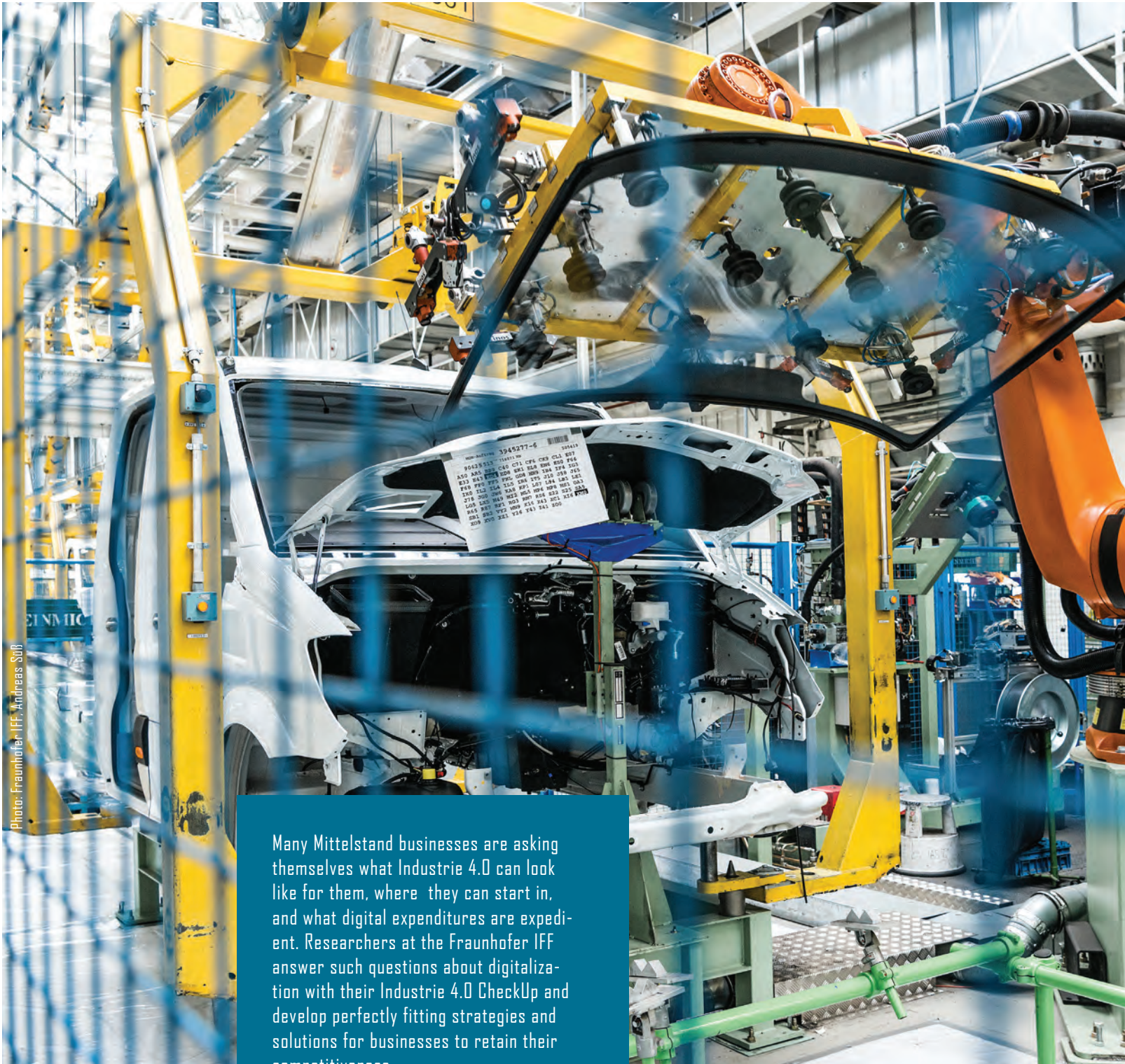


Photo: Fraunhofer IFF, Andreas Süß

Many Mittelstand businesses are asking themselves what Industrie 4.0 can look like for them, where they can start in, and what digital expenditures are expedient. Researchers at the Fraunhofer IFF answer such questions about digitalization with their Industrie 4.0 CheckUp and develop perfectly fitting strategies and solutions for businesses to retain their competitiveness.



The Mittelstand is having trouble with the implementation of digitalization and the vision of Industrie 4.0 because of the substantial uncertainty at the beginning of this transition and the need for major capital expenditures. The resultant benefit is elusive at first. Moreover, Industrie 4.0 and digitalization have long been presented and discussed as purely technological issues in the media. In other words, technical implementation of the idea has been and is the focus of discussion. In keeping with the maxim “we’ve been doing that for years”, some Mittelstand companies tend to think that Industrie 4.0 constitutes the usual technical refinement of established technologies rather than anything new. The approaches in businesses, however, are usually only local solutions incapable of tapping the full potential of Industrie 4.0. For Industrie 4.0 is more. It ultimately compels executives to view their company as a single entity and to digitalize and connect all business units and roles. This necessitates rethinking a few issues. For instance, how should collaboration be organized in the company and with customers and suppliers in the value added network? How can digital tools and methods support the operations in the company? Do operations have to be restructured?

What Can the Transition to Industrie 4.0 Look Like?

The supply chain and factory design experts at the Fraunhofer IFF help Mittelstand businesses with an Industrie 4.0 CheckUp. “In it, we break down the big topic of Industrie 4.0 to the level of the individual businesses,” says Christian Blobner, Manager of International Research Networks at the Fraunhofer IFF. “Not only does ‘Industrie 4.0 capable’ equipment have to be purchased, but the surrounding processes also have to be made ‘Industrie 4.0 capable’. The basic conditions have to be established before the promised value added can be achieved with the equipment.” There are not any off-the-shelf solutions for that, though, since the vision of Industrie 4.0 can take on extremely different forms in individual businesses, depending on the sector and the business’s objective. This can even be true for a single company’s different units.



The Fraunhofer IFF’s experts use workshops and discussions with individual employees to examine the topic of Industrie 4.0 in a company in terms of people, technology and organization, thus learning how the company ticks, what its objectives are, and what its Industrie 4.0 capability maturity index is.

Photo: Fraunhofer IFF, Christian Blobner

The research scientists have therefore developed an Industrie 4.0 capability maturity model with five levels to classify businesses and units. Such models have become established for integrated assessments of production systems and businesses. An initial capability maturity assessment is used to derive and develop development paths just for the

The Fraunhofer IFF's experts are very active internationally with their Industrie 4.0 Checkup and supporting workshops. Photo: Fraunhofer IFF

company. The model covers various stages of capability maturity, which serve as milestones for diagnosing and measuring success factors. Such a capability model has various benefits: It identifies possibilities for improvement and thus facilitates increasing efficiency, establishing new business models and increasing attractiveness for employers. The objective description of the stages of capability maturity can additionally be used to identify a target state based on the particular industry, customer structure or even the dominant national business structure. "Omitting individual stages of capability maturity – more or less in the sense of a revolution – is rarely expedient, though: This would neglect crucial integrative issues such as employee training," explains Sebastian Häberer, expert in corporate digitalization and Industrie 4.0 at the Fraunhofer IFF.

A Gradual Approach

In a first step, Sebastian Häberer and his colleagues ascertain a company's as-is state in relation to its level of digitalization. Based on workshops and discussions with individual employees, they examine the subject of Industrie 4.0 in



- 1** Objective-setting workshop and creation of corporate awareness 
- 2** Expert interviews to analyze material streams and information flows 
- 3** Indexing of the company's Industrie 4.0 capability maturing 
- 4** Formulation of actions and assessment of use cases 
- 5** Combination of the prioritized actions into a road map 



Personal interviews with company staff are part of the Fraunhofer experts' basic repertoire to get to know businesses exactly. Photo: Fraunhofer IFF. Dirk Mahler

businesses in terms of people, technology and organization, thus learning how the company ticks, what its objectives are, and what its level of Industrie 4.0 capability maturity is.

In another step, the researchers define various concrete actions, which can be heavily people-centered, technological or organizational, and develop an implementation road map together with the company. "We thus classify the company in terms of its digital capability maturity index. And accordingly recommend the next evolutionary step it can take – modified for current capabilities and their relevance to the company and the staff," explains Häberer.

Internationally Active – with Positive Impacts for Germany

The Fraunhofer IFF's supply chain and factory design experts have performed their Industrie 4.0 CheckUp at various companies. Some of their most important clients are automotive

suppliers. Inquiries from abroad, e.g. from China, Thailand or Kazakhstan, have been arriving with increasing frequency since 2017. "We additionally bring the experiences we acquire abroad back with us. For we are increasingly seeing a change in thinking: Many German companies are asking for our experience abroad since they intend to expand there," says Blobner. Companies all over the world concur on the underlying technologies. Industrie 4.0 is about more than just the technology alone, though. It is just as much about a change of mind-set to advance digital connectivity in businesses as about organizational issues. The researchers modified their methods to incorporate and factor in the nu-

merous differences between countries that they have experienced first hand. The Federal Ministry for Economic Affairs and Energy launched its Mittelstand Digital initiative to support the Mittelstand in Germany. Twenty-five regional centers of excellence have been established as part of this initiative. They inform small and medium-sized businesses about the opportunities and the challenges of digitalization. They also help during practical implementation by providing free expertise, demonstration centers and networks. The Fraunhofer IFF is involved in two such centers of excellence, the "growing connectedly" Mittelstand 4.0 Center of Excellence Magdeburg regionally focused on Saxony-Anhalt and the "Design and Construction" Mittelstand 4.0 Center of Excellence targeting the German construction industry in all of Germany and represented in several locations. Fraunhofer IFF researchers are also helping regional companies market their services abroad.


Germany Should Not Miss the Boat

Germany still has a technological edge in many sectors. "Other countries are significantly more willing to invest in automation and digital transformation, though. That was a surprise for us – ultimately, the labor costs are significantly higher here and efficiency capabilities in terms of greater connectivity and automation are correspondingly higher," says Blobner, summing up "If we don't want to miss the boat and intend to remain internationally competitive, it will be essential to use coming years to advance the transformation to connected Industrie 4.0 actively. «



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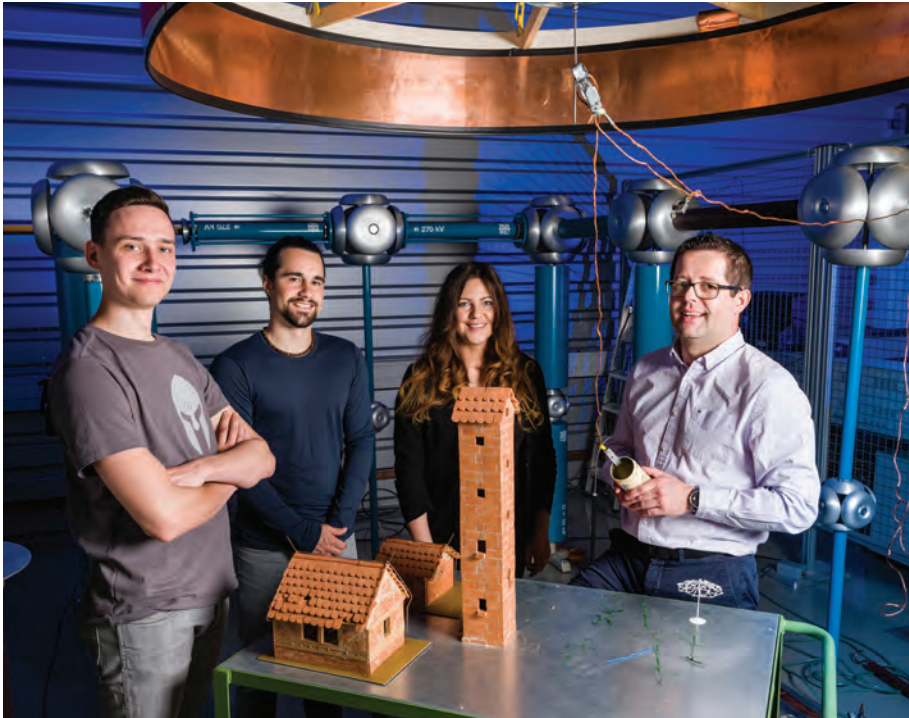


Virtual and real worlds merging smoothly. The Fraunhofer IFF's Elbedome is one of the largest 3D mixed reality laboratories for industry and research applications in the world. The high-resolution three-dimensional VR projections allow exploration of virtual worlds. Entire factories at a scale of 1:1 can be visualized three-dimensionally on the 450-square-meter projection surface and even interactively, if necessary.

Photo: Fraunhofer IFF, Ilwe Völkner



Professorship for Power Grid Expert



Professor Przemyslaw Komarnicki (r.) with students in the high-voltage laboratory of the Department of Electrical Engineering at Magdeburg-Stendal University of Applied Sciences. Photo: Bastian Ehl

Magdeburg-Stendal University of Applied Sciences welcomed ten new professors with abundant international experience in 2018. One of them is Prof. Przemyslaw Komarnicki, manager of Electrical Power Systems and Infrastructures and spokesperson of Convergent Infrastructures Research Field at the Fraunhofer IFF. Professor Komarnicki is now in responsible for teaching and researching electrical power equipment engineering and power supply systems.

Professor Komarnicki has been working at the Fraunhofer IFF for fifteen years. His work is focused on the integration of renewables in the electrical grid and the development and control of smart power supply infrastructures, so-called smart grids. The thirty-nine-year-old expert in electrical power systems helped establish this research unit at the Fraunhofer IFF and is highly esteemed in his field.

Being able to offer future engineers a strong foundation in reality along with teaching

theory is especially important to Prof. Komarnicki. He views his dual role as a faculty member at the university and as a researcher at the Fraunhofer IFF as the basis for this. Along with attending classes, students can get involved in the Fraunhofer IFF's applied research early on. "Enabling students to add another, significant practical component to their degree program this way is a big advantage for university students. That also boosts the quality of teaching and ultimately releases even better educated engineers into industry," point out Professor Komarnicki.

Magdeburg-Stendal University of Applied Sciences offers students five departments at its two campuses in which interested students can choose from around fifty majors. Around one hundred thirty professors guarantee excellent advising for the approximately 6,300 students at present. (mar)

VDI Award for Visualization

Markus Vondran, process and power engineering major at Otto von Guericke University Magdeburg and student assistant in the Fraunhofer IFF's Convergent Infrastructures Business Unit, was awarded the Association of German Engineers' (VDI) Award in May 2018. The Magdeburg chapter of the VDI thus paid tribute his outstanding bachelor's thesis.

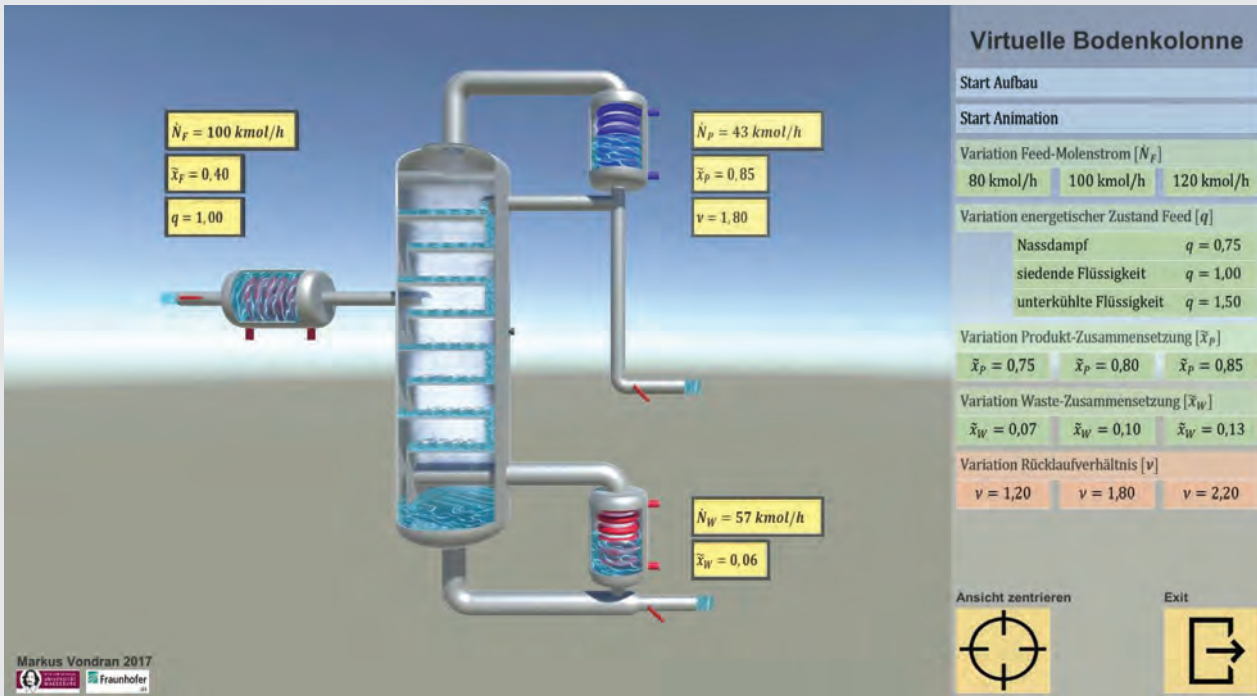


Markus Vondran (m.) with Dr. Günter Ihlow (li.) and Prof Rüdiger Bähr (r.) at the awards ceremony at the 10th VDI Magdeburg Business and Research Forum. Photo: Viktoria Kühne

Bundesvereinigung Logistik



Prof. Thomas Wimmer (r.) bidding farewell to Prof. Michael Schenk (Mi.) from the BVL Scientific Advisory Board. Photo: Kai Bublitz



In his thesis, Markus Vondran modeled an interactive 3D visualization of a fractionating column, equipment that thermally separates chemical mixtures. The visualization is intended to serve as a teaching aid that engagingly teaches students how the equipment operates. His work is available to faculty and students as a free computer program and app now too. It is already being used for teaching at the university in Magdeburg.

"I wanted to add a new feature about Industrie 4.0 to teaching of process engineering," explains Markus Vondran. He intends to expand this approach in his upcoming master's thesis: The virtual equipment models are supposed to become smarter so they can be used in industry too. (gg)

The virtual fractionating column in animation mode. Users can follow distillation in the equipment. The bar menu is used to display and set important variables manually. Graphic: Markus Vondran

Bids Professor Michael Schenk Farewell from Committee Work

Professor Michael Schenk was an active volunteer member of the Bundesvereinigung Logistik's (BVL) committees for over twenty years. He is a recipient of the pin of recognition and an honorary member of the Logistics Excellence and Knowledge Network. The Scientific Advisory Committee bid him farewell with much gratitude.

Director of the Fraunhofer Institute for Factory Operation and Automation IFF in Magdeburg and Executive Director of the Institute for Logistics and Material Handling Systems at Otto von Guericke University Magdeburg, Prof. Schenk made a mark in the BVL from

the late 1990s to the present. He was a member of the board where he represented the interests of the discipline of logistics for over ten years. During that time, he also chaired the jury for the distinguished BVL Logistics Science Award until 2013. He sat on the Scientific Advisory Board from 2008 to 2018.

Professor Thomas Wimmer, Chairman of the BVL Executive Board, thanked him on behalf of the boards and members of the BVL and highlighted his meritorious service in his laudation at the 9th International Scientific Symposium on Logistics (ISSL), "Professor Michael Schenk significantly advanced the development of emerging re-

searchers, funding for research and the establishment of a regularly held independent academic event of the BVL." This was launched in 2002 with the Scientific Symposium, the predecessor of the present ISSL. Logistical issues are discussed at the ISSL every other year, always at a different center of research. Along with Magdeburg, venues have included Berlin, Dortmund, Munich, Darmstadt, Hamburg, Cologne and Karlsruhe.

The BVL Scientific Advisory Board chaired by Prof. Kai Furmans currently has twenty-two members and represents the entire spectrum of logistics research. (pm)

Computer Science for Agriculture

They are only interested in computers, complete introverts and extremely shy. Computer scientists belong a group of professionals that frequently has to struggle against prevailing stereotypes. Uwe Knauer, computer scientist and researcher at the Fraunhofer IFF, does not want to accept that. "A few might appear on television as prime examples of this cliché but I and most of my colleagues would say that is inaccurate," says the researcher. Instead, Uwe Knauer rather likes being on the road and takes advantage of conferences in particular to establish new contacts and dialogue with colleagues in his field.

The native of Berlin has been working on mathematical models that analyze data from various imaging sensors in the Fraunhofer IFF's Biosystems Engineering Business Unit for seven years. His research centers on recording and analyzing aerial hyperspectral images. Based on this, the Fraunhofer IFF is developing and testing innovative scanners together with partners from agriculture and forestry. In the future, this will reduce or supplant time-consuming and expensive laboratory analyses that assess plants' nutrient content and health. The research scientist and his col-

leagues expect the enhanced forecasting methods based on this and the subsequently reduced use of fertilizer and pesticides to ensure tangible improvements such as lower costs and greater environmental compatibility in agriculture and forestry.

In May of 2018, he defended his dissertation entitled "Multi-Classifer Systems for Object Detection in Image Data" in which he examines the automatic analysis of image data sets he collected in numerous projects at the Humboldt University and the Fraunhofer IFF.

He tested different data processing methods and ultimately developed his own method that combines different classification methods. This improves the analysis of such data sets significantly and is now being used at the Fraunhofer IFF effectively to analyze hyperspectral images.

The new doctor is unable to escape all the stereotypes about computer scientists entirely, though. Apart from running, the family father likes tinkering and works on old computers in his free time, fulfilling a common cliché after all (dk)



Uwe Knauer (re.) explaining the capabilities of the hyperspectral scanner for agriculture and forestry to then Saxony-Anhalt Minister of Agriculture and the Environment Hermann Onko Aeikens at the first Holz Sachsen-Anhalt industry get together. .
Photo: Andreas Lander

Corporate Relay



Magdeburg's 10th Corporate Relay with the motto "Run. Motivate. Network." was held with 1000 teams from around 500 regional businesses in the summer of 2018. The Fraunhofer IFF also participated with fifty runners on ten teams. The research institute's motivated employees had not only prepared for it organizationally but also athletically, of course. For instance, they formed a runners' group with an endurance, interval and motivational training plan. Their goal was success through teamwork.

The researchers scored points with their creativity during the relay race. A banner with the institute's acronym "IFF" was put up spontaneously. The striking sign and identical green jerseys made it easier for the baton carriers to find their team in the crowd, cutting important seconds during the handoff.

All the runners celebrated their results at the 2018 Corporate Relay together. Photo: Ralf Warnemünde

The Fraunhofer team "Faster than Forrest" took second place in the mixed category.

Apart from the race results, one thing in particular was demonstrated at this event: The Fraunhofer IFF is a strong community, distinguished by its enthusiasm, creativity and total commitment to common projects – not just in research.

The "relay" project will be continued, of course. We are already looking forward to numerous athletic colleagues and many fans being on the 2019 race course. (gg)

Researching for Robot Colleagues

In the future world of work, humans will be supported by and work hand-in-hand with new colleagues – robots. People's safety has top priority since injuries absolutely have to be prevented in the event of unintended contact. Roland Behrens at the Fraunhofer IFF is studying the conditions that have to underlie safe human-robot collaboration

To this end, the mechatronic engineer is conducting complex collision tests with human subjects on a tester specially built for this for the first time ever. The tests conducted on behalf of the Berufsgenossenschaft Holz und Metall (BGHM) and the German Social Accident Insurance (DGUV) were approved beforehand by the responsible ethics commission. The values ascertained in the tests deliver precise information on what loads injure human tissue causing swelling or on the time after which a human feels pain. The findings made it possible to specify limits for robot and human collisions for the first time, which will ultimately enter into relevant international standards for safe human-robot collaboration.

These tests also served as the foundation of his doctoral dissertation entitled "Biomechanical Limits for Human-Machine Interactions in Collaborative Robotics", which he completed extremely successfully with summa cum laude.

Robotics specialist Roland Behrens earned his doctorate with his dissertation on tests of human-robot collisions.
Photo: Stefan Deutsch



The native of Cochstedt arrived at the Fraunhofer IFF by way of his undergraduate degree in mechatronics at Otto von Guericke University Magdeburg. Immediately afterward, he began working as a research scientist in the Robotic Systems. Business Unit at the Fraunhofer IFF in July of 2009 "The widely varying work among numerous disciplines such as electrical engineering, mechatronics and biomechanics is especially appealing to me," says the robotics specialist.

Having successfully defended his doctorate, Roland Behrens could now devote himself to running again or other recreational activities since they fell by the wayside while he was working on his doctorate. The respite probably will not last long, though. His next "major project" is right around the corner – his wedding. (dk)

The IFF Soccer Team Shows How It's Done

Take a look, Jogi Löw, for you can learn something from our guys! The Fraunhofer IFF not only shines through its numerous research scientists but also boasts excellent athletes among them. Last year's Fraunhofer soccer team tournament in Chemnitz on June 23, 2018 mad that obvious at least.

Its outstanding soccer playing enabled the Fraunhofer IFF's soccer team to return from the city in Saxony with the cup – despite bad weather. The unusually bad weather conditions for the summer with temperatures around twelve degrees and constant drizzle put the IFF eleven's tenacity and ambition to the test.

They confidently advanced from the preliminaries with nine points in three games into the next round in which one win and two ties advanced the team from Magdeburg into the final, playing Fraunhofer IOF Jena for "all or nothing". A scoreless final in regular time caused a good bit of excitement in the stand since the winner of the 2018 Fraunhofer soccer tournament was decided in a penalty shoot-out.

Ultimately, the IFF soccer team returned to Magdeburg with a six-to-five victory and bearing the tournament cup. The next Fraunhofer soccer tournament will be contested on 1st FC Magdeburg's auxiliary fields on June 22, 2019. (dk)



An impressive win!
After a successful soccer tournament, the first-place IFF eleven returned to Magdeburg with the winner's trophy and the Fraunhofer challenge trophy. Photo: Private

Into the Future with a Vision

“Pooling expertise, connecting in partnerships, and facilitating the digital transformation of industry and society with open eyes,” is how Dr. Stefan Scharf with his colleagues from the Fraunhofer IFF would like to help advance digital transformation and Industrie 4.0.



Dr. Stefan Scharf looks inquisitively, openly and confidently into the future. Photo: Gesa Götte

Dr. Stefan Scharf, mechanical engineering manager, has been working as the Director of Business development at the Fraunhofer IFF since September of 2018. In this newly created position, he will be facilitating the institute's sustainable development together with its organizational units and developing new, client-driven services. After having worked in the Department of Manufacturing Engineering and Quality Assurance at Otto von Guericke University Magdeburg for many years, he is now taking up a new challenge.

His goal is to provide the Fraunhofer IFF's clients and partners a wide but nevertheless customized range of services. “We repeatedly encounter issues in everyday life, which cannot be addressed by one single business unit. Often, the diverse expertise at the institute can and must be pooled and integrated in ideally integrated solutions. This necessitates constant networking of research groups and outside partners. I intend to promote and facilitate that,” says Stefan Scharf.

Apart from his day-to-day work, the engineering manager would primarily like to do one thing, to be inquisitive about technological innovations and open for the problems and concerns of industry partners and clients. “It is important to me to reexamine and question things over and over, while bringing in others' expertise too. After all, new perspectives sometimes lead to surprising solutions, resulting in win-win situations. They are the goal.”

What is more, the interdisciplinarity and diversity of research at the institute are a good basis for broadly positioning its activities, both regionally and internationally. This makes it possible to provide businesses complete packages: “Fraunhofer is typically not only responsible for creating technological innovations but also for implementing them effectively in businesses. This also includes keeping an eye on people and their rapidly changing work environment. That is why we want to step up our development of digital and innovative basic and advanced training programs.” Internationally, it is also important to facilitate technological change and to take advantage of and expand the institute's international activities. “Of course, digital transformation will only function in our globalized world when all of the parties involved are able to participate in this transformation,” says Stefan Scharf. (gg)



Presentation of the 2018 gtw Science Award at Magdeburg City Hall on October 4, 2018. Business Commissioner Rainer Nitsche (m.), representing the mayor, congratulating Magdeburg winners Dr. Tina Haase (l.) and Julia Arnold (r.) and



2018 gtw Science Award for Fraunhofer Research Scientist



their advisors Prof. Michael Schenk (2nd from l.) and Klaus Jenewein (2nd from r.).

Photo: Harald Krieg/DVGU Magdeburg

Every other year, the Arbeitsgemeinschaft Gewerblich-Technische Wissenschaften und ihre Didaktiken (gtw) in the Gesellschaft für Arbeitswissenschaft e. V. (GfA) honors academic studies that make an important contribution to developing the state of knowledge in industrial and technical sciences and their educational methods. This year's "Industrial and Technical Sciences" award was presented to four winners at their 2018 Fall Conference in Magdeburg.

One of the winners was Dr. Tina Haase from Fraunhofer IFF. The computational visualistics Engineer and research scientist at the Fraunhofer Institute for Factory Operation and Automation IFF was recognized for her dissertation "Industrie 4.0: Technology-Based Learning and Assistance System for Maintenance". Her study examines professional skilled work in industrial maintenance in high-tech production systems.

Professor Michael Schenk, her dissertation advisor and Director of the Fraunhofer IFF and Otto von Guericke University Magdeburg's Institute for Logistics and Material Handling Systems, stressed that "research and development to design virtual and real learning and work environments are very important in Magdeburg. We are realizing that the impact of digital transformation even on professional skilled work is growing steadily in the context of Industrie 4.0 developments. Dr. Haase has made a relevant, timely contribution to the field of high-tech at the interface of engineering and engineering education as well as information and media systems."

The gtw science award is presented at the gtw conference every other year with the support of Lehrmittel-Verlags Christiani GmbH based on a nationwide call. (pm)

Fraunhofer Researcher Appointed to the State's Climate Advisory Board



Professor Przemyslaw Komarnicki, spokesperson of the Fraunhofer IFF's Convergent Infrastructures Research Field and Professor of Electric Energy Systems Engineering and Energy Supply Systems at Magdeburg-Stendal University of Applied Sciences, was appointed to the scientific advisory board that supports the state of Saxony-Anhalt's climate and energy plan by Saxony-Anhalt Minister of the Environment, Agriculture and Energy Claudia Dalbert.

When presenting the new climate and energy plan in February of 2019, the minister stressed that the state intends to meet its climate change mitigation targets for the year 2020. This includes cutting greenhouse

gas emissions to 31.3 million tons of CO₂ equivalent. The emissions gap is still around 1.8 million tons. Other efforts to mitigate climate change are needed to do this. "Advanced climate change mitigation policy can only be successful when we view climate change mitigation and the energy transition together," said the minister, explaining the approach. "When the climate and energy plan was being drafted, an approach was pursued in Saxony-Anhalt for the first time, which makes recommendations for cutting von greenhouse gas emissions from the perspective of climate change mitigation, while including the energy sector." Saxony-Anhalt is a national pioneer with this climate and energy plan since it calculated cuts in greenhouse gases concretely based on scientific research findings. Its implementation will be accompanied by extensive

monitoring. This will be the job of the independent scientific advisory board and others.

The advisory board has up to twenty full members appointed for four years by the Minister of the Environment, Agriculture and Energy. The advisory board's mission is to advise the government of the state of Saxony-Anhalt on the implementation of its climate and energy plan. It deals with issues that it deems particularly relevant and significant or have been identified by the Minister of the Environment, Agriculture and Energy. Specifically, this includes adapting the climate and energy plan's actions to the state-of-the-art, finding solutions to existing obstacles, and identifying additional actions to meet the climate targets. (mar)

Energy expert Przemyslaw Komarnicki and Minister-President of Saxony-Anhalt Reiner Haseloff inside the Fraunhofer IFF's transportable 1 MW battery.

Photo: Fraunhofer IFF, Viktoria Kühne



Photo: Fraunhofer IFF, Dirk Mahler



Remanufacturing parts gives many a piece of equipment a second lease on life, thus saving valuable resources since no new machines have to be built.

The Fraunhofer IFF helps companies plan and implement actions that boost their energy and resource efficiency.

Publishing Information

IFFocus 1/2019

Publisher: Fraunhofer Institute for
Factory Operation and Automation IFF
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ISSN 1862-532

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Design and Layout: Bettina Rohrschneider

Translation: Krister Johnson

Printing: Harzdruckerei GmbH

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22ND IFF SCIENCE DAYS IN 2019



JUNE 4 TO 6, 2019

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

Attend the 22nd IFF Science Days in 2019 and discuss research approaches and best practices in the thematic worlds of "sustainable digital data use in manufacturing", "digital applications for the future energy supply" and "new business models and value added through approaches to digital transformation in facilities engineering" with representatives of other sectors this year.

We look forward to seeing you at the IFF Science Days in Magdeburg on June 4 to 6, 2019.

Programs and registration on: www.wissenschaftstage.iff.fraunhofer.de

