

**A COMPETITIVE EDGE  
FOR YOUR BUSINESS  
WORKING TOGETHER  
FOR SUCCESS**

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# THE JOINT PATH TO SUCCESS

## PREFACE

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Ladies and gentlemen,

Innovation is one of the keys to a successful economy. With product life cycles becoming shorter and shorter – particularly in high-tech industries – manufacturers are expected to bring a steady stream of innovative products to market.

The race to win customers is heating up, and anyone who falters risks being left behind. But innovation is not only essential for products. It also plays a vital role in manufacturing engineering, in distribution, and in virtually every other aspect of business organization.

Successful business people know that efficient structures are an essential part of a profitable business. This is why they foster an environment that encourages innovation, seek out the best research and development professionals, and promote ideas that nurture the creativity of their workforce.

These in-house innovation practices are perfectly complemented by external research services such as those offered by Fraunhofer. Skilled, experienced research scientists and engineers can provide exactly what your company needs: innovation “on demand” with a scope and schedule tailored to your requirements, making it a very cost-effective option.

This brochure has been designed to provide answers to key questions about Fraunhofer that new customers typically ask us, namely: Who are we? What services do we provide? How do we do business?

Just as a picture says more than a thousand words, we hope that the examples featured here of how our organization operates will give you a better insight into how you could work with Fraunhofer, too. We believe in letting our customers do the talking, which is why we chose these interviews, reports and articles.

Hopefully, the examples in the following pages will pique your curiosity and leave you wanting to find out more. If so, please make sure to get in touch with us. We will be delighted to help!

Sincerely,

Hans-Jörg Bullinger  
President of the Fraunhofer-Gesellschaft

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# FREQUENTLY ASKED QUESTIONS

## EVERYTHING YOU WANTED TO KNOW ABOUT FRAUNHOFER

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Fraunhofer has very satisfied customers – the logical result of tremendously motivated and well-trained staff combined with extensive experience in working with both large and small companies. One indication of how successfully we work together with our customers is the high number of repeat orders. Quite simply, companies that have used Fraunhofer's services once tend to want to use them again. Plus, they often recommend Fraunhofer to other companies.

If you are considering working with Fraunhofer for the first time, you are sure to have lots of questions. We hope you will find the answers to some of your key questions below.

### 1. ARE JOINT RESEARCH PROJECTS REALLY WORTHWHILE?

In short, yes. Innovations offer the basis for both a successful economy and successful companies. This is especially true in industries where product life cycles are steadily getting ever shorter owing to global competition and rapid technological development. Ideas alone are not enough – you also need experienced professionals who can help you transform your ideas into innovations and, ultimately, into successful products.

### 2. WHY CHOOSE FRAUNHOFER OVER OTHER RESEARCH PROVIDERS?

Contract research is the Fraunhofer Institutes' main field of business – a fact that is reflected in their employees' expertise. Fraunhofer researchers are familiar with the conditions and constraints that companies encounter on a daily basis and they understand what is important, often because they have worked in the industry themselves.

Our close cooperation with industry partners means we can constantly tailor Fraunhofer research to address the mounting challenges that companies face. The cornerstones of our approach are guaranteed confidentiality, continuity in key positions, top-class facilities, and reliable project management. Our efficient style of collaboration ensures that our customers get the agreed solution on time and ready to put into practice. We also handle the issue of usage rights with the utmost professionalism.

An increasing number of Fraunhofer Institutes are certified to EN ISO 9001; as well as making it easier to reproduce new developments, this gives customers the reassurance of knowing that the institutes operate in a way that ensures the sustainable implementation of customer specifications.

Other research providers, the bulk of whom are publicly funded, may seem like a more economical option at first glance. But what ultimately gives Fraunhofer the edge, even from an economic perspective, is its professional approach towards cooperation and its long-standing ties to industry. The high levels of customer satisfaction confirmed by survey after survey are an indication of the excellent reputation and stature that Fraunhofer enjoys as a partner to business.

### **3.** **HOW DO CUSTOMERS AND FRAUNHOFER START WORKING TOGETHER?**

Customers tend to have a fairly concrete idea of the challenge they are facing and the deadlines they must meet, and in many cases they simply make a direct approach to the Fraunhofer Institute which they believe can best tackle that challenge. If it is not immediately apparent which institute is the best choice, they can turn to a Fraunhofer Group or Fraunhofer Alliance to get advice and contact details. Alternatively, commercial customers can simply ring the central hotline set up for this purpose.

When it comes to broader concepts such as joint technology development projects, Fraunhofer can organize a Technology Day for a specific company. This is an event that enables both sides to define and stake out a cooperative process by exchanging information.

To help companies better assess their own capacity for innovation when developing product-related services, the Fraunhofer Institute for Industrial Engineering IAO has created a tool which is available for free on the Internet: [www.innoscore-service.de](http://www.innoscore-service.de)

### **4.** **HOW DOES A COOPERATION PROJECT WITH FRAUNHOFER GET UNDERWAY?**

Contact with Fraunhofer is often initiated by companies themselves, but Fraunhofer seminars, events and trade fairs also provide an opportunity to get in touch. Once contact has been made, the company is invited to an initial consultation which is both free and without obligation. The goal of this initial discussion is to establish what the objectives would be for a potential cooperative venture and how the budget and schedule might look. This is followed by contract negotiations, the signing of an agreement, and commencement of the research and development work.

### **5.** **HOW BIG DOES THE PROJECT HAVE TO BE?**

The scope and scale of cooperation with Fraunhofer is flexible, with the institutes catering to the specific needs of each particular client. Successful cooperation often begins with an entry-level project. But regardless of whether your project is large or small, you can be sure you will receive the same professional level of research and development services from Fraunhofer and its employees.

### **6.** **HOW MUCH DOES FRAUNHOFER CHARGE FOR R&D COOPERATION?**

The initial consultation phase is free of charge. Fraunhofer only starts charging for its research and development (R&D) work once the scope of the cooperation has been defined and the corresponding agreements have been finalized.

## 7.

### **DOES THE PARTNERSHIP END ONCE THE R&D PROJECT IS COMPLETED?**

After-sales service is an important aspect of customer satisfaction. Once the innovation has been launched, you can request specific information from the Fraunhofer Institute concerned to address your ongoing needs, for example in the form of staff training and development. Special Fraunhofer spin-offs can also help to lock in the technological support companies often need in larger-scale projects.

## 8.

### **WHO HOLDS THE RIGHTS TO THE DEVELOPMENT?**

Customers that embark on a cooperation project with Fraunhofer receive the rights to the products, prototypes and other material objects that are developed on their behalf. Customers also receive the rights they need to use the inventions, intellectual property rights and know-how generated by Fraunhofer in the course of the project. These rights and licenses are made available to the customer either non-exclusively or exclusively for the application that formed the basis of the contract research project.

Exclusive, application-specific rights of use give the customer optimum protection against competition. Outside the scope of this "customer zone", Fraunhofer reserves the opportunity to further develop and otherwise exploit its own know-how, inventions and intellectual property rights. This means all customers can benefit from the broad technological background that Fraunhofer brings to the table in all its cooperation projects.

## 9.

### **IS IT FEASIBLE FOR FRAUNHOFER TO COOPERATE WITH COMPETING COMPANIES? FOR EXAMPLE, WHAT HAPPENS TO THE KNOW-HOW A COMPANY SHARES WITH FRAUNHOFER DURING A COOPERATION PROJECT?**

Data and information from customers who use our services is always treated in the strictest confidentiality. Fraunhofer bases its work on the need-to-know principle: confidential customer information is passed only to those Fraunhofer staff who need it to carry out their specific project. We use separate facilities and closed-off laboratory areas wherever necessary to ensure confidentiality.

In some cases, competitors from the same industry deliberately choose to work with Fraunhofer in order to create an independent, pre-competitive environment that allows synergies to be exploited.

## 10.

### **ARE COOPERATION PROJECTS KEPT SECRET OR DOES FRAUNHOFER USE THEM FOR ADVERTISING PURPOSES?**

Fraunhofer only uses the name of a customer for its PR work if it has obtained the express consent of the customer in question. Otherwise, any information contained in project reports is edited to ensure the customer cannot be identified.

## 11.

### **IS FRAUNHOFER TECHNOLOGICALLY UP-TO-DATE?**

Yes. We always use the very latest, state-of-the-art technical equipment. And thanks to the close collaboration between Fraunhofer Institutes and universities we get access to the most recent developments in each field. Our international activities keep us in touch with the cutting-edge aspects of each field of technology – and of course, in many fields, the latest technological developments are being pioneered by Fraunhofer itself.

## 12.

### **FRAUNHOFER IS A PUBLIC SERVICE. WHAT DO PEOPLE IN THE PUBLIC SECTOR REALLY KNOW ABOUT THE CHALLENGES FACING BUSINESS AND INDUSTRY?**

Cooperation with companies is the bread and butter of Fraunhofer employees' work. They see it as their fundamental duty to ensure their work always focuses on practical applications. Thanks to their broad customer base, Fraunhofer researchers also have plenty of experience in how companies think and work and have been able to gain major insights into different corporate cultures. Many of our staff worked in industry before they joined Fraunhofer.

Fraunhofer research can best be compared to a company's outsourced research department, another environment where application of the results is the primary goal. And that is how we define ourselves at Fraunhofer, too: We work for businesses, and we help our customers transform knowledge into profit.

## 13.

### **DOES FRAUNHOFER HAVE ACCESS TO DEVELOPMENT GRANTS OR PUBLIC FUNDING?**

To a certain degree Fraunhofer can inject its own funds into future-relevant projects through the Fraunhofer-Zukunftstiftung (Fraunhofer Future Foundation). But what really interests our customers is the fact that many of the cooperation projects in which Fraunhofer plays a major part receive funding from the German state or the EU. An initial consultation with Fraunhofer can help customers sound out the concrete opportunities to work together on these kinds of projects.

## 14.

### **WHY DOES FRAUNHOFER WORK INTERNATIONALLY? DON'T YOU RUN THE RISK OF LOSING MONEY OR KNOW-HOW TO FOREIGN COUNTRIES?**

We apply the same principle of confidentiality internationally as we do nationally. We ensure that all our international research activities offer clear advantages to our customers and our sponsors. Working in international teams and dealing with global market requirements in projects abroad provides our researchers with invaluable experience – and that ultimately benefits our domestic customers, too.



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# HILTI

## PASS ME THE HILTI!

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Wherever there are holes to be drilled or screws to be fastened, a red Hilti tool case is never far away. Yet the company offers a whole lot more than just hammer drills and cordless screwdrivers. To move its business forward, Hilti often places its trust in the expertise of Fraunhofer researchers – especially when it comes to innovation. This collaboration has borne fruit in all kinds of areas, ranging from a new production layout for the manufacturing department to a distribution concept for the logistics department and an office concept for the company's new innovation center. We spoke to Executive Board member Dr. Stefan Nöken about the time he spent working at Fraunhofer and the future of the construction technology company.

**Innovation and research have been fundamental to Hilti's success ever since the company was founded. What led you to start working with Fraunhofer as a research partner?**

Innovation is one of the cornerstones of our corporate strategy; outstanding product, service and business model innovations are key to making our customers happy and ensuring the success of our business over the long term.

I have to admit to a certain bias when it comes to Fraunhofer, because I used to work for the Fraunhofer-Gesellschaft myself! I spent seven years working at the Institute for Production Technology IPT in Aachen. I decided to join the Fraunhofer-Gesellschaft after completing my studies because they give you opportunities to do work that is much more oriented towards industry requirements and practical applications than the work you could do at a university institute. I have never regretted my decision for a single moment!

I think the Fraunhofer model is fantastic because it produces the best possible combination of the two key sides of R&D: solid scientific research of the required depth and rigor coupled with high practical relevance and rapid implementation of results. This is vital if you are looking to solve the challenges companies face, which are inevitably of a concrete and highly practical nature – that's why you need the perfect balance of both aspects. Scientific thoroughness is not enough on its own. You also need the ability and resolve to put things into practice, and that's one of the key selling points the Fraunhofer-Gesellschaft and its institutes offer.

**Did you ever find yourself questioning whether Fraunhofer was the best choice?**

Not at all. I feel very strongly that successful innovations nowadays tend to emerge from networks. Today's new products and services are developed at ever shorter intervals, which means that the window of time in which you can maintain an innovation's competitive edge is far smaller than it was in the past. But at the same time the product solutions are much more technically challenging. For example, our hammer drills are not simply mechanical products any longer, but rather they are intelligent devices with electronic, mechatronic and software technology components and functions.

The only way to keep pace with this increasingly dynamic business environment is by working within innovation networks which we can draw upon as needed. We see the Fraunhofer-Gesellschaft as a solid component of our network and we collaborate with a great number of institutes on a whole host of different projects. Our network also encompasses various university institutes in Europe, Asia and the USA.

To sum up, it's not that we are exclusively tied to the Fraunhofer-Gesellschaft, it's just that Fraunhofer's unique approach achieves the perfect balance between basic research and industrial application.



### Which are the most successful and/or exciting projects you have worked on in collaboration with Fraunhofer?

We've been working with Fraunhofer Institutes on a whole series of projects recently – let me give you a couple of examples.

Over the last 12 months we have been developing an office concept for our new innovation center with the help of the Fraunhofer Institute for Industrial Engineering IAO. The primary goal of this innovation center is to bring all the functions involved in the development process together literally under one roof so as to further enhance the creativity, efficiency and effectiveness of our innovation projects. Fraunhofer IAO helped us to track down contemporary office concepts and then to adapt those concepts in very specific ways to match our needs. To give you a concrete example, we recorded and visualized the intensity of communications between the various different functions with the goal of increasing proximity at the points where that kind of proximity is really useful. That meant drawing up detailed plans of project spaces, time-out areas and communication zones, a process that ultimately led us to complete the transition from fixed, individual offices to more transparent, flexible and versatile office spaces. Fraunhofer IAO worked with us to develop this concept and proved to be a professional and dedicated partner throughout the entire process.

Another project we are working on with Fraunhofer IAO is focused on long-term trends in the construction industry. Essentially we asked ourselves: What will the construction industry look like in the year 2020? This question has enormous strategic relevance for us because we want to keep our customers satisfied over the long-term, too – and that means continuing to offer superior product, service and business model innovations. The outside-in perspective of the Fraunhofer IAO team was a tremendously valuable part of the process. We began by jointly mapping out major economic, social, political and technological trends, and then used them

as a basis to derive specific trends for the construction industry such as mobility, urbanization and ecology. From these we were able to derive even more focused trends that have a direct impact on our business and our solutions. These findings have been incorporated into our innovation roadmap and are already being put into practice.

Of course, we also work with Fraunhofer IPT in Aachen. We are a member of the tool and die making initiative, which provides a superb platform for learning and exchanging experiences. We definitely try to make the most of that!

### Are there any intercultural differences between business and research perspectives?

Not really, because ultimately researchers are also supporting the same overarching goal of doing successful business. You even see that enshrined in the original purpose of the Fraunhofer-Gesellschaft, that symbiosis of science and entrepreneurship. Obviously some differences do become apparent when you get down to practical everyday interactions. The scientific research community leans towards structure, analysis and inductive methods, while companies like us are often looking for pragmatism, speed and more of a deductive approach. But rather than focusing on the contradictions of those differences in perspective, I would rather define it as an opportunity to exploit potential to the full. Whatever you are working on, the secret is to find the right balance – and that is something that Fraunhofer excels at. In many instances, the people who work at Fraunhofer will have carried out similar projects at other companies. They know how dynamically the process can develop and they understand what industrial enterprises are looking for.

### What could Fraunhofer do better?

One aspect which I feel Fraunhofer could improve is the situation regarding contracts. Sometimes it can take months to get a contract signed. I understand that Fraunhofer needs to stake out its claims and ensure it retains rights to the results



## PROFILE: DR. STEFAN NÖKEN

“No other institution combines solid research work with the ability to achieve practical results quite as well as Fraunhofer does. I am as enthusiastic about Fraunhofer as ever.”

Since 2007, Dr. Stefan Nöken has been the Executive Board member responsible for business areas, the supply chain (comprising production, sourcing and logistics), and the field of corporate research and technology. After studying mechanical engineering at Aachen University, where he obtained his doctorate, he initially worked on a number of projects at the Fraunhofer Institute for Production Technology IPT in Aachen. He joined Hilti as Senior Vice President Corporate Engineering in 2000, and in 2004 he was made Executive Vice President Supply Chain Management. Stefan Nöken is a member of the Fraunhofer IPT Advisory Board and Vice President of the UNITECH International Society, a network of Europe's leading technology-focused universities.

## COOPERATION PARTNERS

### COMPANY

**Hilti Aktiengesellschaft, Schaan, Liechtenstein**

[www.hilti.com](http://www.hilti.com)

Employees: 20,000

Revenue: 3.9 billion Swiss francs (2010)

Portfolio: Drilling and demolition, direct fastening, screw fastening systems, anchoring systems, diamond cutting and coring, firestop and foam systems, installation and measuring systems, cordless devices and cutting tools for the professional construction industry

## RESEARCH

**Fraunhofer Institute for Industrial Engineering IAO, Stuttgart**

[www.iao.fraunhofer.de](http://www.iao.fraunhofer.de)

Employees: 340

Budget: 22 million euros

Research areas: Corporate development and work design, service and human resources management, engineering systems, information and communication technology, technology and innovation management

**Fraunhofer Institute for Manufacturing Engineering and Automation IPA, Stuttgart**

[www.ipa.fraunhofer.de](http://www.ipa.fraunhofer.de)

Employees: 600

Budget: 37 million euros

Research areas: Corporate management, surface technology and automation

**Fraunhofer Institute for Material Flow and Logistics IML, Dortmund**

[www.iml.fraunhofer.de](http://www.iml.fraunhofer.de)

Employees: 310

Budget: 21 million euros

Research areas: Material flow systems, enterprise logistics, logistics, traffic and environment

**Fraunhofer Institute for Production Technology IPT, Aachen**

[www.ipt.fraunhofer.de](http://www.ipt.fraunhofer.de)

Employees: 380

Budget: 23 million euros

Research areas: Life sciences engineering, turbomachines and aerospace, optics and optical systems, precision and micro technology, tool and die making

of its work, but it is also important to understand that companies want to ring-fence a certain degree of exclusivity for themselves. We want to make rapid progress in our projects, which is why we choose to work with Fraunhofer in the first place. But spending months honing the contractual agreements is neither in our interests nor indeed in Fraunhofer's interests, so I would like to see a more pragmatic approach in that area.

Nevertheless, I really must emphasize again that I am a huge fan of the Fraunhofer approach in general. The Fraunhofer-Gesellschaft is a model of success for everyone involved – for its customers, for its staff, and for both Germany and Europe as key centers of knowledge and innovation. The Fraunhofer-Gesellschaft offers employees a unique platform for personal development, which is another reason why it is such a fantastic model – and a model that I was able to benefit from, too.



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## **ROTH & RAU**

# **USING PLASMA TO ENHANCE SOLAR CELL EFFICIENCY**

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Plasma technology is the core business of the company Roth & Rau AG, specifically the development and production of systems for the plasma coating of different substrates in a vacuum. Coating systems for the photovoltaics industry are a key part of their portfolio, and this company from the town of Hohenstein-Ernstthal in Saxony is one of the world's leading suppliers in this field. But photovoltaics is not only a growth market and a dynamic creator of jobs. With global warming becoming an ever more prevalent concern, and the ready supply of fossil fuels diminishing, it is more important than ever to significantly expand the use of renewable energies. One of the key goals in the photovoltaics industry is to boost cell or module efficiency while simultaneously reducing manufacturing costs. To achieve this, Roth & Rau is working closely with various Fraunhofer Institutes.



Innovation has always been one of the driving forces at Roth & Rau. When the company was founded at the start of the 1990s, its main focus was the creation of systems for plasma technology based on the scientific know-how of the three founding members Silvia Roth, Dietmar Roth and Bernd Rau, but more recently the company's portfolio has been expanded to include solutions for manufacturing both crystalline and thin film solar cells. Research and development are much key to maintaining a leading position in the international photovoltaics (PV) market, which is why Roth & Rau has boosted its in-house research capacity, investing more than 24 million euros in 2010. At the same time, it increased its global R&D workforce from 33 to 109 employees, most of whom work in the company's technology center in Hohenstein-Ernstthal, which was inaugurated in April 2010. Fraunhofer research scientists and engineers are often found at this cutting-edge R&D facility – as an innovative company, Roth & Rau values cooperation and carries out joint projects with a variety of Fraunhofer Institutes in a number of technical fields.

### PILOT LINE FOR CRYSTALLINE SOLAR CELLS

One example of this cooperation is the production line that is operated in the technology center in collaboration with the Fraunhofer Institute for Ceramic Technologies and Systems IKTS. The pilot line features all the equipment required to process and characterize silicon wafer-based solar cells. With the support of the Fraunhofer researchers, Roth & Rau is aiming to achieve multiple objectives in this joint project, namely to produce new generations of equipment while simultaneously accelerating the development of the associated processes and technologies. The line is also intended as a means of demonstrating the capabilities of the company's systems and processes to customers.

Here, too, the number one priority is to boost the efficiency of the solar cells while reducing manufacturing costs – which is why the main focus is on further enhancing crystalline standard cell technology and developing manufacturing technologies for high-efficiency cells. The research partners hope to improve the passivation and metallization layers, develop new systems and processes for forming selective emitter structures and create an entirely new manufacturing technology based on the heterojunction concept.



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### **ANOTHER STRING TO THE COMPANY'S BOW: THIN FILM SOLAR CELLS**

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At the start of 2009, Roth & Rau AG's Management Board decided to enter the thin-film photovoltaics market, largely on the basis that thin film solar cells are cheaper to produce than crystalline silicon wafer-based solar cells. This is particularly true in the case of cadmium-telluride solar cells, which use glass as the substrate and cadmium-telluride as the photovoltaic active layer. A multi-stage process is used to apply different materials in thin films and arrange them in a way that establishes interconnections within the finished module. To help them carry out this challenging project, the company enlisted the help of the Fraunhofer Institute for Electron Beam and Plasma Technology FEP as a strategic partner. There was plenty to recommend this choice, including a well-established relationship and enough experience on joint projects to enable Roth & Rau to feel confident that Fraunhofer FEP had the resources to perform fast-paced research and development in this area. But the biggest draw was Fraunhofer FEP's experience in the various ways of depositing contact layers, as well as its general expertise and knowledge of vacuum evaporation system technologies. The project is funded by the Saxon State Ministry for Science and the Arts.

Over the course of 2010, the Fraunhofer FEP team worked with Roth & Rau to construct a complete pilot line. The broad outlines of this production line are as follows: First, a transparent conductor is deposited onto the glass substrate; next comes the simultaneous vapor deposition of the photovoltaic active layers of cadmium sulfide and telluride; and, finally, the metal contact is positioned on the rear of the solar cell. This means that complete cells can be manufactured, analyzed and optimized on the pilot line. Since each layer influences the other layers, the team of researchers is experimenting with varying the parameters of the individual layers in order to evaluate the arrangement as a whole. Their ultimate aim is to find an ideal solution that gives the thin film cell the highest possible efficiency, and their ambitious target is to reach an efficiency of somewhere between 15 and 18 percent by 2015.

To foster optimum and continuous knowledge transfer, four of Roth & Rau's employees are spending a period of time working directly on the pilot line at the institute. This enables them to discuss progress with the Fraunhofer researchers on a daily basis and test out their own developments.



## PROFILE: PROF. DR. SILVIA ROTH

"Photovoltaics is a fast-growing industry. Our goal is to consistently develop cutting-edge systems for our customers in order to contribute towards reducing costs and enhancing efficiency in solar cell production. The proven expertise of the Fraunhofer Institutes makes them the perfect partners to help us achieve this – especially when it comes to exploiting new technologies and making them marketable."

"At Roth & Rau, we greatly appreciate our collaboration with Fraunhofer researchers. As a global corporation, much of our success in the future depends on new impetus in research and development and well-established inspection and measurement methods."

Together with her husband Dr. Dietmar Roth and their college friend Dr. Bernd Rau, Prof. Dr. Silvia Roth founded the company Roth & Rau Oberflächen GmbH immediately after the reunification of Germany in 1990. The trio first got to know each other at what was then known as the "Technische Hochschule Karl-Marx-Stadt" (now the Chemnitz University of Technology) where Silvia Roth studied physics, majoring in solid state and plasma physics. Before embarking on her business career, she worked in teaching and research at the University. Silvia Roth has recently returned to these activities and has held the post of Honorary Professor of Industrial Photovoltaic Production at Zwickau University of Applied Sciences since 2009.

## COOPERATION PARTNERS

### COMPANY

#### **Roth & Rau AG**

[www.roth-rau.de](http://www.roth-rau.de)

Current workforce: approx. 1200 employees

2010E revenue: 285 million euros

### RESEARCH

#### **Fraunhofer Institute for Ceramic Technologies and Systems IKTS, Dresden**

[www.ikts.fraunhofer.de](http://www.ikts.fraunhofer.de)

Employees: 400

Budget: 22 million euros

Research areas: Development and application of modern advanced ceramic materials, development of industrial powder metallurgical technologies, and manufacturing of prototypical components

#### **Fraunhofer Institute for Electron Beam and Plasma Technology FEP, Dresden**

[www.fep.fraunhofer.de](http://www.fep.fraunhofer.de)

Employees: 130

Budget: 13 million euros

Research areas: Coating technologies, electron beam and plasma processes

#### **Fraunhofer Institute for Material and Beam Technology IWS, Dresden**

[www.iws.fraunhofer.de](http://www.iws.fraunhofer.de)

Employees: 249

Budget: 18 million euros

Research areas: Laser material processing, plasma coating processes, materials/nanotechnology, system technology, process simulation

#### **Fraunhofer Institute for Solar Energy Systems ISE, Freiburg**

[www.ise.fraunhofer.de](http://www.ise.fraunhofer.de)

Employees: 1000

Budget: 60 million euros

Research areas: Solar thermal systems, photovoltaics, hydrogen technology, energy-efficient buildings, applied optics and functional surfaces



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# FESTO

## GREAT PARTNERS

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Even in the throes of the economic crisis, Festo AG managed to establish new lines of business and maintain its workforce of 13,500 employees. The family-owned company is one of the world's leading suppliers in many fields of pneumatic and electrical automation technology. It offers comprehensive manufacturing solutions from a single source that span the entire process, from initial ideas to finished products. Innovation is a key part of Festo AG's business: The company launches some 100 new products a year, spends 9.5 percent of its sales revenue on research and development, and holds 2900 patents worldwide. In collaboration with Fraunhofer, it has been working on developing new product development solutions such as the "elephant's trunk", which recently received the German Future Prize. This agile and sensitive robot arm is a high-tech helper for industry and the home. Gripping and handling technologies that mimic biology represent an innovative new approach in automation engineering. We interviewed Dr. Eberhard Veit, CEO, Festo AG.

### How did you end up working with Fraunhofer?

I spent some time as a working student at Fraunhofer, where I wrote my research papers and thesis. Fraunhofer is the largest organization for applied research in Europe, and those are the kinds of strong partners Festo needs to maintain its position as a leading innovator in the field of automation technology. Our collaboration with Fraunhofer is a key part of our efforts to gear up our development of new products and processes. We also cooperate in the very important field of training and development – some of our staff are working at Fraunhofer in this field and we have Fraunhofer people working at our sites, too.

### What are the key benefits of choosing Fraunhofer as a research partner?

Well, technological and scientific excellence for a start, as well as many years of excellent and extensive cooperation on all sorts of different projects. We know that we can rely on Fraunhofer's skills and expertise. We know how to build on that to take our innovations to the next level, and we have already successfully brought the results of several joint projects to market. We also work together in large networks; indeed, collaboration in clusters is a real feature of the south-west of Germany. They include Fraunhofer's Digital Production innovation cluster in Stuttgart, and collaborative projects – not to mention an increasing number of European projects.

### One recent piece of good news was that the team of Festo and Fraunhofer employees had won the German Future Prize, worth 250,000 euros. What technical problems did they have to solve in collaboration with Fraunhofer?

The two research and development departments mutually inspired each other and developed a fantastic product: a sophisticated high-tech helper for industry and the home in the form of a bionic handling assistant that mimics an elephant's trunk. I have great respect for this shared enthusiasm in the field of bionics research because it is encouraging us to derive new product concepts from biological models. The challenge was to design a handling assistant that was extremely flexible and lightweight, and, most importantly, that could work together with humans completely safely. We achieved this by developing a synthetic trunk-like system that is driven by compressed air and that expands and contracts like an accordion. It is only since the development of the innovative technology of additive manufacturing that we have been able to render such complex structures from nature with near-perfect precision. The trunk's components are created directly from the design data; they are constructed layer by layer from fine polyamide powder in a process similar to that of a printer, but in three dimensions.



#### How did the collaborative approach work in practice?

The first milestone was the project assignment we gave to the Fraunhofer Institute for Manufacturing Engineering and Automation IPA, the goal of which was to design products based on additive technologies. We then worked with Fraunhofer to jointly establish the German rapid manufacturing platform in 2008. We felt it was important to focus not only on the final product, but also on the path we would be taking to reach that destination, so the manufacturing process took shape in parallel to the creation of the handling assistant itself. The development of the bellows-style design was completed by mid-2009, and Fraunhofer then optimized this structure using simulations that enable us to use the bellows as a pneumatic drive in the project. It was that step that allowed us to meet the project's particular manufacturing requirements. We were then able to combine all that know-how and exchange ideas and patents with Fraunhofer and other development partners. And, ultimately, that led to our presentation of the bionic gripper we called the FinGripper at the HANNOVER MESSE in 2009, and the launch of the entire system one year later. The end result of this development process is a completely new actuator system for the field of automation technology.

#### You have already completed numerous other joint projects, one example being the "Festo Fast Factory" project which you carried out with Fraunhofer IPA.

##### What were the results of that project?

We have to respond very rapidly to customer inquiries, which is one of the reasons we worked with Fraunhofer to develop our three-dimensional printing technology for hardware. The "Festo Fast Factory" allows complex products to be manufactured directly from CAD data, with no need for any other

tools – which means we can have the product in our hands during discussions with the customer rather than just in drawings; we can try it out, modify it and test it. That reduces costs and eliminates the delays that stem from the need to create tools. That in turn makes us faster than our competitors, and our customers benefit from the ability to order online and have their product manufactured from one day to the next. This development has already gained worldwide recognition.

#### What impact did the research results have on your business policy?

We are a technology-driven company, so one of the key objectives in our sustainability-focused strategic approach is to actively and systematically identify future technologies. That means new technologies and processes are embedded in our corporate strategy. For example, we gained a real competitive edge by analyzing and improving the way in which we collaborate with customers – which saw us picking up on the trend for short-run manufacturing and pushing forward with mass customization. Another example is how we began actively investigating the opportunities posed by additive manufacturing back in the mid-1990s: Now, with Fraunhofer as a partner, we have succeeded in getting the results we were looking for – results that will play a key role in defining the manufacturing processes of the future both for us and for companies everywhere.

In addition, in 2007 we commissioned the Fraunhofer Institute for Industrial Engineering IAO to carry out a study to investigate the future of manufacturing engineering by examining the technological, economic, technological and social trends that Festo would be facing, such as the trend towards faster, more flexible production and the increasing importance of energy efficiency. We incorporated the results of the scenarios identified by Fraunhofer IAO into our Corporate Strategy 2015.



**In terms of finding ways out of the economic crisis, has your cooperation with Fraunhofer given that process new impetus?**

We used the economic crisis as a breathing space to re-shape some of our fundamentals and to put our heads together with Fraunhofer to jointly debate questions such as how to usefully apply bionics to the field of automation technology. Our cooperation with Fraunhofer gave us a massive boost, and we also increased our expenditure on research and development to 9.5 percent of sales revenue. Now that we have come through the crisis, we can engage with customers who are once again ready to make investments and offer them completely new concepts and new technologies.

**What research projects are you planning?**

Festo will be looking to draw on Fraunhofer's strengths in the future, too. We are familiar with Fraunhofer's main areas of research and expertise, and each year new topics come up that influence us and that serve to ramp up our cooperation – for example the field of energy efficiency.

In addition, I am particularly interested in working with Fraunhofer to increase the proportion of young people and women entering technical professions. Fraunhofer and Festo have an outstanding reputation and stature; that is something we should be exploiting, working together to get more people interested in technology. Technology should not just be designed for men by men. We need to be encouraging women to inject their ideas and specific needs into future technologies and innovations.

**PROFILE: DR. EBERHARD VEIT**

"We know that we can rely on Fraunhofer's skills and expertise. We know how to build on that to take our innovations to the next level."

Dr. Eberhard Veit has been on the Management Board of Festo AG & Co. KG and responsible for product and technology management since 1997. He was appointed Spokesman of the Management Board in 2003 and Chairman of the Management Board in 2008. He also works as a guest lecturer at various universities and has a seat on numerous management and supervisory boards, including the Board of the German Engineering Federation VDMA.

**COOPERATION PARTNERS**

**COMPANY**

**Festo AG & Co. KG, Esslingen**

[www.festo.com](http://www.festo.com)

Employees: 13,500

Revenue: 1.75 billion euros

Portfolio: Pneumatic and electrical automation technology, industrial training and development, consulting

**RESEARCH**

**Fraunhofer Institute for Industrial Engineering IAO, Stuttgart**

[www.iao.fraunhofer.de](http://www.iao.fraunhofer.de)

Employees: 340

Budget: 22 million euros

Research areas: Corporate development and work design, service and human resources management, engineering systems, information and communication technology, technology and innovation management

**Fraunhofer Institute for Manufacturing Engineering and Automation IPA, Stuttgart**

[www.ipa.fraunhofer.de](http://www.ipa.fraunhofer.de)

Employees: 600

Budget: 37 million euros

Research areas: Corporate management, surface technology and automation

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# CLEANDIESEL CERAMICS

## GETTING A SQUARE PEG INTO A ROUND HOLE

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**Diesel soot is rated as highly carcinogenic, which is why particulate filters have long been standard equipment in diesel passenger cars. Buses, construction machinery and ships will all now have to follow suit to meet the latest EU emissions standards – and that is where the medium-sized German company CleanDieselCeramics GmbH (CDC) has found a market niche. Fraunhofer researchers developed an inexpensive material for the ceramic filters together with a design that can be flexibly tailored to different types of engine.**

“This is our mixer, which was specially built. The mixture goes in our special oven over there.” What Dr. Thomas Rahn is describing with visible pride is not a bakery, but rather the production hall of the company CleanDieselCeramics GmbH, where he holds the position of Managing Director. This manufacturing facility in Grossröhrsdorf near Dresden produces diesel particulate filters for non-road applications such as construction machinery, forklift trucks, ships and rail vehicles, as well as for commercial vehicles.

The aim of the new emissions standards that come into force in 2011 is to cut particulate emissions by a further 90 percent from the level permitted under current regulations. Retrofitting is clearly a worthwhile option for machines that are expensive to purchase and have a long service life, and ceramic filters are already available for heavy-duty engines. The leading suppliers both in this market and in the passenger car market are Japanese companies – but the basic shape of their filters for highly specialized engines is the same as their passenger car filters, namely a square. This has a major disadvantage: In order to fit the square filters into the round pipes, some 20 percent of the material has to be cut away using expensive diamond cutting tools.

### **FINDING A NICHE: FILTERS FOR CONSTRUCTION MACHINERY AND COMMERCIAL VEHICLES**

Jörg Adler and Dr. Reinhard Lenk from the Fraunhofer Institute for Ceramic Technologies and Systems IKTS in Dresden figured that there had to be a better way. Based on a material patented at Fraunhofer IKTS – a porous silicon carbide ceramic – they worked together with the HUSS Group to develop highly efficient ceramic diesel particulate filters for non-road applications. “We compete with some huge players in the automotive supplier market who can easily snap up vital contracts from right under our noses. They have all ploughed into the automotive market segment, but with more of a focus on relatively small filters in massive quantities. Nobody has really been thinking about construction machinery and commercial vehicles.”





The differences are certainly significant: A car maker might easily produce half a million vehicles of a certain type each year, while a commercial vehicle manufacturer might produce 60,000 and a construction machinery manufacturer perhaps just 3000. These small annual quantities offer little interest or profit for the large, automotive-focused particulate filter manufacturers. “We saw a gap in the market which basically involved developing a cost-effective manufacturing process that also works for small and medium-scale quantities.”

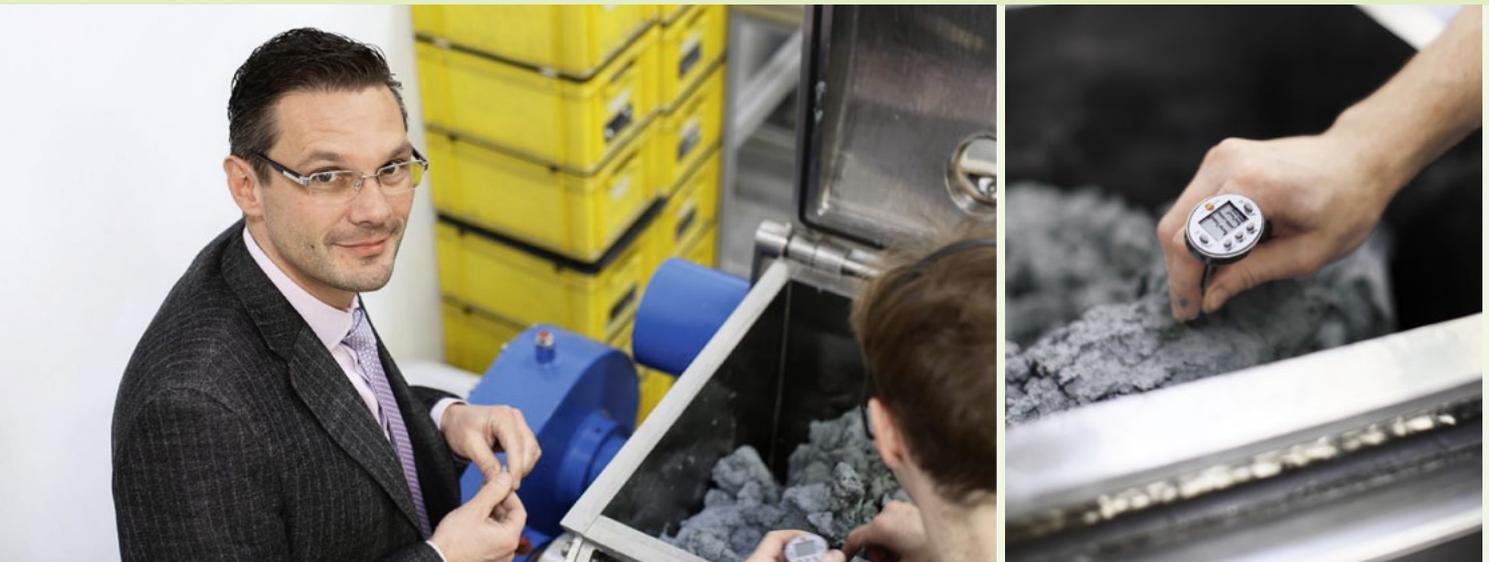
Dr. Thomas Rahn and the researchers from Fraunhofer IKTS, Jörg Adler and Dr. Reinhard Lenk, have known each other for a long time. “Ceramic components are central to particulate filters, so it was clear from the start that we would need Fraunhofer IKTS to work on them with us. The experts there knew how to create a mixture of liquid phase sintered silicon carbide (LPS-SiC), but we had never produced a diesel particulate filter of this kind from the mixture”, says Rahn.

One of the most interesting things about particulate filters is that they bring together things that seem almost irreconcilable. Inserting a particulate filter in a vehicle’s exhaust system is a little bit like deliberately blocking up a moped’s exhaust pipe: You would feel the back pressure, and that is not something that engines tolerate well. But if you want to filter out as many nanoscale particles as possible, you need a fine filter that produces high back pressure. A particulate filter made from ceramic – especially silicon carbide – is highly porous, so this is a solution that provides superb filtration performance while simultaneously reducing the strain on the vehicle. “We can rightly claim to filter out 99.9 percent of the harmful particles. And when it comes to thermal expansion, thermal conductivity and the ability to withstand changes in temperature, silicon carbide really is the best of the batch. It outperforms any other ceramic or metallic materials”, Rahn explains.



Even though the raw materials are comparatively inexpensive and can be processed at low temperatures, it is still far from simple to produce particulate filters from silicon carbide. The team had to specially tailor the material to the application by changing the size, distribution and volume of its pores. “We spent ages trying to decide on the best basic shape for a filter component to maximize the ability to compose different shapes and sizes”, says Jörg Adler. What they came up with was a right-angled trapezium which allows rectangular, hexagonal, oval or circular surfaces to be pieced together without any wastage. The channels in the segments are triangular, not square, which gives a larger filter area.

Once the material and shape had been defined, the team’s next task was to develop a manufacturing method suitable for mass production – which proved to be the biggest challenge of all. The fact that at first the ceramic exhaust component always came out of the machine bent gave everybody sleepless nights, as Thomas Rahn recalls: “There was so much energy involved that the ceramic component was always being bent out of shape. But I had to take a commercial decision to move us forward, even though the backend had not gotten very far at all with the development process.” He pinned his hopes on a new technology – a ram-type extrusion press – and to everyone’s delight the material was soon coming out of the machine much more smoothly and completely straight.



## **AN IDEA THAT MORPHED INTO A PATENT, A PROJECT, A PRODUCT, AND A PROCESS**

This project proved to be a good example of how the industry and research communities can work together closely and rapidly. The first meeting took place in 2005 and a joint research agreement was signed. “We knew the market, we were able to precisely define the niche, we had some idea of scales, and we showed the determination to implement that in an industrial context”, Rahn sums up. Production in the new plant got underway in May 2008. “We were still developing things and were not entirely sure how to configure one of the process steps, but the point had come where we had to order machines for our large-scale facility. The idea morphed into a patent, a project, a product, and a process – and in the end we implemented it on an industrial scale”, he adds.

Working together with the Fraunhofer researchers, the CDC team tested and harmonized all the various steps on a pilot production line at the institute, from the manufacture of the material and the forming of the individual segments right through to the firing and sintering processes. Rahn recalls how things started: “We were able to build the initial prototypes, the first filters, at Fraunhofer IKTS. Once it was clear that production would be taking place in Grossröhrsdorf, we hired staff and sent them to work at the institute in Dresden for six months, after which time they could bring their know-how into our own production hall.” Rahn explains how the project was also a shining example of how the state should carry out its incentives policy, since the money that was invested in the research eventually gave rise to real jobs. “The simultaneous development of the product and the production process went amazingly quickly. We were producing saleable filters from the day the development project was completed”, Rahn enthuses.



### PROFILE: DR. THOMAS RAHN

“The simultaneous development of the product and the production process went amazingly quickly. We were producing saleable filters from the day the development project was completed.”

Thomas Rahn, born in 1970, studied economics with a major in commercial and company law, marketing and human resources at the University of Bamberg. He subsequently obtained his doctorate in the field of economics with the development of an indicator tool for assessing the sustainability of medium-sized companies in a turnaround situation.

Rahn began his career in 1997 as a Management Assistant at UNICOR Holding AG (Germany), where he subsequently took charge of the central departments of human resources, marketing and IT. Between 1999 and 2003, he worked as an Area Manager at Uponor Oyj (Finland), where he was responsible for sales and production in Central Europe. From 2003 he became self-employed, taking on the role of managing partner at HUSS Umwelttechnik (Germany), and in 2008 he became the CEO and President of the HUSS Group (Switzerland).

### COOPERATION PARTNERS

#### COMPANY

**CleanDieselCeramics GmbH (CDC), Grossröhrsdorf**

[www.hussgroup.com](http://www.hussgroup.com)

Employees: 35

Revenue: 2 million euros

Portfolio: Development and production of diesel particulate filters made from liquid-phase sintered silicon carbide (LPS-SiC)

#### RESEARCH

**Fraunhofer Institute for Ceramic Technologies and Systems IKTS, Dresden**

[www.ikts.fraunhofer.de](http://www.ikts.fraunhofer.de)

Employees: 400

Budget: 22 million euros

Research areas: Development and application of modern advanced ceramic materials, development of industrial powder metallurgical technologies, and manufacturing of prototypical components

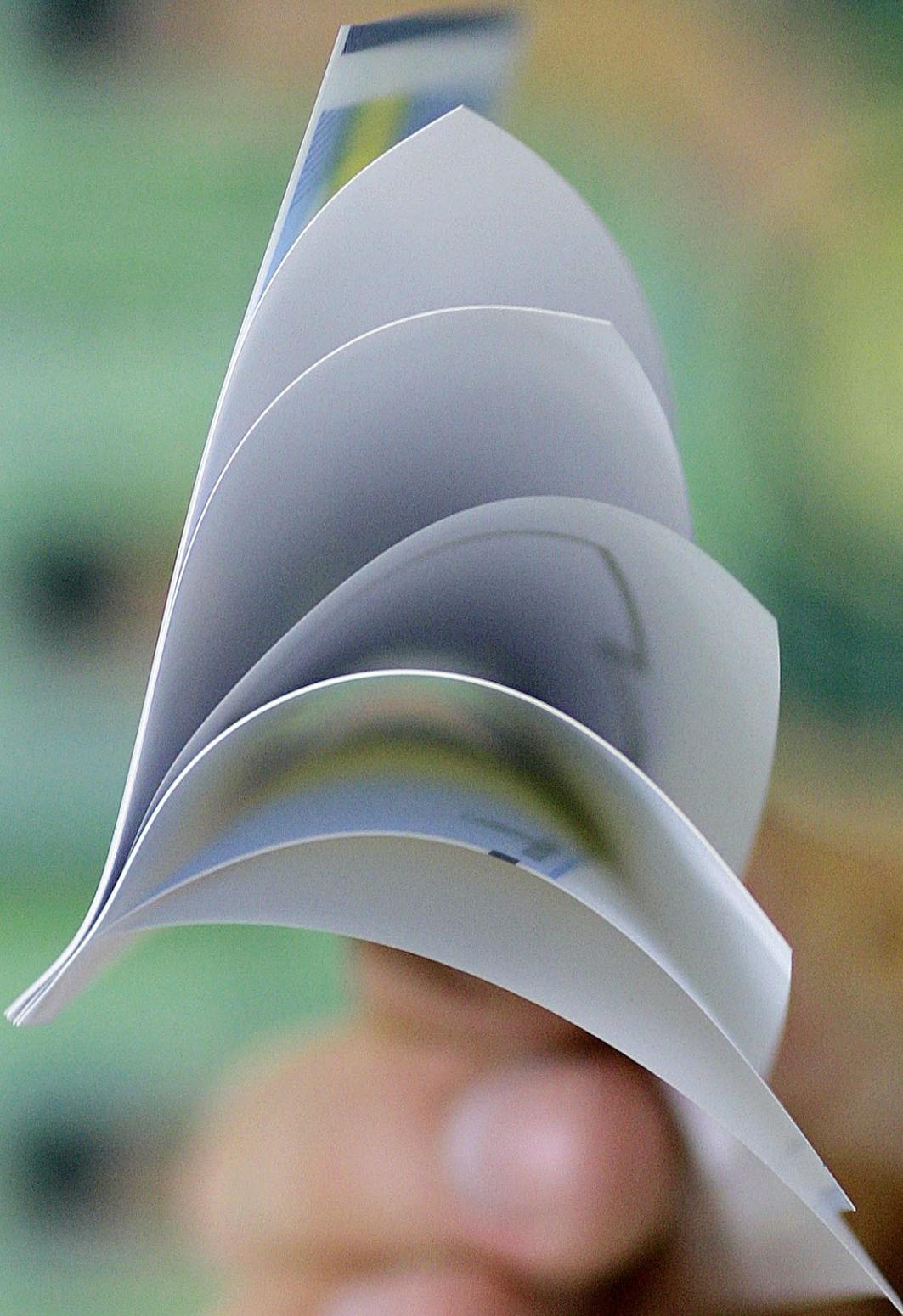
The partners are still working together closely. In a follow-on project CDC and Fraunhofer IKTS investigated how to remove the soot from diesel particulate filters once it had been collected. They determined that the soot would have to be combusted and that they would need to choose a filter coating that would automatically trigger regeneration through a chemical reaction. The challenge for the research team was to find a coating that required little or no precious metal. Vehicle manufacturing typically makes use of platinum and palladium, scarce raw materials that are correspondingly expensive.

Although the researchers were familiar with coatings that oxidize soot even without containing precious metals, the problem was reaching the temperature required to make the particles combust spontaneously. “We managed to develop a coating that is free of precious metals and apply it to the filter”, says Rahn, “but unfortunately we haven’t been able to reach the desired soot ignition temperature.” He nevertheless considers the project a success because the research team came up with a mixture that reduces the precious metal proportion by 50 percent – an approach that the CDC and Fraunhofer IKTS dream team will be pursuing further. “Fraunhofer proved to be such a good partner that we will undoubtedly be working with them on more projects. I am sure we will be drawing on their expertise in the future”, Rahn says.

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**BUNDESDRUCKEREI**  
**SECURE IDENTITY**

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**Communication over the Internet has become a staple of our personal and professional lives. This has turned the theft and abuse of data into a significant issue, with the public becoming increasingly unsettled by security breaches and understandably worried about their personal data. Only if people are confident that their personal identity data are secure will they trust online services that use such data to simplify procedures. This is why it is so important that people's identities are translated into the digital world securely and that data transfers are protected. At the same time, it is essential to safeguard people's right to privacy concerning personal information.**

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### **SECURE ID SYSTEMS FROM A SINGLE SOURCE**

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Bundesdruckerei GmbH is one of the world's leading companies engaged in offering complete, customized solutions in the field of identification systems. As well as passport and ID card systems, the company provides national and international customers with ID documents, high-security cards, document verification hardware, security software and trust center services. Bundesdruckerei also produces banknotes, postage and revenue stamps as well as electronic publications.

In the Fraunhofer Secure Identity Berlin-Brandenburg innovation cluster, Bundesdruckerei works together with five Fraunhofer Institutes, five universities and twelve private sector companies. Joint projects are underway to develop technologies, processes and products to make the identification of people, objects and intellectual property clearer and more unambiguous. These include counterfeit-proof personal identification documents and secure electronic business processes. The cluster's research work also focuses heavily on protection against trademark piracy and communication between individuals and machines.



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## SPECIAL LABORATORIES FOSTER COOPERATION

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Back in July 2007, the Fraunhofer Institute for Reliability and Microintegration IZM and Bundesdruckerei jointly inaugurated the first German laboratory for high security applications – known as the SecurityLab – in Berlin. The aim of the laboratory is to integrate flexible chips in ID security documents and to develop new technologies and security methods. Bundesdruckerei is incorporating its expertise in ID documents into the project to supplement the Fraunhofer IZM experts' knowledge of highly complex and heavily minimized electronics applications. Their successful cooperation has already produced a means of embedding ultra-thin chips in paper-based products.

Bundesdruckerei also collaborates with the Fraunhofer Institute for Open Communication Systems FOKUS in Berlin in their jointly founded Secure eidentity Lab, where researchers are working on new applications and methods for protecting digital identities in commercial and public authority processes. The Lab focuses in particular on developing innovative solutions for user-oriented identity and access management.

One of the key goals of this collaborative work is to establish practical scenarios in the laboratory based on a process-oriented and service-oriented identity infrastructure.

The Fraunhofer Institute for Applied Polymer Research IAP has been carrying out collaborative research with Bundesdruckerei in their joint SecurityLab in Potsdam since 2008. The lab partners focus on analyzing new kinds of materials and checking their suitability for practical applications and security features. Fraunhofer IAP specializes in new materials with special optical or electrical properties, and these can be integrated in ID documents to help prevent counterfeiting. Among other things, the lab team is currently working on new security features such as polymer-based inks and ultra-thin OLED displays.

Bundesdruckerei and the Fraunhofer Institute for Production Systems and Design Technology IPK have spent many years working together on methods of enhancing document security. Based on their successful collaboration, the two partners decided to open a joint Secure Verification Lab in Berlin to promote security standards. This laboratory has already developed a largely automated method of authenticating



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**JENOPTIK**

**A SHARED JOURNEY INTO THE  
"CENTURY OF LIGHT"**

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Photonics is a key technology that plays an increasingly significant role in almost all areas of technology and has a powerful leverage effect on other sectors of the economy. JENOPTIK and Fraunhofer have successfully worked together for many years on a range of projects and cooperative ventures. An interview with Dr. Michael Mertin, CEO of JENOPTIK AG.

**You used to run a working group at the Fraunhofer Institute for Laser Technology ILT in Aachen. In your career since then, how useful has it been to be familiar with both sides, in other words, with both research and industry?**

It's been very useful indeed, and it was a deliberate decision on my part which I hoped would provide me with a greater insight into the professional industrial scene. What attracted me to Fraunhofer is what attracts many people – namely those close ties between physicists, engineers, industry and universities.

**You obtained your doctorate in laser material processing and surface technologies, which was very much a fledgling field at that time. Why is it that knowledge transfer works so well in this field?**

One major reason is that there are such clear requirements, specifications and objectives for lasers and laser-based material processing in industry. Researchers and companies take much the same view of future applications and the competitive edge these will provide. Besides obviously spurring on research, it means there is plenty of money and willingness to invest in these topics.

**According to the trendence Absolventenbarometer, JENOPTIK and Fraunhofer both rank among the 100 most popular employers in the eyes of engineering graduates. What are the key reasons for these positive rankings in your view?**

It is fantastic to be on that list, and the most obvious answer is that it comes down to an attractive working environment that offers interesting projects and career opportunities. Fraunhofer engages with trends that are clearly important for the future, and this is reflected in the corresponding models for long-term success that you see in many of the institutes; they make it clear that Fraunhofer is in it for the long haul. I hope that people see our company in a similar light. And perhaps it also stems from a deliberate attempt to create bonds with universities and the fact that we value what graduates have to offer. People appreciate that. I think that way of thinking is something that our company shares with Fraunhofer.

**Give us an idea of how cooperation in joint research projects actually works: How do you coordinate people's individual skills and combine them efficiently?**

It is fairly simple if you keep everything fairly close-knit, and if people can coordinate things among themselves on a rapid and informal basis. Joint projects thrive on substantive cooperation, on cooperation between individuals. Jena's "optical valley" provides a superb environment for these projects to succeed, not only since we are located close together but also because we are interlinked by all sorts of different groups and committees. That creates transparency and trust and in many cases helps you get things done faster. Whatever the formal aspects of these joint projects, the key to success is essentially that.



### How important is it for industrial manufacturing that we keep improving laser technologies?

Very, very important. Laser technology gives us completely new and much more cost-effective production processes. Innovations in the field of laser technology are always striving to be faster, better, more advanced and more efficient. Laser technology today is making inroads into areas that were previously the sole domain of other technologies. Fraunhofer ILT, Fraunhofer IOF and Fraunhofer IWS are right at the forefront of these developments, and that is why these three institutes and their innovations are so important to us.

### How important is interdisciplinary cooperation in the field of photonics? Can you give us any examples?

Well, one example is this: If you get a physicist to make a laser rangefinder, it will cost maybe 1000 euros to manufacture and will break the first time you drop it. But all that changes if you turn it into an interdisciplinary design process involving physicists, product managers and engineers – who are familiar with the production process and who know how to optimize the housing and the systems while reducing the costs. That's exactly the kind of cross-fertilization of ideas which really creates synergies. And that's why I like the fact that Fraunhofer organizes itself according to thematic areas and gives each institute an interdisciplinary team rather than just recruiting people from a single occupational group. It's something that we should continue to put thought into in the future: not only bringing together physicists, engineers, biologists and chemists, but also bringing product management and marketing into the equation.

### Is it easier to get development subsidies when you are working in partnerships? Do you think the conditions for getting that kind of funding need to be improved?

One thing that people are realizing is that you shouldn't do something just because it is eligible for funding. You should only be drawing on subsidies if your company or research institute is genuinely moving in that direction. I see the way

subsidies are set aside to fund projects in Germany as very positive; I think it works well and is being steered in the right direction by the committees of experts. You have some very sensible people involved who see these options as a tool for developing the German economy. I'm very much in favor of continuing with project-based research subsidies rather than adopting the scattergun approach of tax-based subsidies.

### The Jena site is famous all over the world for optics and optical technologies. What is the secret to marketing a location successfully?

In Jena we really took the change process into our own hands. Twenty years after German reunification, this city is ranked 15th in the German "Zukunftsatlas" [an annual report that examines regions' ability to cope with future economic challenges], and you only attain that kind of position by viewing change as an opportunity rather than keeping your head in the sand. We have to constantly demonstrate this courage in all sorts of areas in Germany, and Fraunhofer is one institution that is helping to do that. I am convinced that what people have achieved in Jena is, unfortunately, fairly unusual and something that we should be learning from in Germany.

### What are the chances that the German photonics industry can beat its international competitors?

We are certainly not lacking in creativity or a spirit of innovation and – at least at the moment – there is no shortage of skilled staff, but what we are short of is products. The small and medium-sized companies are either OEM and component suppliers for larger companies around the world, or they make production equipment for third parties. That means it makes sense for these companies – and for the photonics industry as a whole – to have a certain critical size in the international marketplace. We also need certain critical and supercritical structures to protect innovation and drive it forward, to keep German innovation in the lead over the long term.



### PROFILE: DR. MICHAEL MERTIN

“We need to be more courageous when it comes to transforming research into innovations.”

Dr. Michael Mertin is the President and CEO of JENOPTIK AG. After studying physics at RWTH Aachen University, he obtained his doctorate in engineering at the Fraunhofer Institute for Laser Technology ILT, where he also led the “Optical Coating Technology and Microstructures” working group. After successfully completing his doctorate, he joined Carl Zeiss and spent ten years there in various management roles. Michael Mertin joined JENOPTIK’s Executive Board in 2006 and has been the Chairman of the Executive Board since 2007.

### COOPERATION PARTNERS

#### COMPANY

#### JENOPTIK AG, Jena

[www.jenoptik.com](http://www.jenoptik.com)

Employees: approx. 3000

Revenue: approx. 500 million euros

Portfolio: Optoelectronics group divided into five divisions:

Lasers & Material Processing, Optical Systems, Industrial Metrology, Traffic Solutions, Defense & Civil Systems

#### RESEARCH

#### Fraunhofer Institute for Applied Optics and Precision Engineering IOF, Jena

[www.iof.fraunhofer.de](http://www.iof.fraunhofer.de)

Employees: 247

Budget: 18 million euros

Research areas: Optical coatings, optical systems, microoptical systems, precision engineering

#### Fraunhofer Institute for Laser Technology ILT, Aachen

[www.ilt.fraunhofer.de](http://www.ilt.fraunhofer.de)

Employees: 357

Budget: 23 million euros

Research areas: Lasers and optics, laser material processing, medical technology and biophotonics, laser measurement technology

#### Fraunhofer Institute for Material and Beam Technology IWS, Dresden

[www.iws.fraunhofer.de](http://www.iws.fraunhofer.de)

Employees: 249

Budget: 18 million euros

Research areas: Laser material processing, plasma coating processes, materials/nanotechnology, system technology, process simulation

#### Fraunhofer Group for Light & Surfaces

[www.light-and-surfaces.fraunhofer.de](http://www.light-and-surfaces.fraunhofer.de)

Research areas: Surface and coating technologies, beam sources, micro and nano technology, materials processing, opto-mechanical precision systems, optical measuring techniques

### Why is networking so important to small and medium-sized companies?

It is always a good idea to become part of clusters, establish a joint international presence, and even to intelligently divide up value-adding activities at certain points. In other words, not only does cooperation bring international success, it also means you and your partners add more value overall.

### Experts say that we have so far only exploited between 10 and 20 percent of the technical potential of photonics. What kinds of photonics solutions lie ahead?

People are saying that photonics and optoelectronics are set to become a natural, integral part of many areas of our lives –

and in fact this is already happening right under our noses. It is impossible to imagine how aircraft, cars, and many other of today’s technologically sophisticated devices and instruments could function without optical technologies. Using light as an engineering tool will soon seem as natural as the way we use electricity. Just look at the LED lamps of the future – not only will they be a source of light, they will also use light shaping techniques as a matter of course. Light will enable us to reach a whole new level of comfort and style in our homes. Photonic technology may seem tremendously high-tech at the moment, but the more suitable it becomes for everyday use, the more it will simply become a backdrop that we hardly notice – just a normal part of our daily lives.



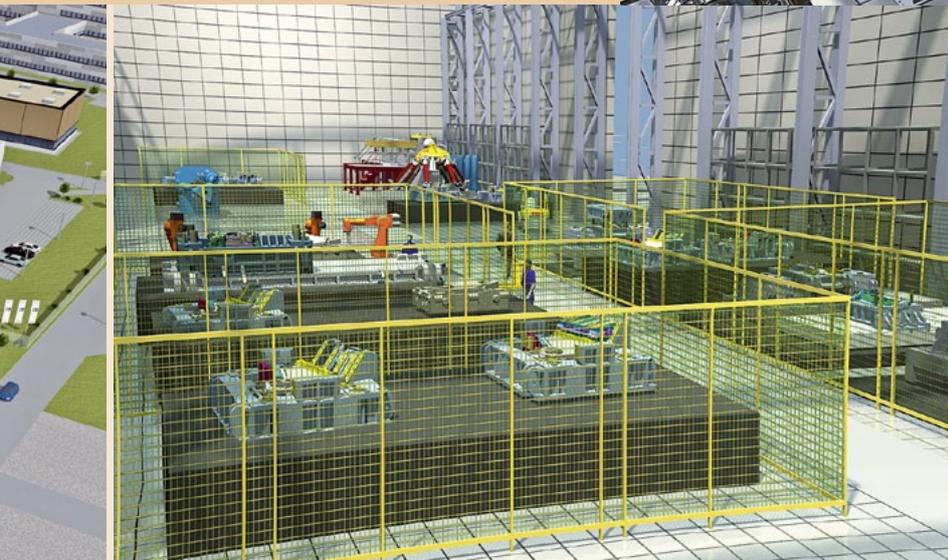
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## **VOLKSWAGEN**

# **MOBILITY MADE IN GERMANY**

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Volkswagen is at the forefront of the automotive industry. The company employs 8800 highly qualified staff in the field of research and development at its headquarters in Wolfsburg alone – a site that has a total workforce of 50,000. Its R&D activities are focused on developing innovative, safe and reliable products. However, Volkswagen is also running an increasing number of research projects squarely aimed at enhancing its production operations, something the company hopes will spur the development of highly effective production systems that conserve resources and help protect the environment. Researchers from Volkswagen and Fraunhofer have been successfully working together on a number of joint projects in this area.



“To successfully attain your goals, you have to seek out suitable allies and work through the challenges you face one at a time”, says Professor Jochem Heizmann. “As a carmaker, we know that we cannot work in isolation to drive forward the kind of technical innovation we need to keep our competitive edge. The industry is changing fast, which is why efficient technologies have such an important role to play in giving companies an advantage over their global competitors. We are facing a time of radical technological change. High-risk phases like this can best be handled with the help of reliable and experienced partners. That’s where the Fraunhofer researchers come in: Their wealth of ideas and superb research skills will help us cope with the challenges that lie ahead – just as they have helped us jointly implement so many innovative processes and products in the past.”

Saxony is one of the birthplaces of the German auto industry. Cars have been built here for more than 100 years under prestigious names such as Horch, Audi, DKW and Wanderer. The founding of Volkswagen Sachsen GmbH at the Chemnitz and Zwickau sites at the beginning of the 1990s was a result of Volkswagen’s determination to continue this tradition, and Golfs and Passats now roll off the production lines in Zwickau on a daily basis. Fraunhofer also set up shop in Saxony soon after the reunification of Germany, integrating research insti-

tutes that offered top-notch scientific expertise in the region. Since then, Volkswagen and Fraunhofer have carried out a series of successful research projects in Saxony designed to shape the future of the automotive industry. Much of the partners’ success is credited to employees who draw on their creativity, superb craftsmanship and team spirit to produce high-quality vehicles. Researchers from the Fraunhofer Institute for Machine Tools and Forming Technology IWU in Chemnitz and Dresden have worked with Volkswagen AG staff on a whole series of joint research and development projects in the field of production engineering. The Fraunhofer IWU Advisory Board has included executives from Volkswagen AG right from the very beginning, and the position of Advisory Board Chairman has been held by Jochem Heizmann since 2007.

The first major joint project – the Mechanical Engineering and Automotive Initiative Next Economy (MAINE) research association – was set up at the initiative of the Saxon State Ministry of Economic Affairs, Labour and Transport, the Volkswagen Group and Fraunhofer IWU. The association is made up of a number of Volkswagen plants, automotive suppliers and engineering companies. They have been working together since 2002 on developing and testing new manufacturing and information technologies in the fields of engine and car body manu-

facturing, and their goal is to sustainably increase the economy and quality of both products and processes in order to boost the competitiveness of the companies involved. Under the leadership of Volkswagen Sachsen GmbH and coordinated by Fraunhofer IWU, more than 30 companies have already participated in MAINE projects. The results have included solutions for clean engine production, the development of lightweight construction components for the body and powertrain, and the optimization of laser welding processes in car body construction. Current projects are working to develop innovative and economical cutting and joining techniques for high-strength steels, for instance, and on incorporating the newly developed technologies into mass production lines.

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## RESEARCH FOR THE NEXT STAGE OF DEVELOPMENT

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“Meeting global climate protection goals and safeguarding supplies of raw materials are two of the most pressing challenges that carmakers like us face. Volkswagen is fully aware of its global responsibilities. That’s why we are continuously optimizing our products and manufacturing processes”, says Heizmann. “Fraunhofer has given us a real impetus in many areas, including multiple aspects of energy efficiency. We move forward with these kinds of developments through clearly focused programs such as ‘Think blue – blue motion’. Sustainability is one of our key business objectives – and building vehicles that emit low levels of CO<sub>2</sub> is only the beginning. For many years, we have been developing efficient technologies and products under the BlueMotionTechnologies label. Some of the research topics we generate stem from internal competition, which is our way of encouraging the emergence of provocative new areas of research right at the heart of our company. This produces new challenges which we can then tackle with the help of external partners.” One goal that Volkswagen and Fraunhofer have in common is to develop manufacturing solutions that minimize the use of resources.

Moving factories closer to the goals of energy self-sufficiency and zero emissions is a vision which researchers at Fraunhofer IWU are steadily pursuing through a three-step process. In their “Research Factory for Resource-Efficient Production”, the first step – efficiency-optimized production – sees Fraunhofer IWU researchers increasing process stability in order to reduce scrap and rework. Subsequent steps focus on sustainable energy management and the use of renewable energy sources.

Since 2008, the Automotive Production Center of Excellence has become an integral part of the “Research Factory for Resource-Efficient Production”. With a clear focus on optimizing value creation while minimizing the use of resources, the three partners – Volkswagen, Audi and Fraunhofer IWU – are engaged in developing innovative methods, tools and systems for car body production together with efficient “green powertrain” concepts suitable for mass production. One of their key goals is to find ways of minimizing the energy consumption of the powertrain and its key components, from the engine to the wheels. “The rights to the joint developments belong to both sides and are laid down in a contract”, Heizmann adds.

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## MAKING PROGRESS TOGETHER

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“We are also a member of the Green Carbody Technologies innovation alliance, a joint research project involving more than 60 companies and research institutions which is funded by the German Federal Ministry of Education and Research (BMBF)”, says Heizmann. This is an initiative of production engineering companies and suppliers – working together with the steel industry and Fraunhofer – that aims to foster new technologies and processes for car body production and rapidly transfer them into industrial practice. To enable new vehicle models to be produced more efficiently and to consume less energy when driving, companies will need to introduce production engineering innovations along the entire manufacturing process chain, from press shop, tooling and body production operations right



through to the paint shop. Industry experts and researchers are hoping to cut energy consumption by up to 50 percent in the vehicle body production process. The body has an impact on energy consumption in two ways: first, the substantial energy savings that can be made in the manufacturing process and then the effect of its design on subsequent fuel consumption and CO<sub>2</sub> emissions.

## DESIGNING THE CAR OF THE FUTURE

No research project could prosper without the enthusiasm and spirited contributions of motivated students. That is why one of the key elements of the partnership between Volkswagen and Fraunhofer is the training and development of new employees and new generations of researchers. Numerous further projects are planned for the future, as Heizmann explains: "Volkswagen is Europe's biggest auto maker, and that means we need solid expertise across the entire spectrum of automotive powertrain designs. Fraunhofer can support us in developing alternative, zero-emission drives. However, we do not currently have the full picture of which production engineering challenges we will be facing in the future. For example, we are still not sure when large-scale production will come into play, and there are unanswered questions regarding the safety requirements for electric vehicles – but we do anticipate that we will need adaptable, open, high-mix manufacturing environments. Now is the time to jointly create tomorrow's production requirements and to steadfastly pursue the goal of reducing automotive manufacturing costs. Fraunhofer technologies can help us to achieve that."

### PROFILE: PROF. DR. JOCHEM HEIZMANN

"The Fraunhofer researchers' wealth of ideas and superb research skills will help us cope with the challenges that lie ahead – just as they have helped us jointly implement so many innovative processes and products in the past."

Prof. Dr. e. h. Jochem Heizmann has been a member of the Board of Management of Volkswagen AG with responsibility for Group Commercial Vehicles since October 2010. Prior to this, he was a member of the Board of Management with responsibility for Group Production and was also responsible for projects in Russia and India as well as for the development of new production facilities in the USA and China. Up until September 30, 2009, he was also a member of the Board of Management of Volkswagen Passenger Cars with responsibility for Production and Logistics. Jochem Heizmann began his career in the car manufacturing industry in 1982 at Audi NSU Auto Union AG in Ingolstadt. He joined Volkswagen AG in 1991.

### COOPERATION PARTNERS

#### COMPANY

##### **Volkswagen AG**

[www.volkswagen.com](http://www.volkswagen.com)

Employees: 390,000 (September 2010 figure)

Revenue: 105 billion euros (December 2009 figure)

Portfolio: The Volkswagen Group based in Wolfsburg is one of the world's leading automobile manufacturers and the largest automaker in Europe. In 2009, the Group increased the number of vehicles delivered to customers to 6.336 million (2008: 6.257 million), corresponding to an 11.3 percent share of the world passenger car market. It is the goal of the Group to offer attractive, safe and environmentally sound vehicles which are competitive in an increasingly tough market and which set world standards in their respective classes.

#### RESEARCH

##### **Fraunhofer Institute for Machine Tools and Forming Technology IWU, Chemnitz and Dresden**

[www.iwu.fraunhofer.de](http://www.iwu.fraunhofer.de)

Employees: 440

Budget: 26 million euros

Research areas: Machine tools, control and automation technology, mechatronics, adaptronics and acoustics, additive manufacturing processes, functionally integrated lightweight structures (e.g. metal foam), sheet metal and bulk metal forming, cutting technology, precision technology and micromanufacturing, joining technology and assembling engineering, production planning and resource management, virtual reality



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# CONCENTRIX SOLAR

## SOLAR-POWERED SUCCESS

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The energy mix of the future will be determined by climate change and the depletion of fossil energy resources. Solar power is set to play a key role precisely because the sun makes energy available in unlimited quantities. The fledgling company Concentrix Solar GmbH has taken on the task of bringing concentrator modules out of the laboratory and into industrial mass production. The special design of these modules and their solar cells makes it possible to convert more sunlight into energy.

It is a gray fall day when I arrive in Freiburg – not the kind of day that makes you think of solar energy – but things brighten up when I enter the production hall of the company Concentrix Solar GmbH for a guided tour led by the CEO Hansjörg Lerchenmüller. The ceiling lights reflect off the metallic frames of the concentrator modules and light up the robot arms of the fully automated production line in a sparkling yellow. Lerchenmüller founded the company in 2005 as a spin-off of the Freiburg-based Fraunhofer Institute for Solar Energy Systems ISE, and the start-up has since become one of the world's top three providers of concentrator photovoltaic systems.

Concentrated photovoltaics (CPV) technology essentially focuses on the construction of solar power plants. Sunbelt countries with plentiful, intense sunlight are weighing up these power plants as an alternative to traditional hydroelectric, coal-fired and nuclear plants. This technology differs significantly from the photovoltaic (PV) modules that have sprouted on many rooftops in more temperate climates: first, because CPV requires just a fraction of the semiconductor material used in PV systems and, second, because it achieves outputs per square meter of module area that are around twice as high as conventional PV modules.

### OPENING UP SPACE TECHNOLOGY TO EVERYONE

This boost in efficiency is achieved by stacking multiple solar cells on top of each other. "Multi-junction solar cells were originally developed for space, and you can find them on most orbiting satellites. They generate the power the satellite needs to operate", explains Lerchenmüller. For a long time, the relatively high production costs of these cells have meant they are little used on Earth. However, by combining multi-junction solar cells with a simple lens, you can create CPV modules that generate the same amount of energy from a semiconductor surface area that is 500 times smaller than that of conventional solar modules. A Fresnel lens is positioned some 10 centimeters above these tiny solar cells, which have an area of just three square millimeters – an arrangement that concentrates the sunlight by a factor of between 400 and 500. To ensure the cells do not overheat, they are mounted on a copper heat sink which facilitates passive cooling. This design produces efficiencies of up to 30 percent.



There seems to be some confusion as to the precise figure, which sometimes appears as 40 and sometimes as 25 percent, so I ask my expert guide to explain: “It all depends on how you define what you are measuring. You get the very highest efficiency with the individual cells, and that is where Fraunhofer ISE achieved its world record of 41.1 percent. Then you have the efficiency of the actual modules – in other words the cells positioned underneath the Fresnel lenses – which is 27 percent for current production modules and will rise to 29 percent for the next generation of products. Finally, we also talk about an overall system efficiency, where you have all the modules mounted on a tracking unit, and on that measure our systems achieve efficiencies of at least 25 percent.”

## **EFFICIENCY IN LARGE-SCALE POWER PLANTS**

Lerchenmüller and his team brought their first modules to market in 2007. These were put to use in various places, including in a 500-kilowatt Spanish solar park – enough to cover the annual electricity consumption of 250 four-member families. More plants followed in Spain and Portugal, and more recently a one-megawatt power plant was installed in New Mexico comprising 170 trackers, each of which provides a 30-square-meter surface area on which 90 modules are mounted.



The last five years have been a turbulent period for Lerchenmüller and his former Fraunhofer colleagues and co-founders. When the spin-off company was founded, they had plenty to work with, including technology analyses, the basic optical principle of the lenses and the technological know-how for the production process. They even had a clear idea of which might be the best materials. “But looking back I would say that what we had was a laboratory product rather than the kind of industrial product that you need to give CPV the kind of pricing structure that would make it competitive”, says Lerchenmüller. He began to establish the company’s operating structures and to look for investors and customers. At the same time, he continued to work on the technology with the support of his co-founders. For the first 18 months, Fraunhofer essentially acted as Concentrix’s research and development department. “Without such close collaboration with my former colleagues at Fraunhofer ISE it would have been much harder to get the product into pilot production so quickly and then to transition it onto its first industrial production line”, states Lerchenmüller. One of the challenges of getting the module into industrial production was the need to adjust its design so that it could be processed using standard machines.

## RESEARCH OPTIMIZES SYSTEMS

Lerchenmüller also relies on Fraunhofer when it comes to continuously improving the systems and manufacturing processes. “The Fraunhofer researchers have years of unparalleled experience in concentrator photovoltaics”, he says. “Plus they have great links to the University. Through Fraunhofer we can get people investigating and evaluating interesting topics in the form of dissertations and theses. That has helped us with things like optimizing the optical design of the lenses.” Fraunhofer researchers have also contributed their expertise to our solar tracking systems. They developed an inverter with an integrated controller which enables the modules to precisely track the sun over the course of a day.

“We put a huge emphasis on quality assurance so that we can guarantee our customers a system efficiency of at least 25 percent”, says Lerchenmüller. “We spent approximately one third of the investment in the first production line on quality control. Checks are carried out at some ten different points during the production process.” The quality control and measurement methods required for this purpose were developed in cooperation with Fraunhofer.

The next step that Concentrix is planning is mass production. Lerchenmüller is convinced there is enough demand and feels they have a good opportunity to put it into practice. In 2009, Concentrix Solar became part of the French Soitec Group, the world’s leading innovator and supplier of the engineered substrate solutions that serve as the foundation for today’s most advanced microelectronic products. Soitec produces more than 80 percent of the world’s



SOI wafers, a product in which an ultra-thin active silicon layer is formed above an insulating layer to create a layered silicon-insulator-silicon substrate. The technology for separating and bonding these thin semiconductor layers also provides the perfect basis for producing multi-junction solar cells. "This approach gives us a lot of scope when it comes to choosing the materials that we can use for the solar cells. It should enable us to achieve further substantial increases in efficiency", says Lerchenmüller. "Soitec is a great partner because they have the financial resources and industrial experience that we need to enter into mass production. That will bring prices down and speed up the process of making electricity generation in solar power plants competitive."

#### **SIMPLE, FLEXIBLE AND ECONOMICAL: A TECHNOLOGY DESTINED FOR SUCCESS**

"We are working from two different angles to make the systems an attractive option. On the one hand, we are cutting manufacturing costs and, on the other, we are working on increasing the efficiency of the cells and the modules", says Lerchenmüller, summing up what lies ahead. CPV cells have a theoretical efficiency of 69 percent. Current manufacturing methods typically produce an efficiency of 38 percent, so there is plenty of room for improvement. The team's next goal is to achieve a solar cell efficiency of 50 percent – and Concentrix and Soitec will once again be drawing on the world-renowned expertise of the Fraunhofer researchers. "We have established a solid partnership and are keen to continue working with Fraunhofer on the really cutting-edge topics, particularly since that also enables us to take part in both nationally and internationally funded projects."



#### PROFILE: HANSJÖRG LERCHENMÜLLER

“We have established a solid partnership and are keen to continue working with Fraunhofer on the really cutting-edge topics.”

Diplom-Physiker (graduate physicist, equivalent to MSc), co-founder and CEO of Concentrix Solar GmbH. Spent 10 years working at Fraunhofer ISE in the fields of technology management and solar power plants, coordination and management of the Fraunhofer marketing network.

#### COOPERATION PARTNERS

##### COMPANY

**Concentrix Solar GmbH, Freiburg | A division of the Soitec Group**

[www.concentrix-solar.de](http://www.concentrix-solar.de)

Employees: approx. 80

Portfolio: Concentrator photovoltaic power plants

##### RESEARCH

**Fraunhofer Institute for Solar Energy Systems ISE, Freiburg**

[www.ise.fraunhofer.de](http://www.ise.fraunhofer.de)

Employees: 1000

Budget: 60 million euros

Research areas: Solar thermal systems, photovoltaics, hydrogen technology, energy-efficient buildings, applied optics and functional surfaces

Over coffee in the break room, Lerchenmüller explains why he is so sure that concentrator technology is destined to succeed. He offers four key reasons: “First, performance is much better thanks to high-precision tracking and resistance to temperature stress, something that can often cause problems for other types of solar cell, especially in the sunniest regions. Second, CPV power plants are quick and easy to build. Third, the technology has a very small environmental footprint, especially when you consider that CPV technology does not require cooling water. Elevation of the modules on a tracking unit keeps the impact on the countryside to a minimum – a major advantage, particularly in regions that are home to rare animal species. The fact that the technology keeps habitat disturbance to a minimum has won accolades from environmental protection associations. But ultimately the technology will succeed for reasons of cost. No other technology offers such high efficiency through the use of simple materials, and this results in major cost benefits.”

The last stop on our tour is a series of display screens, where Lerchenmüller can call up the various demonstration facilities at the touch of a button. “Our live cameras allow us to track how things are going at each site. We also have online access to the data on both demonstration plants and power plant operations.” The view of the sun-drenched plants in Italy, Spain, Israel and South Africa – to name just a few of the sites – is fascinating, but, for me, it is time to return to the gray fall day that awaits outside.



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## TABLE D'OR

# A HIGH-TECH CELEBRITY CHEF

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A master chef's kitchen is not dissimilar to a high-tech laboratory: Sparkling, functional surfaces and carefully arranged special tools are as much a part of the process as are creativity and perfectionism. The well-known celebrity chef Johann Lafer has combined both worlds in his cooking school "Table d'Or", which is a forum for the culture of cooking and savoir-vivre in Guldental. He asked researchers from the Berlin-based Fraunhofer Institute for Telecommunications, Heinrich-Hertz-Institut, HHI to equip his kitchen with one of their innovations: the iPoint Presenter. However, the Fraunhofer team had little time to complete the task since renovation work on the 100-year-old house at the foot of the Hunsrück mountain range was already at a very advanced stage – and a date had been set for the grand opening. But in the end, their extraordinary dedication and project management skills turned the project into a remarkable success.



Johann Lafer is not only a multi-award-winning celebrity chef – but he is also an enthusiastic innovator and technology aficionado outside the kitchen. When it came to refurbishing his “Table d’Or” cookery school, he not only insisted on top-quality kitchen fittings and equipment, but also on the very latest developments in smart building and media technology. A member of his team was instructed to scout out specific technical innovations, and during his research he stumbled across the iPoint Presenter, a device that enables users to control a computer with gestures. Calls were made to Fraunhofer HHI, and in November 2008 Johann Lafer himself came to Berlin, tested the system and was so impressed that he asked researchers if they could incorporate it into his new kitchen. The cookery school was scheduled to re-open in the renovated building in July 2009, so the team from Fraunhofer HHI worked against the clock to finish the project in time.

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#### THE iPOINT PRESENTER POINTS THE WAY

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*The “Table d’Or” cookery school is housed in a 100-year-old building at the foot of the Hunsrück mountain range. During the wholesale renovation of the building, only the timberwork frame was maintained, and within it an entirely new structure was created that left a space no bigger than a hand’s width between the interior and exterior walls – a space that contains some 20 kilometers of wires. This wiring links up an extraordinary array of modern gadgetry, from sophisticated LED lighting to video and audio equipment, all of it carefully integrated in the building’s structure. However many pans are on the boil, the cutting-edge air-conditioning system keeps the temperature just right while minimizing the use of resources. Participants in the cookery school’s courses can consult recipes on the monitors and follow their own progress on video. And the crowning glory is the iPoint Presenter, featuring a recognition device about the size of a keyboard which is housed in a drawer on the front of the large dining table. When the drawer is opened, the gesture recognition system automatically switches on. The iPoint Presenter tracks the user’s finger and the cursor moves on the display as if worked by an invisible hand. To open a program, users simply keep their fingers briefly pointing at the relevant button. An interface*



connects the device to the smart home control system. A flick of the finger is all it takes for Johann Lafer to dim the lighting in the dining area or switch the mood lighting to a different color.

Some 50 people were involved in refurbishing the studio, including equipment manufacturers, craftsmen and technical experts, and all of them described Johann Lafer as a person who expects the best and is enjoyable to work with. The technology of controlling a computer with gestures requires a considerable amount of fine-tuning and tailoring, and the Fraunhofer team put a great deal of effort into adjusting it to suit Lafer's kitchen environment. Lafer had previously been using touch panels and voice recognition to control most of his equipment, but gesture control offers a number of advantages: Touchless operation is perfect for kitchens, allowing cooks to flick through recipes and choose the background music while they are busy kneading dough and filleting or marinating meat – without having to put their greasy hands on buttons or touch panels. At the moment, Lafer primarily uses the iPoint Presenter to control lighting, music and demonstration videos with gestures, though one option for future development is to use the device to control kitchen equipment, too.

Automatic, integrated control of the heating, ventilation and air conditioning systems creates the perfect atmosphere for cooking, no matter how many pots are on the boil. Meanwhile, a sophisticated lighting system with energy-saving LEDs offers a variety of moods, ranging from the best lighting for kitchen duties to a pleasant dining ambience. The command "Light orange" is all it takes to bathe the kitchen in a warm orange glow. And thanks to the sophisticated audio equipment, the tips and explanations provided by the chef and his three assistants can easily be understood by all the trainee cooks, even if they are standing at the other end of the work surface. The "training kitchen" has a whole host of other exquisite details, including the sensors and interior lighting in the kitchen units and cabinets, which can be opened by applying gentle pressure to the drawer.

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#### **HIGH-TECH SOLUTIONS THAT MAKE COOKING MORE FUN**

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So why is Johann Lafer so enthusiastic about modern technology in the kitchen? Does it improve people's cooking? "No, but these high-tech solutions do make cooking even more fun! And the technology makes working in the kitchen easier",



says the chef. "The most important thing for me is enjoying the experience of cooking and tasting and having a good time with my guests – and this technology certainly gives me the support I need to devote more time to them." And there is one more reason why Johann Lafer is a technology fan: "I want to get young people interested in cooking. And one way of getting through to them is by using modern communication technologies."

In the course of their joint work on this unusual project, the Fraunhofer team and their client discovered that even though research and cooking might at first glance seem worlds apart, in fact they have a whole host of things in common. Both activities place an emphasis on creativity, inquisitiveness and perfectionism, as well as the joy of creating something extraordinary. And of course contract research teams and Michelin-starred restaurants are both expected to thrive under time pressure! In both cases, the results need to be served on time, according to the client's wishes, and with nothing out of place.

#### PROFILE: JOHANN LAFER

"My trainee cooks are always fascinated by the iPoint Presenter. I am tremendously pleased with the professional solution provided by the Fraunhofer team."

Johann Lafer has won numerous awards and distinctions for his cooking skills and his dedication to good ingredients and healthy food. His innovative spirit is also very much in evidence in his teaching work at the Fulda University of Applied Sciences.

In 2010, he received the Sinus award in the Entertainment category for his creative use of systems integration and media technology at the "Table d'Or" cookery school.

#### COOPERATION PARTNERS

##### COMPANY

**Table d'Or GmbH, Guldental**  
[www.johannlafer.de](http://www.johannlafer.de)

##### RESEARCH

**Fraunhofer Institute for Telecommunications,  
Heinrich-Hertz-Institut, HHI, Berlin**

[www.hhi.fraunhofer.de](http://www.hhi.fraunhofer.de)

Employees: 250

Budget: 30 million euros

Research areas: Photonic networks and components, electronic imaging, broadband mobile communication networks

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# PARTNERS IN INNOVATION

## WHAT DOES FRAUNHOFER DO?

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### FRAUNHOFER CONDUCTS RESEARCH AND PRODUCES INNOVATIONS

The Fraunhofer Institutes undertake research of direct utility to private and public enterprise. The aim of this applied research is to use science and technology to create innovative products and applications.

Fraunhofer delivers what the economy needs: innovation, which is one of the most important factors in achieving commercial success. To maintain an edge in a competitive global market you need to understand your customers' needs, deploy the very latest technologies and respond quickly to market developments.

If you want to make your business successful, you need to find a professional team of innovators – creative minds, experienced developers, and in-house research departments.

And if you want to exploit every available opportunity, you need to bring in skills from the outside. The Fraunhofer Institutes are an economically viable alternative. They can help bring your company's innovation process to life.

### ACHIEVING SUCCESS THROUGH A COMMITMENT TO PROGRESS: THE FRAUNHOFER STORY

Things started off small, and the future was uncertain. The Fraunhofer-Gesellschaft was founded in Munich in 1949 and was initially responsible for arranging funding for close-to-market research. By 1952 it still had just three employees.

But the booming economy soon boosted the demand for contract research: Thanks to a range of innovative, top-quality products, Germany was becoming one of the world's top export nations, and Fraunhofer kept pace with this rapid growth, enabling it to cover the steadily increasing demand for research services. Today, more than 18,000 staff work in over 80 research units with an annual research budget of 1.7 billion euros. Of this sum, 1.4 billion euros is generated through contract research. Two thirds of the organization's research revenue is derived from contracts, and one third is contributed by the German federal and *Länder* governments in the form of base funding.

That makes the Fraunhofer-Gesellschaft the biggest organization for applied research in Europe. Its customers include companies of all sizes and from all industrial sectors – from small and medium-sized companies to global enterprises.

## **FRAUNHOFER OPERATES INTERNATIONALLY**

Globalization is a phenomenon that affects all areas of the economy, including the market for research and development services. To stay in the race, an organization has to measure itself against its international competitors, forging contacts and picking up on the latest technological trends. That is why Fraunhofer has been running outposts in the world's major economic regions for many years. These offices maintain permanent contact with the economic regions and scientific areas that are most important for business today and in the future. As well as picking up on new trends, this also allows Fraunhofer to see how its own work stacks up against global benchmarks – a process that ultimately benefits its domestic customers, too.

## **FRAUNHOFER OFFERS TAILORED PARTNERSHIPS**

In most industry sectors, research is an essential prerequisite for building a successful business. But research does not come cheap, which is why companies need to focus on structuring their innovation work as efficiently as possible.

Contract research can be a good solution for many companies: As a temporary partner, Fraunhofer Institutes can carry out concrete projects in a timely and professional manner. Costs are generally lower and easier to calculate than equivalent research projects run internally.

## **OUTSTANDING EXPERTS AND WORLD-CLASS SKILLS**

Fraunhofer offers a superb basis for a career, and working here provides a clearly defined path to success. The combination of interesting research and direct applications gives people the best kind of practical experience. It is also highly motivating: Fraunhofer consistently takes a top spot in the popularity rankings for technology-oriented employers.

So Fraunhofer's customers have the reassurance of knowing that their cooperation partners are not only highly competent, but also intensely motivated.

The Fraunhofer-Gesellschaft is a recognized non-profit organization which takes its name from Joseph von Fraunhofer (1787–1826), the illustrious Munich researcher, inventor and entrepreneur.

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# COOPERATION MODELS

## WHAT ARE THE DIFFERENT WAYS OF WORKING WITH FRAUNHOFER?

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### ONE-OFF CONTRACTS

The classic model of cooperation: A company perceives a need for research or development – for example, it wants to launch an innovative product, improve a method or technique, solve a logistical problem, or audit a process to obtain certification. A discussion with Fraunhofer identifies possible solutions and clarifies the form the partnership could take and the estimated cost. Regardless of whether the project is large or small, its goal is to solve the problem and to launch the innovation within the company or on the market.

### LARGE-SCALE PROJECTS WITH MULTIPLE PARTNERS

Some challenges are so complex that they require multiple partners to develop a solution. Clients in this situation have access to the full range of Fraunhofer Institutes. It is also possible to incorporate external partners and additional companies. Fraunhofer researchers have plenty of experience in running large-scale projects efficiently and fairly – and they know how to check what government funding is available.

### INTERNATIONAL COOPERATION

Fraunhofer also has an international presence. Many Fraunhofer staff have international experience and sophisticated cultural and language skills, and they are personally familiar with global markets. As a result, companies operating internationally can often draw on Fraunhofer's services abroad, too.

### STRATEGIC PARTNERSHIPS

Fraunhofer is determined to foster promising new technologies. Pre-competitive research which starts off without any ties to specific development contracts often results in long-term partnerships with companies. One example is the Dortmunder OberflächenCentrum (DOC), a surface engineering center that brings together companies from the steel industry, Fraunhofer Institutes, universities, and universities of applied sciences. The goal of this network is to foster the application of new coating technologies.

### INNOVATION CLUSTERS – NETWORKS THAT ENHANCE EFFICIENCY

Complex projects often require a whole range of different skills and disciplines to succeed. Long-term collaboration between multiple research institutions and companies often provides key benefits, which is why Fraunhofer decided to create its innovation clusters with support from the German government. The goal of a cluster is to bring together competent partners from within a region to solve challenging tasks. Clusters incorporate industry and universities, as well as other locally-based non-academic research institutions which are capable of making important contributions to the topic at hand.

The physical proximity of the research organizations, investors and companies generates networks that can lead to new business ideas and start-ups. Regional innovation clusters close the gap between the business and research communities, and successful clusters stimulate competition and give rise to productive cooperation that ultimately benefits everyone involved.

## **SPIN-OFFS**

Fraunhofer researchers are creative and know how to put good ideas into practice. They often take the step towards independence by founding their own company with an innovative development, product or method. Fraunhofer itself only participates in these kinds of start-ups up to a certain extent. Sometimes the customer who commissioned the new development is interested in taking a stake in the spin-off company itself, a decision that enables them to play a long-term role in the ongoing success and further development of the technology.

Spin-offs generally maintain close ties to the original Fraunhofer Institute. These start-up companies know from their own experience how beneficial it can be to cooperate on research projects, so they typically choose to maintain their contacts and their links to Fraunhofer.

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# THE NUTS AND BOLTS OF COOPERATION

## HOW DOES FRAUNHOFER HELP ITS CUSTOMERS?

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### IMPROVING PRODUCTS

As every business person knows, you should always focus on staying one step ahead. In practice, that means refusing to be satisfied with even your most successful products, and instead continuously seeking out improvements and launching new products. And that is where Fraunhofer comes in: We improve your products, enhance their performance, develop entirely new offshoots, and help you to cut costs in areas such as manufacturing and distribution.

### MOVING FROM PRODUCT DEVELOPMENT TO SHORT-RUN PRODUCTION

Sometimes a successful job involves more than just a tailor-made solution. Developing an innovative prototype is an important step, but the production process often poses similar levels of complexity and must be developed in tandem with the product. Fraunhofer researchers can work with the customer to take both product and process all the way through to short-run production – just one way in which Fraunhofer helps customers to launch new products swiftly and successfully.

### MARKET ANALYSIS AND INNOVATION CONSULTING SERVICES

Anticipating a trend and getting your new product onto the market before anyone else is a great way to get ahead. That's why the Fraunhofer Institutes carefully monitor technological trends and market developments to help customers get ahead of the curve. Fraunhofer can also carry out feasibility and profitability studies and provides information on available sources of funding.

### INCORPORATING NEW TECHNOLOGIES

Fraunhofer is at the cutting edge of technological development. Its researchers have played a key role in the development of fields such as LEDs, audio and video coding, and laser technology. And Fraunhofer Institutes are also your best choice when it comes to transforming these kinds of new technologies into products. Our researchers hit on the right ideas – and they know how to transform them into products and processes.

## **ACQUIRING LICENSES**

Fraunhofer carries out contract research for companies, but it also carries out its own independent research in some areas, often with interesting results. This pre-competitive research has given rise to inventions that can be commercially exploited by companies under license. Examples include the mp3 license, the H.246 video compression format and a manufacturing process for low-fat sausages.

## **OPTIMIZING EXISTING PROCESSES AND ORGANIZATIONAL STRUCTURES**

Markets change – and so do technologies, statutory requirements and economic conditions. Companies change too, by expanding, entering into new partnerships and customizing their product portfolio. There are many reasons why an existing production facility or structure might no longer meet current requirements. Fraunhofer experts have extensive experience in finding the best ways to improve technical and organizational processes, motivating people to come up with innovative ideas, and identifying and spurring on under-exploited capabilities.

## **CHARACTERIZATION, TESTING AND CERTIFICATION**

Development also involves analysis and testing. The Fraunhofer Institutes have an extensive range of high-quality equipment designed to test components, materials, coatings and processes and to reproducibly demonstrate their levels of functionality, safety and reliability. They also offer contract testing services and issue test reports and certificates (at Fraunhofer's accredited test laboratories).

## **FRAUNHOFER – A PRESTIGIOUS PARTNER**

Fraunhofer is highly regarded by the professional and business communities and by buyers of finished products. That's why many companies are happy to reveal that their development work was carried out in collaboration with a Fraunhofer Institute. Nevertheless, all publications require prior approval and we only ever name our customers if we have first obtained their express consent to do so.

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## Fraunhofer Groups

The institutes of the Fraunhofer-Gesellschaft have organized themselves into seven research groups, each specializing in a specific area of technology, in order to promote collaboration in related disciplines and offer customers a unique source of coordinated joint services.

Fraunhofer Group for Defense and Security VVS  
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Fraunhofer ICT Group  
[www.iuk.fraunhofer.de](http://www.iuk.fraunhofer.de)

Fraunhofer Group for Life Sciences  
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[www.light-and-surfaces.fraunhofer.de](http://www.light-and-surfaces.fraunhofer.de)

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Fraunhofer Group for Production

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