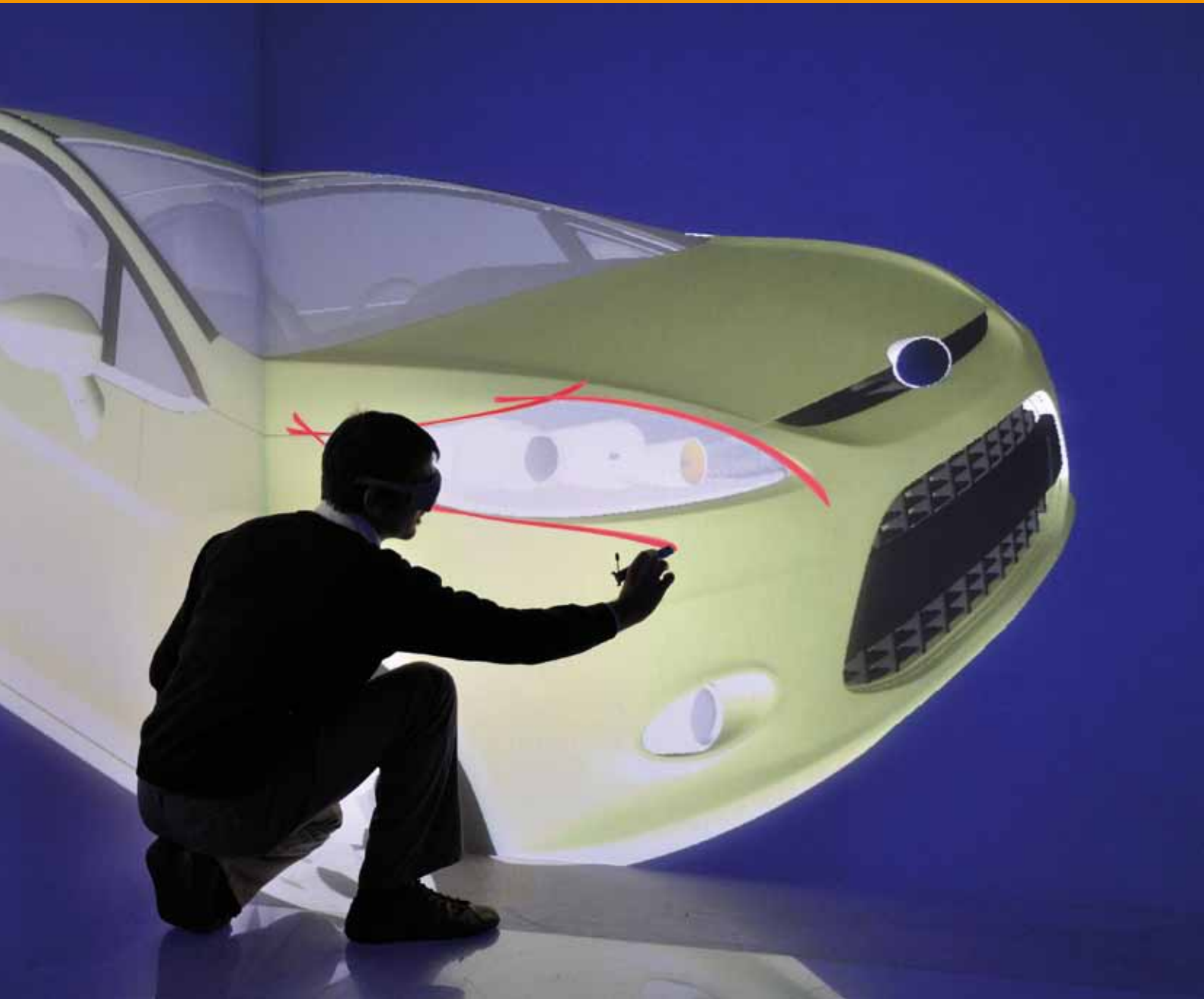


VIRTUAL PRODUCT CREATION



Expertise

Information and Process Control <ul style="list-style-type: none">- PDM/PLM- Collaborative Engineering- Process Optimization	Model-Based Engineering <ul style="list-style-type: none">- Product Modeling- Functional Modeling- Virtual Reality
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Prof. Dr.-Ing. Rainer Stark
Head of the Virtual Product Creation Division



VIRTUAL PRODUCT CREATION

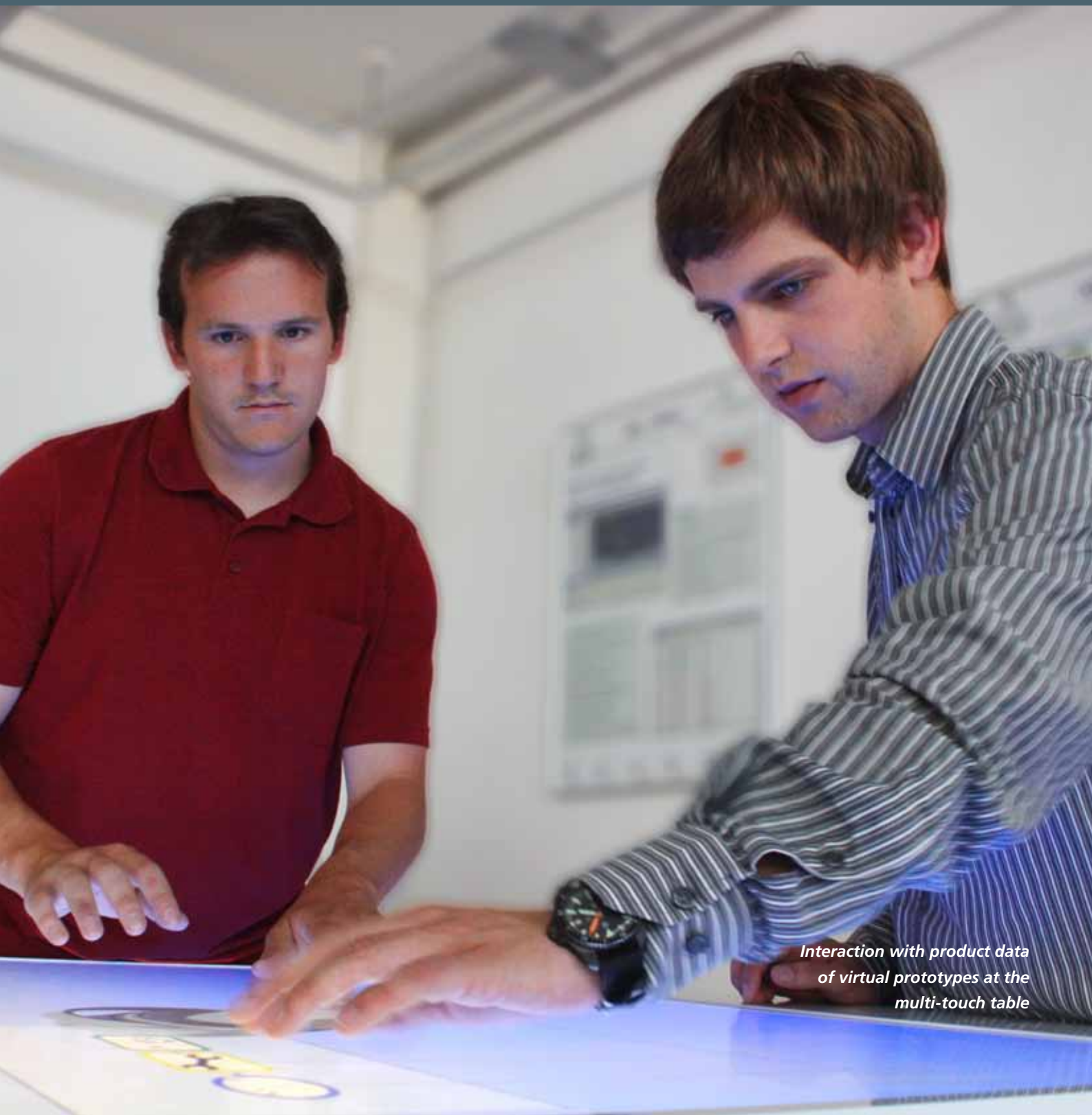
Digital techniques, processes and methods are now an essential part of the entire production technology network from product planning through to product maintenance and overhaul. They enable targeted planning and control of product development cycles, product quality and associated costs. At the Virtual Product Creation division of the Fraunhofer Institute for Production Systems and Design Technology IPK we are engaged in realizing the vision of a completely digitalized product creation process. Our aim is to design methods and tools so that later phases – from actual production and customer use to the range of associated services – can be factored in and planned for at a very early stage of the product lifecycle.

Our specialist departments »Information and Process Control« and »Model-based Engineering« support industrial companies and public institutions who demand ever-higher standards of excellence in their solutions. Our portfolio of consultancy and development services ranges from independent technology surveys through analysis and optimization of digital processes and methods in product development to analysis and development of information standards, engineering applications and IT integration architectures. Unlike most other IT consultants and PLM providers, we offer a rich and solid fund of expert knowledge – even when it comes to tomorrow's IT technologies, solutions and standards. Our bespoke scenarios tailored to your own situation and factoring in digital business and cooperative mechanisms show you just where you stand and where you could actually be. Our expertise is based on a deep well of experience in the many and diverse areas that go to make up virtual product creation:

- PDM/PLM
- Development alliances
- Process optimization
- Product modeling (from initial sketches, intelligent Computer Aided Design (CAD) and digital mock-ups (DMU) to functional mock-ups and virtual reality)
- Cross-domain mechatronic systems development
- Digital production planning (CAM, CAP)
- Functional modeling and functional validation (for instance with special CAE solutions for flexible component simulation)
- Evaluation and system approval based on intelligent hybrid prototypes

» **Virtual Product Creation is one of the keys to ensure effective product and manufacturing engineering. Digital innovations are essential for the future because they enable engineers to master the increasing complexity of information and to allow intuitive use of process and functional simulation.** «

EXPERTISE



*Interaction with product data
of virtual prototypes at the
multi-touch table*

COORDINATING AND STEERING DEVELOPMENT PROCESSES AND DATA

Management of product data and processes in digital product creation requires both clear structures and continual coordination. We ensure that all relevant data associated with your product is captured, transparently processed and continually monitored so that you can be certain that your development processes will run smoothly without troublesome hitches and glitches.

INFORMATION AND PROCESS CONTROL

An engineer sketches details of a new product on a drawing board. He keeps on checking with his colleagues, drawing up one version after the other. In the end everybody heaves a sigh of satisfaction. Then a good deal of money goes into building a functional model. Only this shows that the product doesn't function as planned. So it's back to the drawing board.

Thanks to modern information technology scenarios like this are a thing of the past. An economic system in which quality and speed in product creation are critical for all-important market success relies on digital development. The success of the development process largely depends on what kind of digital process management the company uses.

Because increased focus on customer needs – or delivering the right product for the right customer – means steadily broadening the range of products. Whoever can respond flexibly to customer preferences stays ahead on the global playing field. In product creation speed and quality are of the essence.

A trend to pure virtual modeling has set in as present information systems become steadily more advanced and more highly differentiated. Developers increasingly cooperate on an interdisciplinary basis, from a variety of different geographic locations and even across company boundaries. All this is not without impact on the diversity of data and its forms of presentation. Dealing with new problems thrown up by the huge flood of data is something companies now have to do on a daily basis. Our Information and Process Control department builds the solutions to meet such problems – and what's more builds them on the systems you already have up and running.

Data Management – across the whole product lifecycle

Product data management (PDM) collects all the information about a product, correlates it and images it, thus producing an overall picture that serves as the basis for all other product-

associated management processes. Product Lifecycle Management (PLM) or the strategy of digital oversight of a product across its entire development and lifecycle through to its sign-off is built on the foundations of PDM. To keep pace with the increasing quantity and diversity of data, we collaborate with our industrial customers to develop solutions for innovative PDM/PLM technologies.

Collaborative Engineering – where everyone knows just what they are doing

Two heads are better than one – but only when they communicate properly with one another. Collaborative Engineering is a discipline which ensures that developer teams from various company departments can work simultaneously on various aspects of a single product and even collaborate with partners extraneous to the company in an overall situation where everyone is always in touch with the latest developments. Collaboration management means the transparent administration of information – as transparent as the particular collaborative situation allows for without, for instance, divulging company secrets. This is an area in which we are truly expert.

Process Optimization – always room for improvement

Core processes, management processes and support processes all guarantee the manufacturer fast product creation and high product quality. But product creation is never a process with final closure – product details need to be changed, computer performance needs enhancing or new suppliers have to be brought in. All such changes mean that existing processes have to be correspondingly modified so they can continue to operate smoothly. We use methods of process modeling and management to analyze and optimize operational processes. And where standard methods do not kick in, we develop new ones.

EXPERTISE



*Smart hybrid prototyping
at Fraunhofer IPK's Virtual
Reality Solution Center*

MODELING AND VIRTUALLY EVALUATING NEW PRODUCTS

The key challenges for virtual product creation are the increasing complexity and ever greater quantity of data. We develop virtual tools with intuitive user interfaces, find solutions for digital functional models and digitalize your production processes, leaving you free to focus on what's truly important – your product.

MODEL-BASED ENGINEERING

Second Life is a relatively new innovation where we can lead parallel lives in a virtual universe. Virtual product models have a much longer history. Module by module products are completely digitally designed. The CAD system gives the exact position of welding joints and critical material stress, and product functions are checked by the engineer using a virtual model. Digital prototypes are increasingly coming to resemble their physical counterparts. All this is made possible by IT technologies which facilitate the engineer's work while also easing the strain on the company's development budget. Yet while the geometric layout of a product no longer poses any problems, the same cannot be said when it comes to the smooth interaction of all its assembled parts. CAD data are not designed to spring to interactive life. In particular, mechatronic products and their cross-domain development cycles pose huge challenges to IT experts. Our Model-Based Engineering department fine tunes and perfects existing solutions and creates new avenues of approach where traditional methods have led to a dead end.

Model-based engineering puts the development spotlight squarely on virtual product models. These models carry all the information needed for the generation, analysis and documentation of the product. Typically they are networked to a very high degree, specifications, functions and components come together to form a complex system. Product models are the basis for modern communication structures in development processes – which can come as descriptions, abstract notations or visual representations. Just how diversified model-based engineering can be is shown in the following examples:

Smart Hybrid Prototyping – tangible experience of the product during its development cycle

Many companies would dearly love to eliminate physical models altogether. This is hardly surprising as digital product models save both time and costs. As a pre-requisite virtual models need to enable the simulation of key product characteristics and

functions already during development. For instance, if a mechanism is put in motion in a virtual model, its motion sequence must correspond exactly to the motion sequence a physical model would show. Even though this is possible in a reasonable number of cases, in highly integrated products the model is simply too complex to allow for it. For such products we have developed »Smart Hybrid Prototyping« technology in which we combine virtual elements with real elements and link them with high-end visualization and intuitive interaction techniques.

Automatically digital

If a product or installation functions parallel to reality in a virtual environment, its status and the room it offers for improvement can be analyzed in the simulation. Such features would be extremely difficult to identify in a real-world system, particularly one in full operation. Digital simulation is worth a lot of money in terms of repair and maintenance measures when damage due to unexpected problems may be reckoned with. We use reverse engineering techniques and 3D data processing for automated product and installation digitalization and status diagnosis – even in contexts where no prior digital product data is available.

Immersive Physics-based Product Modeling

Product development is not some rigid ossified procedure – first and foremost it's creative work that needs to be supported with user-friendly tools. We offer an immersive virtual development environment in which the product developer can use ergonomic instruments, pens and surface tools to intuitively model objects, change them, coat them with material and manipulate them. Our »Immersive Physics-based Modeling« system demonstrates the possibilities inherent in tangible user interfaces and real-time simulation: Lines and surfaces come to form bodies that can be pressed and pulled and which behave as though they really are made of real material.

THINKING AHEAD: PRODUCT CREATION 2015

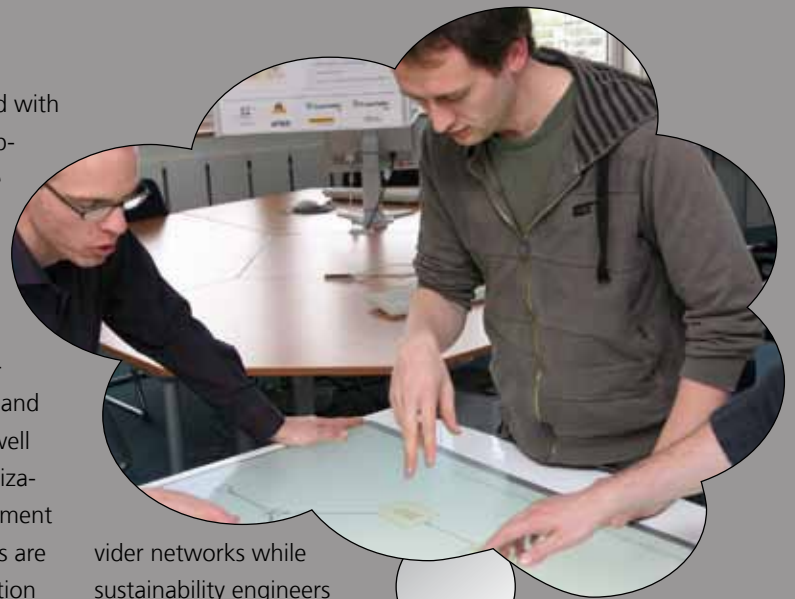
FIVE FIELDS OF RESEARCH FOR TOMORROW'S DEVELOPMENT PROCESSES

At the Virtual Product Creation division we don't just support our customers in terms of helping them meet present-day challenges; we are also engaged in preparing the tools and methods needed for the product creation and production planning processes of the future. In five research fields we develop forward-looking digital techniques that will give you a decisive competitive edge in the post 2015 period in the development, use and servicing of your products.

Product development methods and processes

In 2015 a new generation of techniques, methods and technologies will be available for collaborative, interdisciplinary modeling and reviewing of products, development processes and product-process modeling. Their introduction will be flanked by new value-added models. New vocational fields and spheres of action in research and industry are leading to greater professionalism and efficiency in interdisciplinary work. New types of jobs are evolving

such as those associated with the coordinated development of product-service systems (PSS), in the sustainability sector (where the technical product function is on a par with economic efficiency, and ecological and social acceptability) as well as in the effective visualization of product development processes. PSS architects are facilitating the introduction and application of PPS development methods in industrial contexts and complex pro-



vider networks while sustainability engineers ensure that aspects of sustainability are factored into product develop-

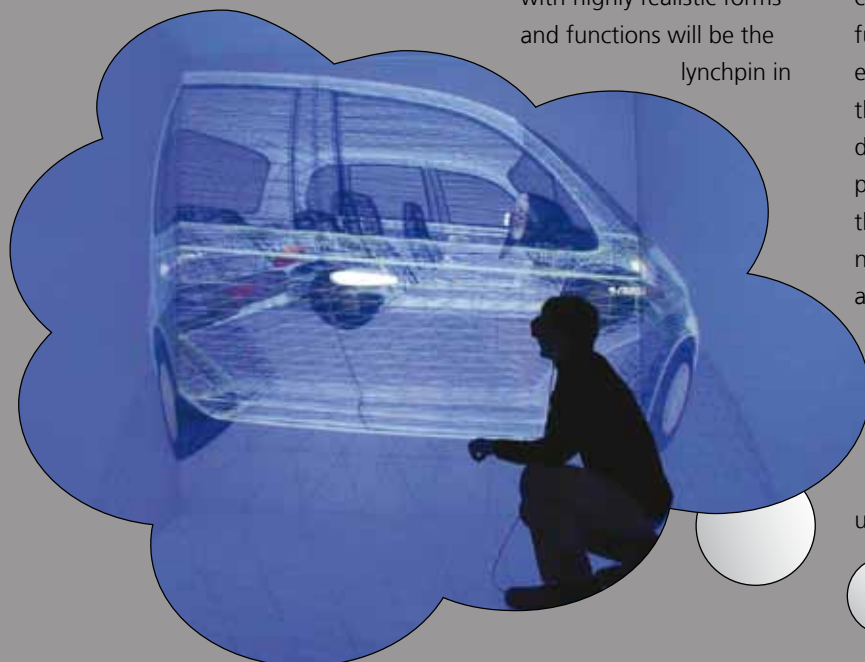
ment and are considered on a par with quality issues.

Product design and functional verification

From 2015 virtual prototypes with highly realistic forms and functions will be the lynchpin in

product development processes. This means that in future simulation and modeling will begin early on in the concept phase and be deployed across the whole of product and system design through to production and final product approval. In such an end-to-end approach each stage of development will use digital models which can be linked across individual process stages and development domains. Set-up is facilitated by module

systems and automatic generation of simulation models from base models. Yet pure virtual design is not the end of the story: A combination of digital and real models to form smart hybrid prototypes aids in accelerating the pace of design processes. And an opposite approach is also possible as optimized reverse engineering techniques enable automated product and installation digitalization and functional diagnosis – even in retrospect.



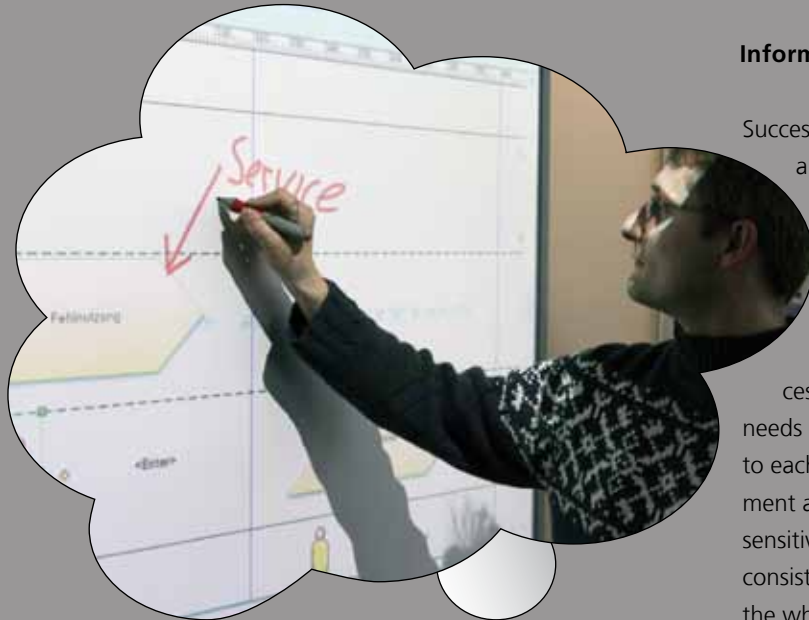
Intuitive interaction with virtual prototypes

In 2015 interacting with virtual development tools will be intuitive, opening up their use to non-specialist product development engineers. »Intuitive« means that they can be used with little or no dedicated training. On top of this, new ways are now being found of giving engineers visual and interactive virtual prototypes. Prototype work is becoming more

focused as less attention needs to be paid to the use of computer interfaces, thus giving engineers more room to concentrate on development work itself, while at the same time stimulating interaction techniques lend a new impetus to creative work. By 2015 the widespread use of multitouch systems, tangible user interfaces and novel holographics, image process-

ing and tracking technologies will completely blur the boundaries between physical and virtual prototypes. Virtual prototypes will

then be capable of types of interaction that are now only possible with actual physical models.



Information management for product creation

Successful management of all development-relevant information is the basis on which competitive product production is built. In collaborative processes such information needs both to be aligned to each respective development activity in a context sensitive manner and to be consistently spread across the whole range of acting disciplines and participating companies. At the same time

data generated from customers and users and from product use and maintenance is playing an increasingly important role in product creation. From 2015 onwards there will be PLM tools that enable the bidirectional information flow to be channeled across the entire product lifecycle. Networking of the development, utilization and recycling phases of the product lifecycle enables benchmark optimization of the prospective product.

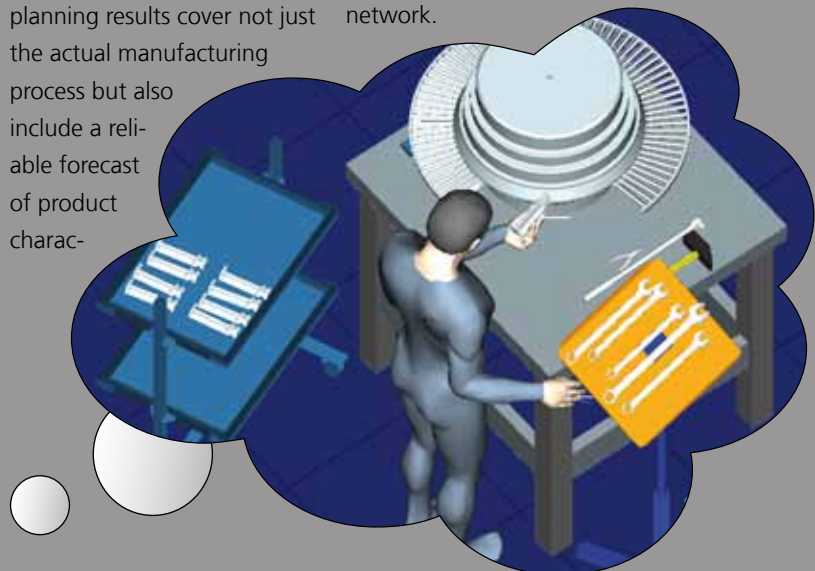
Digital production and factory processes

From 2015 onwards more and more manufacturing plants will have virtual counterparts: The real world factory will be faithfully reflected in a continuously updated virtual representation accessible by production planners, product developers and other actors. The digital factory is a highly realistic tangible model that simulates not merely correct geometric appearance but also the actual behavior of all component

parts. This means that they can all be manipulated and evaluated on the virtual level. A full simulation also factors in the entire value creation network playing a part in production with all its resources and planning and production domains. Such fully inclusive imaging enables alternative proposals for products and processes to be tested and evaluated before their roll-out in real-world production. At the same time all adjustments

that need to be made to value creation networks can be derived automatically. Thus planning results cover not just the actual manufacturing process but also include a reliable forecast of product charac-

teristics after run-through of a technical production process chain in a value creation network.



WHAT WE OFFER YOU



CONSULTING – RESEARCH – DEVELOPMENT

We offer you a broad bespoke tailored range of services from consulting and planning through to realization and roll-out. We have a rich record of proven expertise especially in the automobile and automotive supplier industry, aerospace technology, machine tool and plant construction, and energy and medical technology.

OUR SERVICES

OUR CUSTOMERS BENEFIT FROM THE FOLLOWING SERVICE PORTFOLIO

Technology and methods consulting

Our focused technology consulting services help you identify and make the right choice of future technologies. What's more, we also support you in the development, introduction and application of novel virtual development methods.

Potential analyses and surveys

We use product and technology-oriented feasibility studies, market monitoring and trend analyses to investigate and evaluate the inherent potential of technologies and products.

Optimizing product creation processes

We investigate technological feasibility and implement on-track process and technology optimization that gives greater economic efficiency to your own product creation processes.

Implementing new technologies

Our on-going, forward looking research and development puts us in an excellent position to offer you fully comprehensive technological expertise and support you in the planning, realization and roll-out of novel technologies in your own product creation processes.

Support with national and international research and development projects

We advise project carriers in the run-in phase to research alliances and support you throughout the funding application process.

Training programs

We offer our customers a comprehensive range of seminars that accelerate the pace of knowledge transfer from basic research and application research to industrial usage.

WHAT WE OFFER YOU



WORKING TOGETHER ON YOUR SUCCESS

Innovation is vital for a company's success. Innovation is what can turn a company into a technology leader on the global market. With our distinguished track record of proven expertise we develop innovative products, technologies and methods and support you in mastering the challenges of tomorrow's world.

PARTNER ALLIANCES

WE OFFER A BROAD SPECTRUM OF TYPES OF PARTNERSHIPS AND ALLIANCES

Industry projects

Research and development projects are an effective means of driving forward innovation in a company. We develop economically viable solutions on your behalf.

Competence networks

To ensure that our customers really do have fully comprehensive expertise brought to bear on finding solutions to their specific application-related problems, we cooperate with a variety of other institutes and associations. We are affiliated to:

- The Fraunhofer Group for Production
- The Fraunhofer AutoMOBILE Production Alliance
- The Berliner Kreis (competence network to enhance product innovation in mechanical engineering and cognate industries)
- The European Manufacturing and Innovation Research Association
- The Innovation Alliance for Virtual Technologies

Cluster initiative

Founded in March 2009, the Fraunhofer innovation cluster »Maintenance, Repair and Overhaul in Energy and Transport« (MRO) is a further cooperative alliance between science, industry and government to ensure long-term cooperation and knowledge transfer in the Berlin/Brandenburg metropolitan area.

Strategic preliminary research

New and further development of technologies and markets for the future is what independent, publicly financed preliminary research is all about. Our business partners benefit from the insights gained in such preliminary research.

VISIT OUR ESTABLISHED INDUSTRY WORKSHOPS

Our industry workshops are a forum for the exchange of views and experience between scientists, engineers and product users. They offer a place where you can talk directly about matters of theory and practice to our own experts and the representatives of major companies and small and medium sized enterprises. The set of objectives such gatherings subscribe to ranges from honing expertise and building cooperation networks to the initiation of joint application-oriented research projects and transfer of research results to the enterprise sector.

The key themes and issues addressed in the Industry Workshops are:

- Managing collaboration in product creation
- Robust planning and management of MRO factories and processes
- Successfully integrating virtual reality in development processes (PLUG-IN VR)
- Development of reliable mechatronic systems



FRAUNHOFER IPK – YOUR PARTNER

The Fraunhofer Institute for Production Systems and Design Technology IPK and its six business divisions – Corporate Management, Virtual Product Creation, Production Systems, Joining and Coating Technology, Automation Technology, and Medical Technology – are dedicated to applied research and development for industrial production. We develop methods and technologies for corporate management, product development, production processes and the design of industrial plants and facilities. Our research centers on processes that enhance productivity in terms of the development and realization of products and their integration in systems solutions. This includes such challenges as the design and realization of intelligent production equipment, its integration in complex manufacturing environments, and its operational optimization. On top of this, we also develop novel applications in cutting-edge fields such as security, mobility and medical technology.

Interdisciplinary cooperation of the business divisions:

- **Corporate Management**
 - **Virtual Product Creation**
 - **Production Systems**
 - **Joining and Coating Technology**
 - **Automation Technology**
 - **Medical Technology**
-

For over 30 years now our international, interdisciplinary team of scientists, engineers and student assistants has driven application-oriented research and development for the benefit of our partners and customers. Along with our own in-house applied research, we also develop new solutions in close collaboration with national and international companies. We work together with our industry partners in turning our basic innovations into fully fledged functional applications. Our approach covers the entire product lifecycle – from the initial product idea and its development, layout and manufacturing through to product recycling and disposal. The processes and methods

we develop are the hallmark of an all-embracing holistic approach. Our work combines sound economic principles and sophisticated technology with ecological benchmarks such as sustainability and environmental friendliness. We are aware that our achievements rest in large part on the innovativeness and dedication of our team players. This is why we attach great importance to the coming generation of creative scientists by promoting long-term training for specific know-how for our core competencies in management, product creation, production processes and the design of industrial plants.

CONTACT

You have questions regarding research and development in the Virtual Product Creation division or require further information on selected research areas? In this case please address our contact persons. They are looking forward to your call!

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WE OFFER THE FOLLOWING INSTALLATIONS FOR YOUR BENEFIT:

- Virtual Reality Solution Center VRSC
- Center for Innovative Product Creation ZIP
- Innovation Lab iLab
- Virtual Engineering Learning Center VELC, in cooperation with TU Berlin

