



# HIGHER, FASTER, BETTER

USING DATA AND KEY FIGURES FOR IMPROVED EFFICIENCY AND TURNOVER

# A SMALL SELECTION OF OUR STUDIES ON THIS TOPIC

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FRAUNHOFER CENTER FOR APPLIED RESEARCH ON SUPPLY CHAIN SERVICES SCS



## SECTOR ANALYSIS CONTRACT LOGISTICS

**A Market and Employment  
Analysis in Germany**

**Authors:**

Moike Buck,  
Heiko Wrobel

**Year of publication:**  
2015

**Price:**  
Free download

**ISSN:**  
2509-2359



## WHOLESALE IN BAVARIA

**Market Structure  
and Digitization**

**Authors:**

Heiko Wrobel,  
Alexander Köhler,  
Estella Cäsar

**Year of publication:**  
2016

**Price:**  
Free download



## RFID-MIDDLEWARE

**Metastudy and Market Over-  
view: Principles, Suppliers, and  
Products from the Proprietary  
and Open-Source Sector**

**Authors:**

Sebastian Lempert

**Year of publication:**  
2015

**Price:**  
285.00 euros

**Publisher:**  
Fraunhofer Verlag,  
Stuttgart

**ISBN:**  
978-3-8396-0915-6



## VALUE CREATION- ORIENTED BENCHMARKING

**Logistical Processes  
in Healthcare and Industry**

**Eds.:**

Herbert Woratschek,  
Jürgen Schröder,  
Torsten Eymann,  
Moike Buck

**Year of publication:**  
2015

**Price:**  
34.99 euros

**Publisher:**  
Springer Vieweg

**ISBN:**  
978-3-662-43718-6 (online)  
978-3-662-43717-9 (print)

You will find more information and downloads of our studies on our homepage  
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## DEAR READERS,

Data keeps companies competitive: If used correctly, it makes processes more efficient, opens up opportunities for flexibility and speed, and supports companies in transforming traditional underlying business models.

If analyzed and interpreted correctly, data can be turned into key figures that can be used not only to control company processes better and then to continue to optimize them systematically, but these numbers and this information can also be comprehensively turned into new business models. This is an effect that will continue to grow in times of increased digitization and automation.

Which data is the right data? Which processes can be made more efficient with data and key figures? What kind of new business models result? What prerequisites are needed, what technical infrastructure, which type of company organization? And, what can we do today, and what is worth doing?



Many companies have not yet been able to develop any solutions or strategies in this area. There are, however, certainly some interesting approaches as to how data and key figures can be used, with or without the support of technology, to improve processes and thus increase value creation.

Collecting, analyzing, and optimizing – and then evaluating – data from processes is the core business of our center for applied research. That is why, for this issue of SCS Special, we have decided to pursue these questions with some of our partners from practice, while being well aware how complex, networked, and diverse the world of corporate data already is. For a clearer overview, the ideas and projects presented here are oriented towards the elementary stages of the value-creation process, from production and warehouse, transport, and distribution activities to the customer's door. The articles are marked accordingly.

We hope to be able to offer you not only some interesting reading, but also a clear way of shining some light on the question of how today's technologies and methods can be used to produce data and key figures that will improve your company's efficiency and turnover tomorrow.

Kind regards,

A handwritten signature in black ink, appearing to read 'Alexander Pflaum'.

Prof. Dr. Alexander Pflaum  
Head of  
Fraunhofer Center  
for Applied Research on  
Supply Chain Services SCS

A handwritten signature in black ink, appearing to read 'Roland Fischer'.

Dr. Roland Fischer  
Managing Director of  
Fraunhofer Center  
for Applied Research on  
Supply Chain Services SCS

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## PUBLISHING NOTES

### EDITOR:

Fraunhofer Center for Applied Research on Supply Chain Services SCS of the Fraunhofer Institute for Integrated Circuits IIS, Nordostpark 93, 90411 Nürnberg, Phone: +49 911 58061-9500, Fax: +49 911 58061-9599, E-mail: info@scs.fraunhofer.de, www.scs.fraunhofer.de

The Fraunhofer Center for Applied Research on Supply Chain Services SCS of the Fraunhofer Institute for Integrated Circuits IIS is a legally non-independent research institution at the Fraunhofer-Gesellschaft. Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V., Hansastraße 27 c, 80686 München, www.fraunhofer.de

### EDITORIAL TEAM:

Daniela Rembor (responsible), Christina Waibel

### PROOFREADING:

Daniela Rembor, Karin Matura (graphics)

### LAYOUT AND PRODUCTION:

kleines designstudio, Nuremberg

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## HOW DIGITIZATION IS CHANGING COMPANIES

# SMART NEW WORLD

It's no longer a secret that digitization means more than just connecting the Internet and computers. The increased integration of microelectronics into everyday products is opening up completely new worlds of application.

Cyber-physical products, known as »smart products« have the potential to fundamentally change companies. They are moving the boundaries of sectors, opening up new opportunities, and revolutionizing business models. In order to generate actual added value, however, complementary innovations such as mobile and cloud computing, data analytics, and digital social networks are needed. The individual technologies merge to form a new IT infrastructure that allows innovative, data-driven information services but also presents a company's innovation management with new challenges.

### UNDERSTANDING DATA AS A VALUE AND USING IT ACCORDINGLY

A very important point here is that data continues to increase in value compared to physical products. Cyber-physical systems allow data to be recorded more frequently, more comprehensively, and in an automated way. The granularity, quality, and availability of the data available in the company are growing constantly. Data firstly allows reality to be modeled in more detail and thus better decisions to be made. Secondly, data can also be used to predict the future to a certain extent with the help of statistical processes. And, thirdly, data forms the basis for working out recommended actions for the future, making use of analytic-mathematical processes. Recognizing and implementing these potentials is not simple, and presents management with special challenges.

### DATA-DRIVEN SERVICES ALLOW NEW OFFERINGS TO BE MADE TO CUSTOMERS

An increased orientation towards data as a value-bearer is always connected to development and offering of data-driven services. Customers no longer pay for the product; they take advantage of it in the form of a service. Backflow no longer



**CONTACT:**  
PROF. DR. ALEXANDER PFLAUM  
INFO@SCS.FRAUNHOFER.DE



occurs directly after production of a good, but is accumulated over a longer period. Due to this increasing service character and their direct integration into the value-creation process, customers are increasingly becoming co-producers. New service-oriented payment models also mean a change to the market. Small and medium enterprises, as well as workshops, now suddenly become potential users of the service. In addition to the actual value offering, the business model is also changing dramatically from the customer's point of view.

#### THE FUTURE WILL BE A »BUSINESS ECOSYSTEM«

The same applies to the resource point of view. Handling and evaluating data are becoming key activities. Digital service platforms are developing into an important key resource without which the transformation of a company into a digitized version of itself is unthinkable. The necessity of also setting up a service organization in addition to the existing product-oriented organization results in new cost structures that must be managed by the company. New key skills e.g. in the area of embedded systems and data management that were traditionally not developed by production companies in the past require a targeted and well thought-out expansion of

a company's partner network. An equal cooperation replaces the classic supplier/customer relationship and turns company networks that are oriented towards focal companies into »business ecosystems.« Data generated by smart products thus changes not only the manner in which companies make their money; the data's influence also affects the company as a whole. Data and the information generated from it are thus no longer considered a means to an end, as simple support for physical procurement, production, and distribution processes. They should instead be considered value-bearers, a valuable natural resource that needs to be used. Companies that have recognized this and actively live digital transformation will develop a clear advantage for the future.



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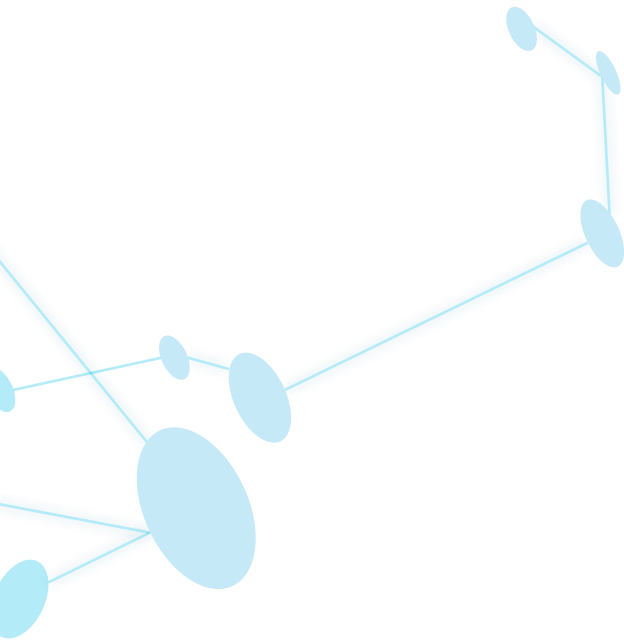


INDUSTRY 4.0 IN PRODUCTION

# THE STATE OF PLAY







**CONTACT:**  
MAXIMILIAN ROTH  
INFO-MARKT@SCS.FRAUNHOFER.DE

As a production-specific aspect of the Internet of Things (IoT), Industry 4.0 promises large cross-sectoral growth potential.

An increase in efficiency in production and logistics by means of the comprehensive use of data and information will help Germany to take on a leading industrial role. At the same time, there is an ongoing controversy about what Industry 4.0 actually includes, which Industry 4.0 applications are currently on the market and which specific measures users and providers should implement in order to close possible gaps between requirements and current technical abilities.

#### **DEFINITION OF SECTOR-SPECIFIC APPLICATIONS REQUIRED**

Anyone who would like to know what makes a functioning and sustainable Industry 4.0 application needs to enter new terrain. He needs to create a basis by asking protagonists about their requirements, working out the abilities and status quo of the existing technologies, and, especially, defining the applications that make up the sector in question. The results are otherwise too heterogeneous and not informative. For the automation and microelectronics industry, Fraunhofer SCS has compiled these questions in a current Industry 4.0 study.

#### **CPS IN THE AUTOMATION INDUSTRY**

Drawn up by request of the Deutsche Forschungsgesellschaft für Automatisierung und Mikroelektronik e.V. DFAM (German Research Association for Automation and Microelectronics), the first stage of the study, based on more than 100 research projects investigated, identified the 12 important applications of cyber-physical systems (CPS) in production, including the management of logistics, energy, or tools, condition monitoring, adaptive production systems, and human-machine interaction. After that, the most important functions that cyber-physical systems are intended to fulfill in this area were then defined. From the point of view of the experts questioned, these are up to ten functions or requirements that can be demanded of a CPS: Identification, sensors, data processing, localization, networking, visualization, control/monitoring, actuating, simulation, and adaptability.

## APPLICATION DETERMINES SCOPE AND DEPTH OF FUNCTION

Naturally, not every function needs to be covered by every application and the aspects in question can also differ. These ten defined general requirements thus represent the possible function scope, but this may differ depending on the application. In addition, within every individual function, the next step is to determine the function depth or the individual form of the function, based on the specific requirements in a given use case. Let us take an example. If, within an application, a CPS needs to be localized, the function scope is thus expanded by the »Localization« point. How exactly the localization takes place is determined by the function depth – for example, there is less depth if only a space-exact localization is required but there is greater depth if centimeter-exact localization is needed.

## STATUS QUO AND FUTURE OF CPS IN THE AUTOMATION INDUSTRY

Using a subsequent market investigation of currently available Industry 4.0 products, a determination was made as to how applications with regard to function scope and function depth are currently put together, i.e. which needs can be serviced. By investigating associated research projects, a future scenario was sketched for every application. These scenarios show the direction that practical requirements but also technological feasibility will take in the near future. In the next step, comparison of the future scenario and current products supplied the development requirements for each application.

The implications of implementation were also demonstrated for the communication and security requirements of the future scenarios.

Finally, cross-application function and technology evaluations, aggregated statements from expert interviews, and evaluations of existing publications were used to provide additional information about Industry 4.0 requirements. Recommended courses of action were then derived. The study also gives a final overview of the application process for obtaining funding for Industry 4.0 plans, including potential funders, and makes it easier for companies to implement their own Industry 4.0 plans.

## EXAMPLE: LOGISTICS MANAGEMENT USAGE CASE

The study made one thing clear: As part of ongoing digitization, the processes in logistics and intralogistics are about to undergo great changes. The vision that came out of the analyses and interviews about logistics management focuses in this example usage case clearly on more automation: In the future, intra-logistics processes are triggered in a decentralized and automated manner and without the support of employees. In order to realize this vision, containers, transport machines, and company software – as well as the systems and employees – need to be linked to each other and be able to communicate. The integration of highly flexible actuators allows machines to handle and transport even fragile goods. Using advanced sensors means that machines can detect their working environment independently. This means that time-consuming teaching-in and configuration processes are no longer needed. The transport machines used can detect conditions independently and use them as the basis for making their own decisions.

## IMPLEMENTATION OF INDUSTRY 4.0 IN LOGISTICS

In order to investigate the current implementation status of Industry 4.0 in logistics, three commercially available products were selected that already match this vision to a certain extent and they were then methodically evaluated by Fraunhofer SCS experts. The products are the G-Com system from Grenzebach, the Flexconveyor from Gebhardt Fördertechnik and the picking robot Toru from the young company Magazino. These products all allow independent and efficient goods transport. Grenzebach's G-Com uses driverless transportation systems that follow floor markings for orientation and are coordinated centrally by software. The Flexconveyor from Gebhardt is a modular conveyor technology that uses sensors to analyze current capacity and then optimizes the routes of goods to be transported in a decentralized manner. Toru from Magazino is a picking robot that can work side-by-side with humans in warehouse environments. The robot independently finds the shortest routes and can add or remove goods with various dimensions to and from the warehouse.

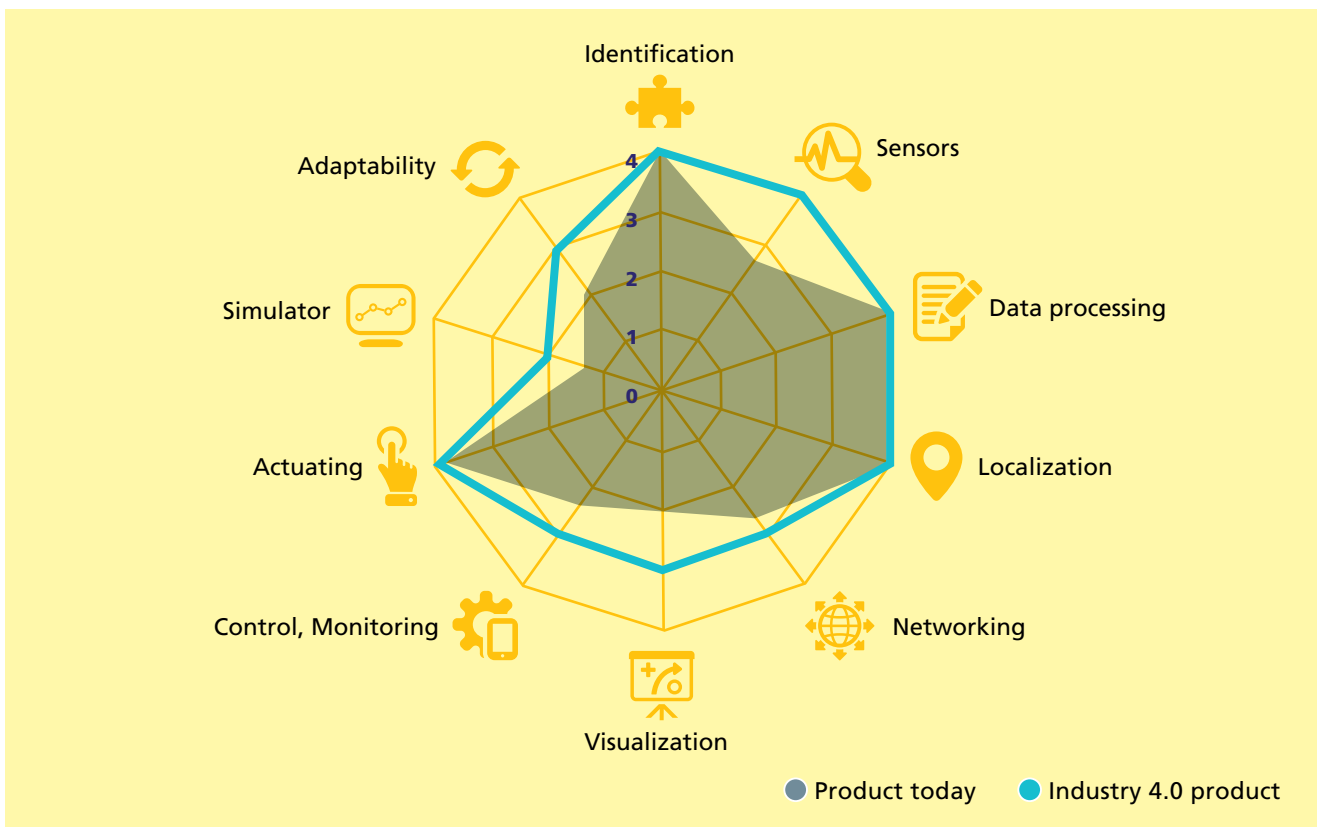


Fig. 1: Functional comparison of the Industry 4.0 future scenario for the »Logistics management« application with currently available products.

If you compare the implementation of the functions of the products presented with those that are actually required for the Industry 4.0 future scenario shown, you will see that independent transport of goods as per the future vision is a very demanding task (see the blue line in the spider-web diagram). The products presented (gray area) can already independently identify goods and items; data that is produced is processed in accordance with requirements and localization is very precise for many applications. Future developments are intended to add improved sensors to the hardware. Furthermore, improvements to the machines' software can ensure that the data collected by the sensors is used more effectively. These improvements would mean better analysis of the environment and thus increase the self-sufficiency and adaptability of, say, driverless transportation systems.

This is just an example of one future scenario within an application. The study contains future scenarios for the other 11 identified applications, each of which is considered in the same depth.

The study can be downloaded from  
[www.dfam.de/service-studien-handbuecher.php](http://www.dfam.de/service-studien-handbuecher.php)



### ☛ Integration and application platform IAP

When coming up with company-specific applications, various functions are to be taken into account such as the identification of individual objects, recording and visualization of geodata indoors and outdoors, and the processing of sensor data such as temperature, humidity, or speed. Furthermore, tasks for the active control of basic technologies are also possible, e.g. an optical or acoustic signal from a sensor node. The variety of data obtained must be evaluated and translated into operative company processes on an event-by-event basis. That is why Fraunhofer SCS developed the integration and application platform IAP.



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CONTACT:  
ULLI MÜNCH

INFO-TECHNOLOGIEN@SCS.FRAUNHOFER.DE

## A HALL FOR INTELLIGENT PROCESSES

# INDUSTRY 4.0 YOU CAN TOUCH

The vision of Industry 4.0 is that tomorrow's production will be completely networked, flexible, energy efficient, and scalable. To this end, data is required to be generated almost in real time, to be included in products and processes, and to be distributable along the value-creation chain. The aim is vertical and horizontal digital value creation, i.e. comprehensive across all levels, stages, functional areas, and company boundaries.

### NEW TECHNOLOGIES FOR A NEW TYPE OF VALUE CREATION

This is possible thanks to the use of new technological solutions and the setting up of the right infrastructures. Once a company decides to implement its vision of digitization, e.g. in order to optimize processes and applications, this always has an effect on other protagonists in the value-creation chain. This is because digitization does not end at the shop floor of the producer. Neighboring internal and external functional areas such as suppliers, logistics service providers, or retailers, also need to react and adapt their processes and business models to the new conditions. Industry 4.0 affects more and more companies.

### QUESTIONS POSED BY DIGITIZATION

But: How can the steadily increasing amount of information and growing information density be intercepted technologically? What data and key figures are really needed and which ones are insignificant? How can new technologies be integrated into the existing infrastructure and how does this change established processes? Which applications are predestined for a digital transformation? But, most of all: Which of the many possible technologies is the right one for my individual needs?

Precisely these complex questions need to be answered before a financially significant decision can be made. Small and medium-sized enterprises, in particular, often lack the required resources to find out the right answers.

### TEST AND APPLICATION CENTER FOR DIGITIZED PRODUCTION AND LOGISTICS

That is why the Fraunhofer Institute for Integrated Circuits IIS set up the L.I.N.K. test and application center: In the hall, production operations and their service providers will find a realistic and practically tested production and logistics environment, with loading ramps, pallet warehouses, a supermarket, ground conveyors, and much more.





L.I.N.K. test and application center in Nuremberg

All the processes and applications found there run digitally. The necessary cyber-physical systems (CPS) are developed in the center's own research departments with the focuses on localization, identification, navigation, and communication.

Companies can test, validate, and – if necessary – adapt technology-supported processes before integrating them into their own value-creation chain. Or, they can just find out general information about specific processual and technical solutions for classic intralogistics problems.

Currently, for example, a system is set up in the hall that can localize every type of ground conveyor in an indoor space. Key figures are automatically generated from this data in order to be then able to optimize the routes taken. A new type of picking system based on wireless sensor networks is also installed. Wireless compartment displays, shelf signal lamps, and picking nodes are connected to a warehouse management system using middleware. Temporary warehouse structures, quick redesign of removal compartments and shelves, or even location-specific special functions that are only relevant

to one part of the hall are no problem to this system. The hall also has solutions for the management of load carriers or production operations with small batch sizes, and for tool tracking.

### WELCOME TO REALITY – TESTING, VALIDATING, AND INFORMING IN A REALISTIC ENVIRONMENT

In this hall, companies can test their own processes and technological solutions for feasibility in realistic conditions and get to know the latest technical digitization approaches on the shop floor and in the neighboring internal and external function areas. They also find out which process-related and economic framework conditions have to be taken into account, how increasing digitization affects the company's own IT systems, and how human-machine interaction is changing. It's barely possible to be closer to practical conditions.

## 👉 Technologies and solutions for digitized value creation

*Value-creation processes are changing due to increased digitization. More and more companies use technologies to optimize logistical and industrial processes and to use data to create added value. But only the intelligent linking of goods and information flows and the holistic interpretation thereof – linking current technological means with individual company processes and the needs of people, i.e. employees and customers – will turn pure data into future-proof opportunities for companies. Only this linking will create more flexible and more efficient working and production processes, new service ideas, and products.*

*That is why Fraunhofer SCS is working together with departments at Fraunhofer IIS on the research project »Technologies and solutions for digitized value creation,« which looks at specific solutions for practical application. The aim is to place technologies in a clear business and economic context, including the three usage cases that are currently in focus:*

- Smart containers in production processes
- Automated key figure collection in internal company transportation
- Supporting assembly with intelligent objects

*The project is being funded by the Bavarian Ministry of Economic Affairs and Media, Energy and Technology as part of the Bavarian digitization initiative »bayern digital.«*



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**CONTACT:**

CHRISTOPH HOHMANN

INFO-TECHNOLOGIEN@SCS.FRAUNHOFER.DE

FROM KEY FIGURE, TO  
CLOUD, TO NEW SERVICE

# THE SMART SERVICE FACTORY

**Digitization is changing production: Technological systems of ever-increasing intelligence can be used not only to actively control and optimize production processes; the data collected is used more and more to develop new services and business models. Cloud services collect and bundle this data and open up new access routes. Furthermore, new smart data approaches offer the ability to analyze and visualize data. However, the use of the data and its actual implementation in specific solutions is currently falling short of its potential.**

## KEY FIGURES IN INTRALOGISTICS – EXAMPLE OF TUGGER TRAINS

Often, the problem lies in capturing suitable data as automatic and fault-free recording is generally not established for every process without additional changes having to be made. Taking the example of intralogistics: Here, transportation processes and, in particular, tigger trains, play an ever more important role in lean process execution. For more than a decade now, tigger trains have been in use in more and more production environments for material supply and disposal. The tigger train is essentially composed of a tractor with several trailers and generally calls at certain stops along a previously defined route. At each stop, material is deposited and generally also collected. The high level of transparency and structuring of the material flow and the higher transportation capacity mean that tigger-train systems are replacing forklifts as a means of

material transportation. In order to keep tigger-train systems efficient after introduction and to adjust them to sometimes creeping changes to the environment, supervisors must record suitable key figures. To this end, Fraunhofer SCS developed the innovative »Intelligent key-figure determination IKE« system, which can be used to record tigger-train processes in a production or warehouse environment in detail. This data can then be used to make transportation faster and more efficient, but also to generate new business.

## HOW DO WE DETERMINE THE RIGHT KEY FIGURES?

Thanks to a sensor box on the tigger train tractor, location data and data on driving times and downtimes, as well as the condition of the load, can be recorded. This basic data makes it possible to analyze the routes taken as well as the capacity of the tigger train in order to make a valid statement about potential weaknesses in the processes. Based on the data held by the company about its processes and structures, individual conclusions can then be drawn and improvement measures worked out.



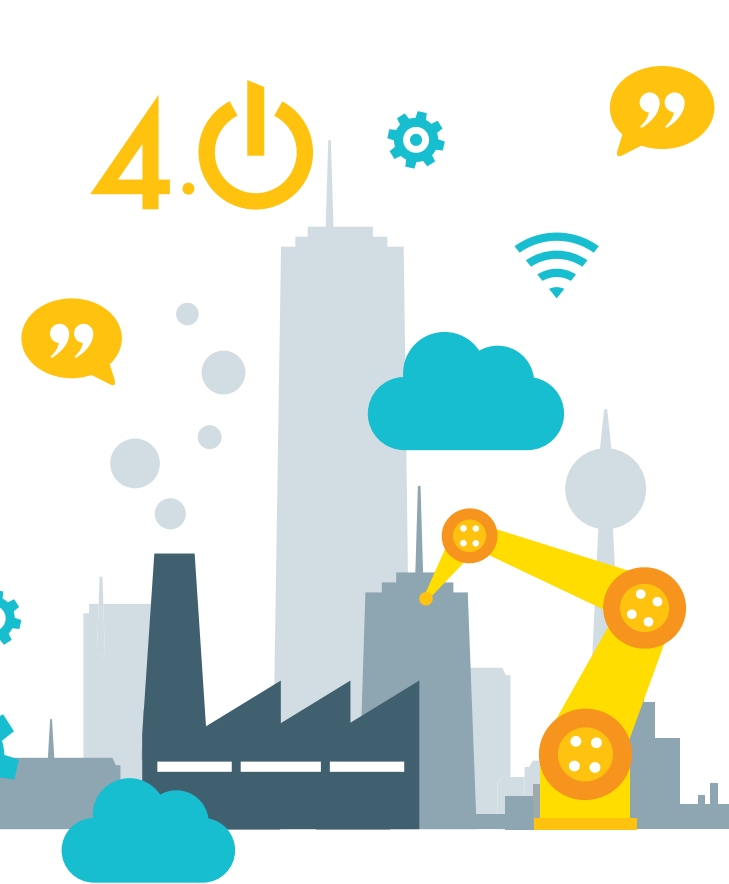


Photo: © Mimi Potter – fotolia.com

### FROM MANY DATA SILOS ...

As the example of the IKE system clearly shows, the use of data is currently limited to a very small area. Although companies often have a large stock of data, it is generally held in numerous »data silos,« i.e. in closed, non-networked data spaces that are only used for a clearly delineated field of topics and tasks. Other areas of the company generally have no access to them, or only limited access, and the use thereof is not shared.

### ... TO A CENTRAL DATA HUB: THE CLOUD PLATFORM

Here, however, is the very key to the actual and sustained benefit of increasing digitization in production: Only when all relevant and existing data is used and combined across the whole company and the whole function, can the necessary added value that would justify a significant investment in new technological solutions be attained. But how can data from very different areas of a company be merged and used to develop new services? One possible solution is offered by cloud platforms. Here, data is collected, processed and placed into context centrally in order to optimize existing processes, but also to realize new services.



### SmartDiF research project

*The »Smart service factory« (»SmartDiF«) research project is being funded by the German Federal Ministry of Education and Research. Affiliated partners include, in addition to the Fraunhofer Center for Applied Research on Supply Chain Services SCS of Fraunhofer IIS, Friedrich Alexander University of Erlangen-Nuremberg, Siemens, and Schaeffler.*

### USING THE CLOUD TO CREATE NEW SERVICES: THE SMART SERVICE FACTORY

The increasing availability of internal and external data offers enormous potential for the services of the future. This data can be used to make forecasts about customers' future requirements, e.g. when patterns in the usage data of a machine indicate that failure is imminent or where weather data shows that a delivery might be late. Developing services based on this kind of data – fact-based service engineering, as it is known – is currently held back by the lack of a simple, secure, and easy-to-handle methodology and tool support that could be usable by a large number of medium-sized companies and start-ups. This means that systematic and fact-based innovation support that includes various actors and thus improves the speed and the quality of service development beyond company boundaries is not yet possible.

This gap is addressed by the »Smart service factory« (»SmartDiF«) research project. Based on existing cloud offerings as a prototype development environment, the project is developing and testing a methodology for fact-based service engineering and creating a physical-digital workbench. This refers to a mixture of physical and digital aids that can be used to develop service innovations. This means providing small and medium-sized enterprises (SMEs) with the necessary support for a service design procedure that is appropriate to the application and is based on existing and newly created data resources. Furthermore, the logic and mechanisms and the challenges and limits of the transfer of the fact-based service engineering methodology to other fields with data-intensive service innovation are also being highlighted. In the future, the actors involved, particularly SMEs, will be able to develop, introduce, and operate smart services as a community.



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**HOW WAREHOUSE PERFORMANCE  
AND EMPLOYEE MOTIVATION  
ARE CONNECTED**

# HARD AND SOFT KEY FIGURES IN THE WAREHOUSE

In a warehouse, all processes need to be optimally adapted to one another in order to allow quick and reliable delivery of goods. In order to improve its own warehouse, a company often uses the warehouse benchmarking method. A highly efficient and effectively organized warehouse based on hard, qualitative key figures is just one side of the coin.







INTERVIEW WITH MARKUS OLBRICH  
LOGISTICS DIVISION MANAGER  
AT KONRAD KLEINER GMBH & CO. KG

This is because high-performance and flexible logistical processes live only if employees are motivated. It is they who, in practice, ultimately decide how well the theoretically designed processes work. For this reason, companies should be familiar with the correct indicators in order to be able to rely on motivated and thus high-performance employees.

In order to increase motivation, financial incentive systems are generally used. In the low-wage sector, however, these are not much of a lever. Logisticians, in particular, do not have any alternatives. The »MoLa« research project – »Increasing motivation for logistics specialists and assistants in warehouses« – is concerned with this very question. The aim is to find out how the motivation of employees in logistical processes in the warehouse can be increased in order to improve the efficiency and quality of warehouse processes and the innovativeness of small and medium-sized logistics service providers and wholesalers. To this end, the warehouse performance of the companies involved is benchmarked, and a suitable methodology toolbox is developed to improve employees' motivation.

**Fraunhofer SCS spoke to Markus Olbrich, the logistics division manager at Konrad Kleiner GmbH & Co. KG – one of the companies involved in the research project – about their own approach to warehouse benchmarking and employee motivation.**

**»A warehouse can be as well organized as you like from a process point of view – if the employees don't pull together, it'll be difficult.«**

*Warehouse benchmarking is a tried-and-tested method to measure and evaluate one's own warehouse performance. Based on certain key figures, you can quickly get an overview of productivity, quality, and costs. Which process key figures do you use, for example, to control your warehouse at Kleiner?*

Every day we record a range of numbers and data that we collect directly in our warehouse and thus within our division. On the one hand, this includes data on the infrastructure such as the number of trucks to be unloaded daily, the load carriers delivered daily or transported internally, or the package rate. On the other hand, the actual availability of the employees is reported daily in the individual warehouse departments, as is the vacation and sick-day rate. We also work with productivity-related data such as non-personalized evaluation of the daily pick performance across all picking areas, the maximum numbers of picks possible based on the available employees assuming a defined average pick performance per hour, unprocessed goods receipt, or the permanent analysis of daily pick development in order to be able to react quickly to changes in our customers' ordering behavior. In addition, we consider quality aspects such as the development of the logistic error rate per week. We currently do not use key figures on the turnover frequency and stock development to control our warehouse processes for organizational reasons.

*When key figures are captured, they can be useful when used for a comparison with other figures. Then, it is naturally particularly interesting to see what other people really do in the warehouse in order to improve their warehouse performance. But can these highly individual best practices in the warehouse really be transferred to one's own company?*

This best practice transfer is not always possible. There cannot be one hundred percent adoption as the warehouse structures of different firms are too different. Individual processes or sub-processes of a warehouse organization can, however, be transferred as best practices to one's own warehouse. It must be easy to implement the practice in question in one's own warehouse structure. Then, a good idea from practical application will also be a good idea for the company. We need to keep our own organization and our own processes in our sights in order to be able to make the right decisions. It's not that we need to have one-to-one transfer, but we need new and implementable suggestions. For example, we saw at a pharmaceutical wholesaler's that the company was automatically generating a box specification at the packing stations based on the item's stored master data. This ensures that the optimum packing material is used, space is not wasted, and the goods to be dispatched are optimally protected. That's a great idea and, for us, a best practice, as the box to be used for the packing process in our company is still selected by the employee. The necessary link between the volume of the box and the overall volume of the shipment is not currently available, however.

In many sub-processes, such as quality systems, a transfer is possible. Some smart ideas – such as zoning, visualization, appointment of a quality manager for a warehouse sector, acoustic or light signals in the event of quality problems, the creation of an alarm plan, etc. – can be implemented quickly at any type of warehouse or organization. It is simply a matter of continuously questioning oneself and looking around to see how other companies approach the same problem. Ways to improve the warehouse and move it forward can be selected from the possibilities noted.

*Simple organization of the warehouse processes is one thing, but the employees are another. What effect do they have on a warehouse's performance?*

A warehouse can be as well organized as you like from a process point of view, but if the employees don't pull together, it'll be difficult to fulfill the warehouse's requirements. Employees have a very big influence. That is why they need to be

included in upcoming changes in good time instead of simply being presented with a fait accompli. Employees can join in and ultimately make their own positive contribution to better key figures, improved performance, and optimized processes as they will identify with the innovations or changes. That's why our motto is: »Talk to them and take them along from the beginning.«

*Why are you involved in the MoLa research project that poses the question as to how employees' motivation can be increased?*

Because employees have such an influence on the performance of our warehouse, we are very interested in finding out what motivates them and how we can do more for this motivation. Thus, we want to find new approaches to an intrinsic increase in motivation in order to improve the efficiency and quality of our warehouse processes. We can then use the evaluation to determine how satisfied our employees are with the existing structures and what effect new measures, e.g. those to improve processes, can have. This feedback is very important to us.

*Mr. Olbrich, thank you very much for talking to us.*

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### ➡ MoLa – Increasing motivation for logistics specialists and assistants in warehouses

*The aim of the research project is to increase the motivation of employees in logistical processes in the warehouse and thus to increase the efficiency and quality of warehouse processes. Various non-financial intrinsic methods are identified, described in an accessible way, and evaluated. Performance indicators are captured and contrasted by means of comparative measurements in a benchmarking approach, while the same thing happens with subject evaluations of motivation and health. The result is a catalog of various motivation methods drawn up for operational managers in the warehouse and a draft version of an online platform that allows easy access to the lessons learned from the project.*

*Within the project, Fraunhofer SCS is responsible for performance evaluation of warehouse processes compared to a benchmarking database with more than 160 warehouses. It also analyzes the effect of motivation and the methods used on warehouse performance. In addition to Fraunhofer SCS, the project partners are Augsburg University of Applied Sciences and Friedrich Alexander University of Erlangen-Nuremberg. A committee overseeing the project supports the plan from the practical side of things – the following logistics service providers and wholesalers are involved: Spedition Benedikt Biehle GmbH & Co.KG, Hagebau süd Logistik GmbH, Max Müller Spedition GmbH, Spedition Nuber GmbH, Konrad Kleiner GmbH & Co. KG, PIEL Die Technische Großhandlung GmbH.*

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THE NEW TYPE OF ORDER PICKING  
WITH PICK-BY-LOCAL-LIGHT (PBLL)

# DIGITIZATION IN THE WAREHOUSE

When new technologies enter the warehouse, certain obstacles need to be overcome. Not every technological solution is compatible with the existing warehouse equipment, certain software architectures prevent a fluid exchange of data, and overly complex systems quickly overstrain employees. Nevertheless, digitization continues apace because technologies simply make processes more efficient – including within order picking. Here, for a long time, many different products have been available on the market that are intended to support employees with selection, assignment, and distribution of goods to make work faster and produce fewer errors.





In manual ordering picking, pick-by-light (PbL) is a widely used system that supports employees. The only problem is that common commercially available solutions are greatly dependent on a fixed assembly and cable-based energy and communication supplies. This means high levels of installation work and a lack of flexibility. The available cable-free solutions are generally not practically feasible due to the difficult and expensive maintenance required.

#### PBLL – WIRELESS, INTUITIVE, AND LOW-MAINTENANCE

For this reason, and together with the »Materials Handling, Material Flow, Logistics« chair at the Technical University of Munich, Fraunhofer IIS and Fraunhofer SCS have developed a wireless pick-by-light order picking system called pick-by-local-light. The system has three node types and is based on the wireless protocol developed by Fraunhofer IIS for wireless sensor networks, »s-net.« The structure of the wireless system hardly differs from the PbL systems available on the market: the withdrawal quantity is shown on a display, LEDs show the picker where items need to be taken from, and confirmation is carried out at the touch of a button. Thanks to s-net protocol, however, the system has a long battery life (approximately one year) and mobile sensor nodes carried by the pickers allow location-independent functions such as automatic logging in to zones.

#### ☛ Pick-by-local-light (PbLL)

*The PbLL research project, designated IGF project 18139 N for the Bundesvereinigung Logistik e.V. (BVL International) research association, was funded by the German Federal Ministry for Economic Affairs and Energy via the German Federation of Industrial Research Associations (AiF). This is a program for funding collective industrial research, created by an act of the German Bundestag.*

#### PRACTICAL TEST PASSED

The pick-by-local-light system has now been tested both in volunteer tests at TU Munich and in field tests carried out by the project partner BSH Hausgeräte. For BSH, two aspects were of particular benefit: simple installation and flexibility. This system means that pallet cages can be equipped with PbL compartment displays and items can be reorganized in a flexible and very simple manner.

After the four days of tests, the pickers were asked about the use of pick-by-local-light in their company. All participating pickers from BSH Hausgeräte declared the system to be practically feasible in later surveys. Only in 2.9 percent of orders occurred critical faults that needed to be fixed by the end of the project duration. Furthermore, the pickers found working with the pick-by-local-light system to be motivating and intuitive. Together with industrial partners, work will be carried out after the project ends to implement the system with high-quality components suitable for industrial use.



**CONTACT:**  
ANDREAS HÖLCZI  
INFO-TECHNOLOGIEN@SCS.FRAUNHOFER.DE





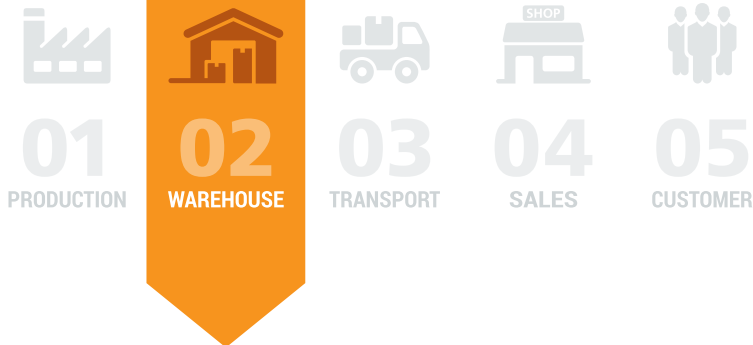
**ANDREAS RÖGNITZ**  
**WAREHOUSE MANAGER**  
**AT BSH HAUSGERÄTE GMBH**

## **ANDREAS RÖGNITZ TALKS ABOUT THE PRACTICAL TEST OF THE PICK-BY-LOCAL-LIGHT (PBLL) ORDER-PICKING SYSTEM**

The international parts logistic center in Fürth supplies around 16 million spare parts and accessories to more than 80 countries for the brands within the BSH Hausgeräte group. The spectrum of items covers more than 150,000 material numbers, which are held in a warehouse space of about 50,000 m<sup>2</sup>. The customer structure stretches from end customers, dealers, and service partners to the company's own service technicians and international BSH regional and central warehouse locations.

Due to growth in the building layout, the heterogeneous order structure, and a high degree of seasonality, we already use very flexible order-picking solutions such as pick-by-voice and classic pick-by-light. Pilot installations of PbL solutions in the racking system have, however, shown us the limitations. The large, one-off expense for installation and the work required to adapt the system, e.g. changes to the compartment subdivisions, quickly make conventional systems uneconomical. These experiences and the motivation of being able to work on the development of new technologies from the user point of view moved us to join the project committee as an industrial partner.

One particular highlight was the final practical test in our logistics center at the end of the project. To make the test as realistic as possible, our aim from the beginning was to pick orders »live« using real order data. To this end, an interface between our warehouse management system (WMS) and the PbLL demonstrator needed to be programmed. As a back-up, the employees had pick lists from our WMS in order to detect any errors that occurred and had to report them to the on-site project team. The employees in the warehouse were very enthusiastic about being involved in this kind of practical test and, in a subsequent feedback session, everyone involved was able to contribute their comments and suggestions for improvement. In conclusion, the PbLL system passed its practical test at BSH, even if additional optimizations are required, as one would expect for a system to be given an industrial use.

**CONTACT:**

TOBIAS SEIDLER

INFO-TECHNOLOGIEN@SCS.FRAUNHOFER.DE

Containers play a big role in production and logistics. When goods and products need to be produced and made available, containers are used. With their help, the goods are collected, lodged in warehouses, and transported to their destination. To this end, there must always be enough containers of the right kind. They also need to be in the right place at the right time, or else production processes get delayed.

**CONTAINERS DO CREATE VALUE!**

But this is precisely where the problem lies, as in many companies the issue of container management, i.e. the control, monitoring, improvement of container circulation is rather neglected. Containers generally are not (yet) considered to be among the value-creating elements of the supply chain, so appropriate management is not a priority. As a result, large numbers of safety stocks are held in order to guarantee the necessary availability, and the lack of knowledge – especially real-time knowledge – of the stock numbers, circulation times, reasons for loss, or markings, leads over and over again to operational faults such as delivery delays or short-term production failure.

**CONTAINER CIRCULATION – UNTAPPED POTENTIAL**

The fact that scenarios such as this are not very rare is shown by the St. Gallen container management study. Most of the companies surveyed that use containers classified their container-related processes as critical or very critical [1].

There is thus enormous potential; the crux of container management is container circulation with a clear focus on container availability. So, if you always know exactly which

containers there are, what condition they are in, and how many there are, you can guarantee a friction-free flow of materials in the supply chain.

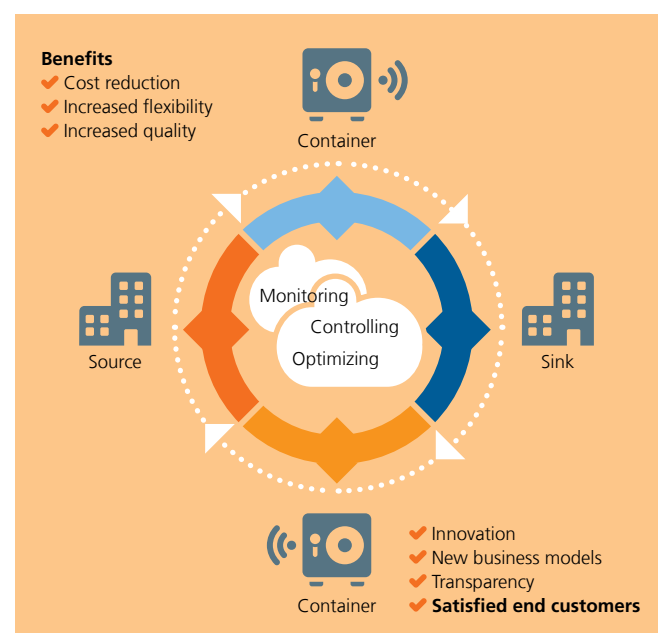


Fig. 1: Intelligent container management

# ANALOG BECOMES SMART

## CONTAINER MANAGEMENT OF THE FUTURE



Photo: © olly - fotolia.com

### CONTAINER MANAGEMENT – CURRENT CHALLENGES

However, this is not all that simple, as optimum management must be able to handle a range of challenges in container control. This means that container management changes constantly: On the one hand, this is due to the high degree of labor division – many container-related tasks are farmed out to third parties – and, on the other hand, it is due to technical change and innovations. In the last 50 years, information technologies have twice completely changed the competitive environment, and thus companies' strategies as well. During the first IT wave in the 1960s and 70s, initial manual activities were automated such as order processing or bill paying. The arrival of the Internet in the 80s and 90s changed corporate activities for the second time. The Internet allows global integration and cooperation of individual activities in the value chain of external suppliers, distribution channels, and customers. Logistics, as a cross-divisional function within a company, is particularly affected. Until now the product, i.e. the container, has remained largely unchanged. But this is going to change [2].

### Platform for the digitization of near-production logistics services: DProdLog

*In practice, producing companies and logistics services have few means of precisely controlling containers to supply production. The results are tricky manual tasks for recording processes and high levels of container stocks. As a rule, the control is missing the necessary information or, if the information is held as data, the technical infrastructure in order to find the relevant information from among all the information that is received. The DProdLog research project therefore aims to develop a modular service platform for the digitization of near-production logistics services concerning »smart« containers. To this end, data about container processes is captured using basic Industrie 4.0 technologies and is analyzed and processed on a software platform. Data acquisition is carried out by integrating microelectronics into the small load carriers. The data-based services are developed and then made available via the software platform. The benefit: quicker, improved processes, lower costs, and more quality.*

*The project partners are Euro-Log AG, Böllhoff GmbH, GS Frachtlogistik GmbH and Otto-Friedrich-Universität Bamberg. The project will end in March 2019.*

*Beyond that, Fraunhofer SCS is developing other solutions for smart container management. The focus lies on the development of services based on Industrie 4.0 technologies for various container types.*

### SMART – FROM A SIMPLE CONTAINER TO A PROMISING DATA SUPPLIER

Here, a change can be seen, as trends such as digitization and servitization do not stop before they reach container management. The new technological possibilities and business strategies have more and more of an effect on the function and performance of existing products, including containers, up to and including the redefinition thereof. Containers with embedded microelectronics now provide data that can be used to increase the transparency of container circulation. Provided in the form of key figures, e.g. attrition rate or turnover frequency, this data improves the entire process chain. This means that costs can be significantly reduced and productivity increased. Ultimately, the digitization of container management allows the development of new, data-based services up to and including entire business models.

And that's just the beginning: smart containers will trigger a large, if not the largest, transformation of value creation networks. Technology-based development of services will play a decisive role. Smart container management will thus, in the future, affect not only the process organization itself, but also companies' business models and thus the entire supply chain.

[1] Hofmann, E., Bachmann, H.: Behälter-Management in der Praxis: Die St. Galler Behälter-Management-Studie. State of the Art und Entwicklungstendenzen bei der Steuerung von Ladungsträgerkreisläufen, DVV Media Group, Hamburg (2006)

[2] Porter, E.M., Heppelmann, E. J.: How Smart, Connected Products Are Transforming Competition. Harvard Business Review November 2014 issue

# THE FUTURE IS SMART

## CONTAINER MANAGEMENT IN TIMES OF DIGITIZATION

Fraunhofer SCS is doing research with application partners into the possibilities and potential offered by smart containers and relevant production-logistics services. As part of the research project »DProdLog – platform for digitization of production-related logistical services,« Fraunhofer SCS talked to Mario Grassy, business development department at Böllhoff GmbH, and Peter Steyer, logistics planner at Bosch Rexroth AG, about aims, potential, and trends in the supply process for C-parts.



Peter Steyer



Mario Grassy

INTERVIEW WITH MARIO GRASSY,  
BUSINESS DEVELOPMENT, BÖLLHOFF GMBH, AND  
PETER STEYER, LOGISTICS PLANNER,  
BOSCH REXROTH AG



*Which aims are you pursuing in the C-parts supply process?*

**Grassy:** More efficiency, quality, and transparency! Our systems allow us to take control of the entire delivery chain for our customers: material planning, procurement, quality check, warehousing and internal company goods distribution, right up to the conveyor belt. In doing so, we use modern RFID technology. With digitization and container processes, we want to attain the necessary flexibility and productivity in order to be able to fulfill customers' requests to the best of our ability.

**Steyer:** Within C-parts management, a short replacement time of 24 hours is the goal, where material availability is optimum. We also try to reduce the complexity of the procurement process in order to minimize the material planning work, the stock, and the space needed.

*How do you measure whether you have achieved your goal?*

**Grassy:** For our systems, a backlog rate is determined for small load containers that need to be supplied. Instead of key figures, values are determined for these closed systems. These values are checked annually. For container processes that do not run on our systems, however, key figure determination is necessary and this requires a greater effort. For these processes, we establish the completeness and correctness of the deliveries, a credit note rate (error percentage), and productivity.

**Steyer:** To check whether our aims have been achieved in the container processes, we record the stocks, the outflows or consumption, and determine the coverage. These are compared with the targets and thus form a significant element of the materials planning control. These are determined separately for different production areas.

*Which data and services would improve the container processes?*

**Grassy:** For our systems, positioning/localizing data for small load containers would be relevant. This would allow attrition due to false storage to be reduced. Furthermore, automated reordering based on a level indicator would be a good idea. Information about available storage spaces on our customers' premises could also lead to additional cost reductions. Transport costs could be calculated more accurately when compared with stock costs.

## A FEW THEORIES ABOUT DEVELOPMENT IN CONTAINER MANAGEMENT:

When smart technologies integrate the physical world of containers with the virtual world, supply chains become more cost-efficient and time-efficient.



**Grassy and Steyer**

When container information is transmitted continuously using smart technologies and can be processed into key figures, the planning, control, and monitoring of the container circulation is improved.



**Grassy and Steyer**

When containers are universally equipped with smart technologies, new business models become possible.



**Grassy and Steyer**

**Steyer:** For reordering of C-parts, it would be a good idea if the manual tasks required to read out RFID tags on the small load carriers were no longer needed. Currently, an employee needs to transfer the RFID tag of an empty small load carrier to an RFID letterbox in order to trigger reordering. An additional advantage for us would be a reduction in replacement time, e.g. through an increase in transparency of stocks and delivery times. In addition, a service that monitors the expiry dates of goods in containers and intervenes if critical events happen would be useful.



## COMPARISON OF FREIGHT COSTS IN THE CHEMICALS INDUSTRY

# BETTER PURCHASING

Around a third of the total costs that a dispatching company spends for its logistics services is spent on transporting the goods. So it is a good idea to negotiate well with your service providers. How does the purchaser know, however, that the negotiated price really matches the market value and that competitors are not paying much less for similar distances and services?

Obtaining prices from several different suppliers is difficult and also only provides limited information, as negotiation positions are always limited without external information.

### BENCHMARKING IN FREIGHT PURCHASING IMPROVES PURCHASING PROCESSES

Particularly in the chemical industry, the conditions for purchasing are particularly complex: The transportation of chemical products is sensitive and is subject to comprehensive legal regulations, meaning that demands on service providers are particularly high. Service providers' price levels are thus generally not comparable with the rest of the transport mar-

ket, meaning that there is asymmetry of information between service providers and shippers.

These conditions meant that, more than ten years ago, an amalgamation of chemical companies encouraged the Fraunhofer Center for Applied Research on Supply Chain Services SCS in Nuremberg to develop a benchmarking methodology based on internal company data for this market. With its help, the level of freight costs and the development thereof among participating companies on European routes can be compared in an anonymized manner. The participants in the Fraunhofer working group »Freight Price Index Benchmarking

for the European Chemical Industry,« most of whom have been involved for years, appreciate that this allows them to position themselves better in purchasing negotiations and to control their internal purchasing processes in a more targeted manner.

**Fraunhofer SCS spoke to Stefan Bartens, Vice President Logistics Procurement Europe at BASF, about the benefits of freight benchmarking in the chemicals industry.**

*What information does the freight benchmarking from Fraunhofer SCS provide you with?*

The benchmark holds a mirror up to us and shows us where we, as BASF, stand with our freight agreements compared to the rest of the chemicals industry. This mirror shows us not only an up-to-date image; it even has a memory: the benchmark shows us across a longer period how our freight is developing compared to the overall market.

**»I appreciate the sophisticated methodology, the professional execution, and the fact that the results are not used by Fraunhofer for other purposes.«**

*How do you evaluate this information in freight purchasing?*

We use the benchmark primarily as important market information in order to adapt our procurement strategies permanently to market development. In addition, the benchmark is also suitable for internal discussions with our management, as it shows us where we stand and where action needs to be taken.

*How have the purchasing processes changed?*

For us as purchasers, it is always exciting when the benchmark holds a mirror up to us. This leads to a sporting ambition always to purchase better than the competitor. After an analysis of the results, particularly when they don't look very good, we very quickly come up with new ideas in order to do better next time.



**STEFAN BARTENS**  
VICE PRESIDENT LOGISTICS  
PROCUREMENT EUROPE, BASF

**What do you particularly appreciate about freight benchmarking?**

In addition to a very sophisticated methodology and years of professional execution, I particularly appreciate the fact that the benchmark results are not used by Fraunhofer for other purposes such as consultancy services or freight tenders for other companies. This means that the data will not be misused.

**Mr. Bartens, BASF has been a member of the Fraunhofer working group for ten years. Why? And what would you like to say to companies that are not yet members?**

Both for small and large companies in the chemicals industry, freight benchmarking offers an attractive cost/benefit analysis. This has been shown by its ten years of experience with a very stable group of participants. The benchmark has developed very dynamically over the last few years, from both a methodological and technological point of view due to the use of web-based databases. New members will be entering a feathered nest, so to speak, and, together with established users, can increase the benefit to everyone by adding more data.

*Mr. Bartens, thank you very much for talking to us.*

## ABOUT THE METHOD

# FREIGHT COST BENCHMARKING FOR MORE EFFICIENCY AND LOWER COSTS



With the »Freight Price Index Benchmarking for the European Chemical Industry« working group, Fraunhofer SCS offers manufacturers and raw material suppliers, particularly those for chemical products, an anonymized comparison that reduces the lack of market transparency of freight rates in Europe. This means that the dispatching companies can control their purchasing strategies in a more targeted manner and improve their negotiation position with service providers.

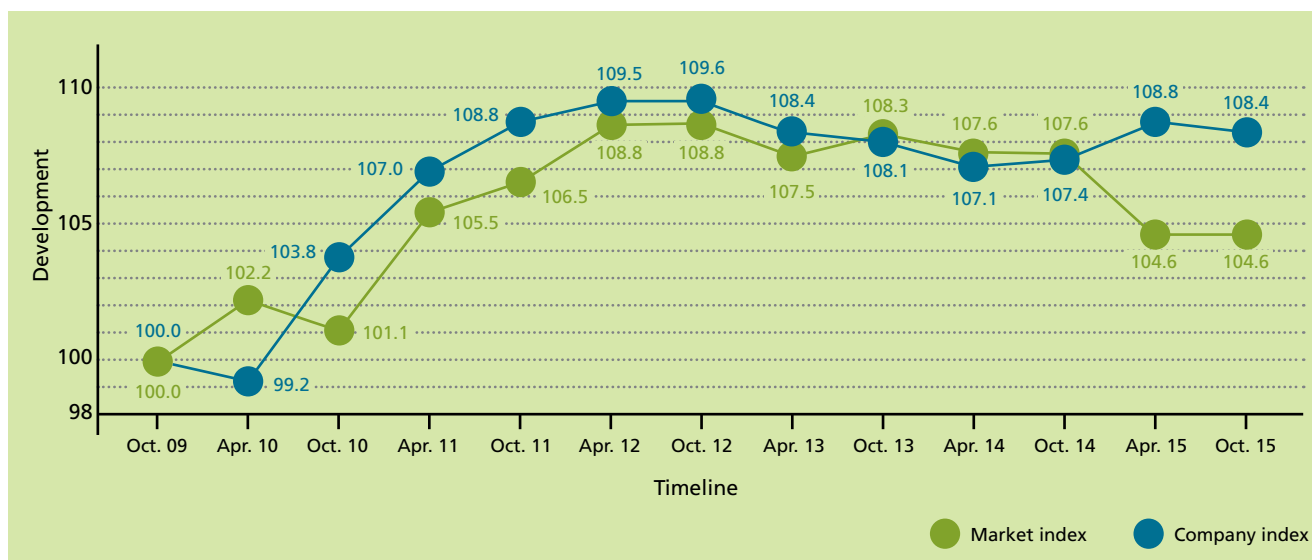


Fig. 1: Region-specific representation of semiannual freight rate development from 2009 to 2015.

The benchmarking methodology developed by Fraunhofer SCS has, for ten years, allowed participating companies to compare the level and development of their own transport costs with current market prices. To this end, internal company data is drawn on, processed in an accumulated manner, and made available to participants in the working group in an anonymized manner in a shared data pool. This means that every company can compare its data with that of other companies and check its own position compared with the market.

#### CONSIDERATION OF ALL RELEVANT COST DRIVERS IN AN ANONYMIZED COMPARISON

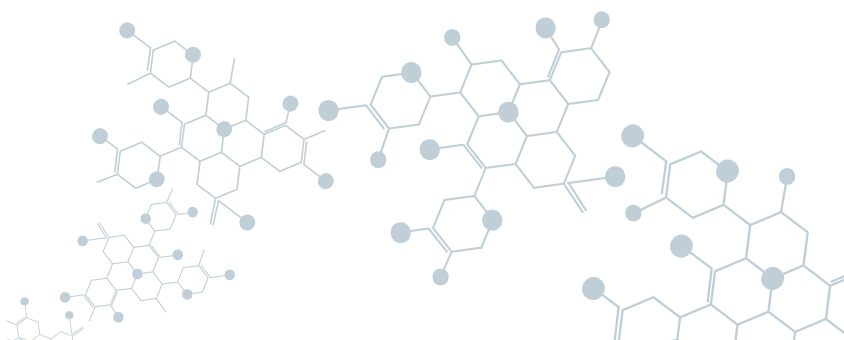
Data collection in the Fraunhofer method covers, in addition to the freight prices for the transport quantity, the transport type, the transport distance and the geographic categorization as well as information about a hazard surcharge, etc.

In the first step, Fraunhofer SCS defines the relevant transport routes in a personal meeting with the individual companies. For data collection, the companies receive entry sheets to state the specifications and freight prices for individual trips. This data is then checked by Fraunhofer SCS and made comparable – e.g. by standardizing the transport data. This means that only the relevant information is included in the evaluation and the data quality is always guaranteed. For reasons of anonymity, only connections with enough participants are benchmarked.

#### EXAMPLE OF PORTFOLIO-BASED RESULT PRESENTATION

An example of a portfolio-based result presentation of company-specific trips can be seen in figure 2. It can be divided into four quadrants (comfort, observation, danger and problem zone). For each category (FTL, tank, etc.), the company receives an individual graph that shows the freight rate development of individual trips for the company in question when compared to market development (vertical axis). On the horizontal axis, the company index is also specified in comparison to the market index. The market index classifies the position of the company by comparing its absolute freight prices with the absolute market prices.

The form of representation selected here not only shows the current positioning, it additionally presents the previous period. This allows a change in classification of trips to be detected quickly and it can be quickly seen to what extent there is currently a need for action, and/or to what extent adaptations already made resulted in the hoped-for success. In this example, the company ought to analyze particularly the cost structure for the connections between DE-IT, BX-BX, BX-DE, and DE-DE more precisely and step up its efforts at the next price negotiation in order to reach the comfort zone in the future.





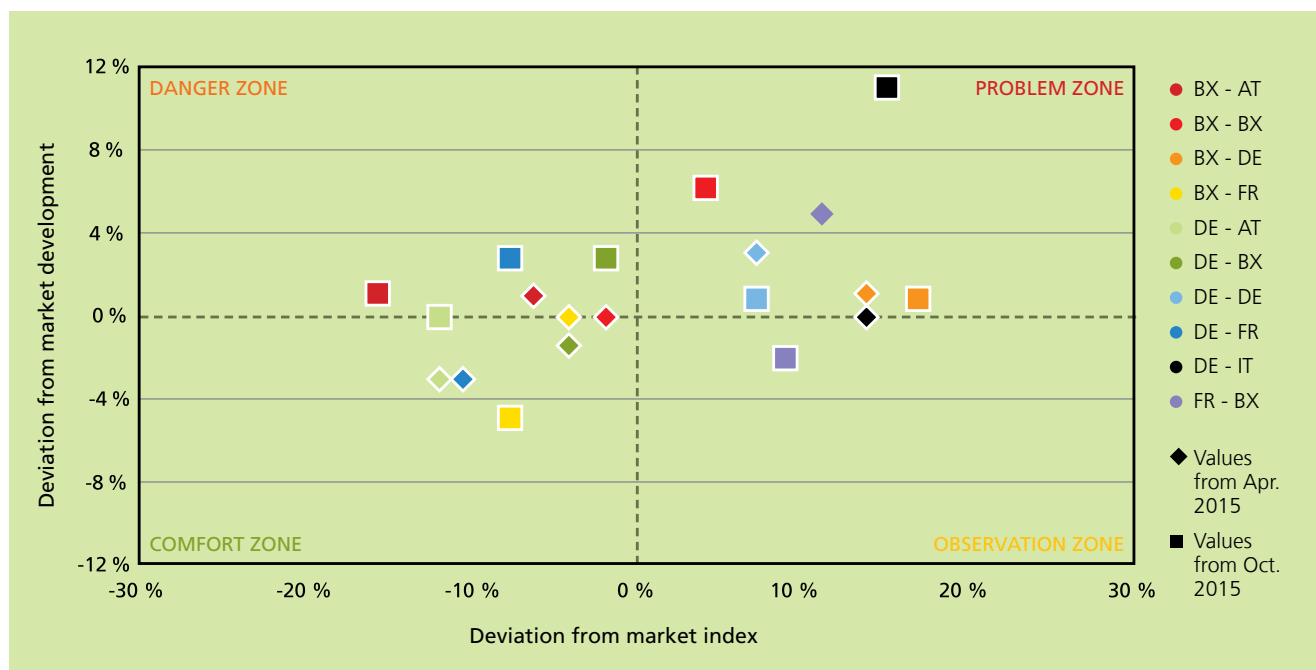


Fig. 2: Fictional example of a portfolio-based result representation of company-specific trucks in the area of »full load truck, packed goods.«

### STRENGTHENING THE PURCHASING PROCESS

The dispatching companies can strengthen their purchasing process with the information about their benchmarking results. The areas in which the absolute prices and/or the development of the prices seem unfavorable when compared to the market, special analysis can be carried out inside the company and addressed separately to the service providers. The internal company evaluation, and the exchange with the service providers, can then be based on facts.

### Working group »Freight Price Index Benchmarking for the European Chemical Industry«

The anonymized and aggregated freight rate benchmarking and the appropriate working group for the chemicals industry in Europe has been offered by Fraunhofer SCS since 2005. Twice a year, the researchers investigate the freight rate development of companies using European connections.

The further development of benchmarking is agreed with the participants to match their requirements and is based on scientific findings. Fraunhofer, as a scientific institution, also guarantees neutrality and confidentiality when handling the sensitive benchmarking data. To ensure compliance with anti-trust and competition, the freight benchmarking is supervised by a lawyer specialized in such laws. This lawyer checks the benchmarking methodology and participates in the annual meetings of the group.

#### Become a member

The Fraunhofer working group »Freight Price Index Benchmarking for the European Chemical Industry« offers:

- Benchmarking results in an individual online dashboard
- Participation in the annual meeting
- Fraunhofer expertise on the European transportation market

The group is run as an open project and can be expanded to add suitable companies in order to guarantee the comparison basis for the benchmark.



**CONTACT:**  
FLORIAN MÄGERLEIN  
INFO-PROZESSE@SCS.FRAUNHOFER.DE

FROM PEERING INTO A CRYSTAL BALL  
TO A KEY FIGURES-BASED  
COST FORECAST



01  
PRODUCTION



02  
WAREHOUSE



03  
TRANSPORT



04  
SALES



05  
CUSTOMER

# PUTTING LOGISTIC COSTS AND MARKET COSTS TO THE TEST

Which market prices are justified when purchasing logistics services now and in the future? How are logistics costs in the logistics sub-markets used by a company developing? Are the costs incurred and the market prices to be paid in a healthy ratio and which developments are to be expected in the future? Fraunhofer SCS, by request of Henkel AG & Co. KGaA, has developed a tool for cost forecasting that is based on market data and allows forecasts for the next 18 months. The company has been able to look successfully into the future for more than five years.

Internationally acting companies of the dispatching industry use the various offerings of the logistics market: depending on the focus of the company, the goods to be stored and transported, or the market being targeted; Purchasers in the company regularly need to award services in warehousing, freight and general cargo, courier express and package services, or services in sea and air freight. This means that they need to request and evaluate tenders. The more global the companies are, and the more diverse their products, the more difficult it is for freight purchasing. When many company divisions require different logistical services or the transport is to many different countries around the world, not only the country-specific details with regard to logistics costs or market prices in general need to be taken into account, but so too do the specifics of the sub-markets in question or the special requirements of internal units.

If a freight purchaser would like to take all of these individual factors into account adequately with regard to the company division, logistics function, or country-specific details, he/she must consider a wide range of possible combinations, know the market background, and, at best, be able to evaluate the future developments of the cost- and price-determining individual factors. The capture and evaluation of retrospective values thus also plays as big a role in effective control as the use of valid tools for forecasting costs and prices in the the future. Only in this way can a purchaser carry out well-grounded and successful negotiations with service providers.

### KEY FIGURES FOR AN EFFECTIVE FORECAST

Efficient and effective matching of logistics purchasing with market developments is made much more difficult due to all of these aspects, however. In order to support purchasing effectively, both representative and forward-looking key figures are needed. These key figures, however, cannot just be purchased on the market due to the complexity and variety of influencing factors. Instead, what is needed is a suitable tool that can not only measure the current logistic costs and then forecast them, but that can also take into account the market price development. This development takes not only the costs, but also the demand development into account, meaning that it can move in a different direction from the cost curve.

#### STEP 1:

#### DETERMINATION OF THE COST STRUCTURE AND THE COST PARAMETERS

The first step is therefore to determine the underlying cost factors for each section. What is more, the determination must be made in a manner that is adapted to the requirements of the company in question. This may depend on the countries through which the transport route passes, which goods are to be transported, which service is used in which country, or how high the company's transport volume is in individual sub-markets. In addition to obvious parameters such as diesel costs, toll road fees, or any personnel costs that arise (administration, maintenance, etc.), additional dimensions such as rent costs for logistics properties (in particular for warehousing services), capital costs (in the procurement of trucks or planes), or energy costs (climate control of logistic properties) are relevant.

In order to be able to compare individual countries as well as the aggregated logistics costs and market prices of several national markets, the development of individual cost factors must be kept updated in an indexed manner. Only in this manner can a uniform basis be formed, and this basis is a requirement for the cost forecast. In addition, a suitable weighting factor is needed. This individual company value presents, in practice, the importance of individual purchasing countries within a relative comparison. All these values together provide a precise view of the current and future development of the logistics costs. An example of the procedure can be found in the following figure.



Fig. 1: Elements of logistics cost analysis at country level

#### STEP 2:

#### DETERMINATION OF THE MARKET PRICE

In the next step, the determined costs for logistics services are compared with the development of the actual market prices. In order to guarantee the most effective benchmarking possible for logistics service purchasing, the forecast costs and the actual price developments are compared at regular intervals. While the development of logistics costs is mapped by the aggregation of the sub-factors in question, the market price side is largely affected by two driving factors: the actual costs incurred by the logistics service provider, and the capacity and demand situation in the country in question in which the service is being provided. This situation also affects the price of a service.

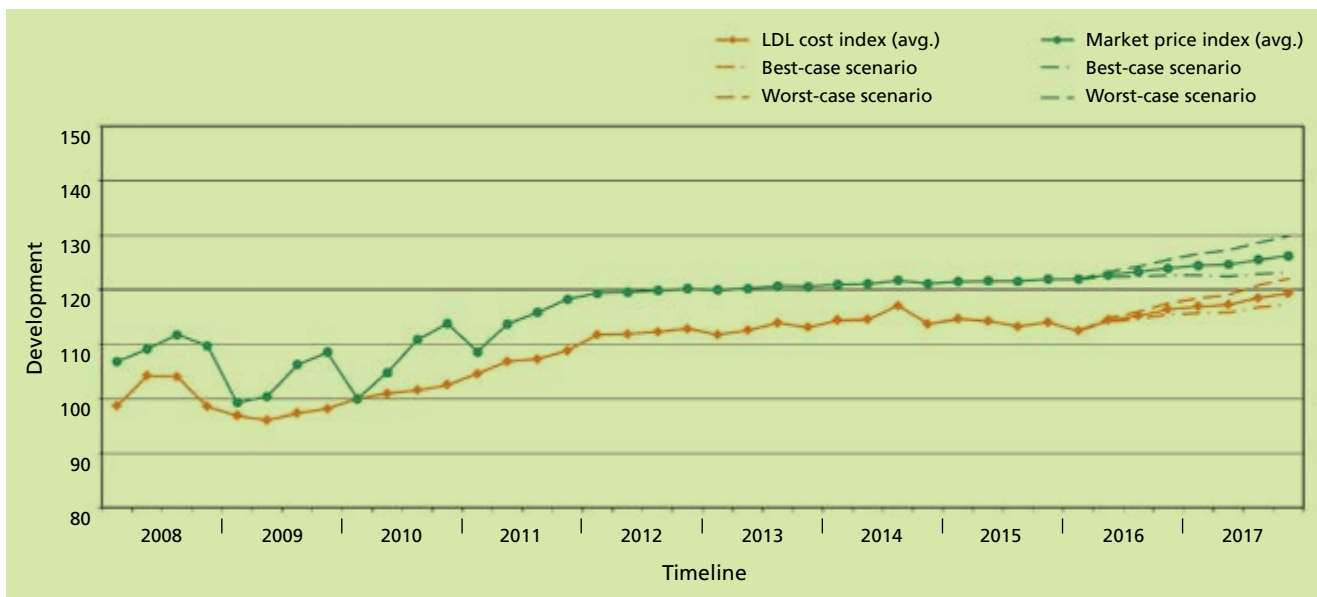


Fig. 2: Example: Cost and market price development for FLT transports in Austria

There are several factors in the evaluation of the economic output of an economy. In the case presented, the national gross domestic product was selected as a decisive factor in the development of logistics demand. Furthermore, the fact that the effect of logistics costs and economic output on the market price can show country-specific differences. In highly developed industrial countries such as Germany, the market price is affected considerably more by the current economic development and thus by the existing demand. This differs from developing and emerging countries, where the price to be paid is affected much more by the costs in question.

### STEP 3:

#### COMPARISON

The tool developed for Henkel AG & Co. KGaA now offers the option of showing a history for each of the around 30 countries included, indexed according to cost and market price development and weighted according to transport volumes. In this way, comparisons can be made between individual national markets and the success of the logistics service purchase can be evaluated directly. Noticeable changes in the individual cost elements, such as the recent persistently low diesel prices, are also made as transparent as demand shocks in individual markets. For example, the price index in the full truckload (FTL) sector has now risen by about 10 percent in Germany when compared to the start of 2008, while in Greece – due to the drop in demand – it is below its 2008 value. Regular updating of individual input variables guarantees that the cost and price forecasts are as up to date as possible.

### FORECAST:

#### WHICH CORRIDOR IS PROBABLE?

The individual results presented in the tool show purchasers not only the cost and price development up to the current quarter, but also the assumed future changes. With appropriate indexes saved, the future course of the curve within a certain corridor can be shown realistically. The forecast horizon shown covers 18 months. This adds actual facts and an expectation corridor for future development to the experience of logistics purchasers. With a tool like this in the background, transparent facts complement the »crystal ball,« providing a much sharper image of the future.



**CONTACT:**  
UWE VERES-HOMM  
INFO-MARKT@SCS.FRAUNHOFER.DE





**HOW DATA (COULD) REVOLUTIONIZE  
THE TRANSPORT PROCESS**

# TRANSPORT LOGISTICS

# 4.0

Industry 4.0., Internet of Things, cyber-physical systems: these buzzwords are currently generally associated more with the production industry. Here, the latest information and communication technology is used actively in order to network a company's own supply chain comprehensively and to generate data that can be used to monitor, control, and optimize processes better. But the increasing digitization does not stop when it reaches transportation.



On the one hand, dispatching companies expect an appropriate level of technological upgrading to ensure that the companies' value creation can be organized as efficiently as possible. On the other hand, transport logistics would also like to benefit from the digital changeover. With sensors and suitable infrastructure for data capture, analysis, and evaluation, the classically organized inter-company transport processes are developing into transport logistics 4.0. Data is captured and evaluated during loading and unloading and from within the transport processes. It is important to turn this data into a digital image as quickly as possible in order to be able then to link it to additional information from IT or camera systems and sensors. In real time, measures are derived or self-controlling subsystems are set up. The aim is an efficient, decentrally organized, flexible, and agile transport execution.

**That at least is the vision. But how does reality look? As part of its internal research project »Transport logistics 4.0,« Fraunhofer SCS asked experts, including Matthias**

**Braun, Planning Manager in Network and Location Projects at Volkswagen AG, about the theory and practice of digitized transport.**

*Mr. Braun, how does the ideal digitized transportation chain look to you?*

If I want to design efficient networks, it is not enough only to consider the physical processes. The whole thing starts with forecast data and an effective call-off. We're all familiar with it from online shopping: if I'm surfing at home on a weekend and I look at the various offerings on the Internet, the online trader is able to record my preferences, e.g. what pages I have been too, where I spent a long time, and what topics I was searching for. Sooner or later, I do in fact click on the »order« button to buy the product and complete the process. But I need information like that in transport logistics, too. This means that I need forecast data that will become real call-offs with a certain degree of probability. This information forms the trigger for efficient transport logistics 4.0. By the

**MATTHIAS BRAUN  
PLANNING MANAGER IN NETWORK AND  
LOCATION PROJECTS AT VOLKSWAGEN AG**



way, as far as I'm concerned, this transport process does not end when the delivery is unloaded at the recipient's premises, but only after the bill has been paid. To me, that is the entire transport logistics process that we should focus on.

*In this context, we are also talking about a technical data connection to upstream and downstream systems. How are you currently implementing this?*

Our call-offs are triggered by our production control. And our production planning is hard-wired to the distribution information via the order inboxes. There is thus a logical process chain from preliminary distribution planning to customer orders and production. After goods receipt, this captured data then passes to subsequent systems that are used to pay the supplier and the haulage company.

*What technologies do you currently use to identify your packages in order to guarantee as comprehensive a flow of information as possible?*

Barcodes.

*Do you think that other technologies will be used in the next five years, technologies that may be able to transmit more information independently?*

This is a question of efficiency and economy in a process. The costs may not be higher than the efficiency that I can create. That is a business matter. Naturally, I then need to find new tasks for the employees who are currently responsible for these tasks within the process. But I do assume that something will come along, as the sensors are becoming cheaper and cheaper and their range is becoming much better.

*In what area of transport execution do you see the greatest added value for a digitally supported solution?*

To begin with: wherever we still have lots of paper and changes in media. In the notification process between suppliers and haulage companies, for example, a wide range of media is still in use: fax, e-mail, telephone. I also see additional potential when it comes to freight invoicing. For the haulage companies, it is a great deal of work to merge the delivery notes in order to create or check invoices. The driver also always has plenty of paper on the front-passenger seat. I think that a lot more could be digitized than is already the case.

**»Linking and networking all process participants will become a key factor.«**

And then there's also the full truckload sector. There, completely automated unloading could take place, for example with the use of driverless forklifts or other technology to load and unload trucks. The truck and its driver are a valuable resource and they must be quickly sent off to the next value-creating task. I think that issues like that can be expected to arise soon.

*That brings us to the future of transport logistics. Can you paint us a picture?*

If a better linking of modes of transportation – particularly land-based transportation, such as trucks and the railroad – could be achieved, that would be a huge step. The issues of platooning, vehicles with alternative drives, and autonomous driving are bound to become more attractive for comprehensive use in the future. Linking and networking of all parties to the process will also become a key factor, to ensure that they can then communicate better and more actively with one another than they can today. With this valid and transparent information, the processes can be designed to be much more agile, which will also increase the performance and the competence of individual players.

*Mr. Braun, thank you very much for talking to us.*

### ☛ »Transport logistics 4.0« study

Using the keyword »Transport logistics 4.0«, Fraunhofer is currently investigating the degree of implementation of Industry 4.0 technologies in many sectors within the area of transportation, particularly in logistics, automobiles, chemicals, or machine construction. The study queries the status quo and planning with regard to digitization activities in the company. To this end, interviews were carried out with supply chain experts and a comprehensive online survey was also drawn up.

Specifically, questions were asked about the basic technologies used, the direction of the business model with regard to digitization, the degree of use of digital applications, and the type of data processing. All participants received individual evaluations connected to recommended actions in order to increase or redirect their digital activities. The results of the study will be available at the beginning of 2017.

**01**  
PRODUCTION**02**  
WAREHOUSE**03**  
TRANSPORT**04**  
SALES**05**  
CUSTOMER

TRANSPORT OPTIMIZATION  
DONE A BIT DIFFERENTLY

# THE FASTER PATIENT

When talking about the issue of KPI-driven process optimization, the first thing one thinks of is the improvement of processes in the classic supply chain, such as production, storage, or, in particular, the transportation of goods and products. But products are not the only things that need to be transported – be it with trucks, forklifts, or conveyor belts. People also need transportation, for example in hospitals. Here, again, the aim of the game is to make processes leaner and more efficient to ensure that clinics can absorb the growing cost pressure.



**CONTACT:**  
FRANZISKA JEHLÉ  
INFO-PROZESSE@SCS.FRAUNHOFER.DE



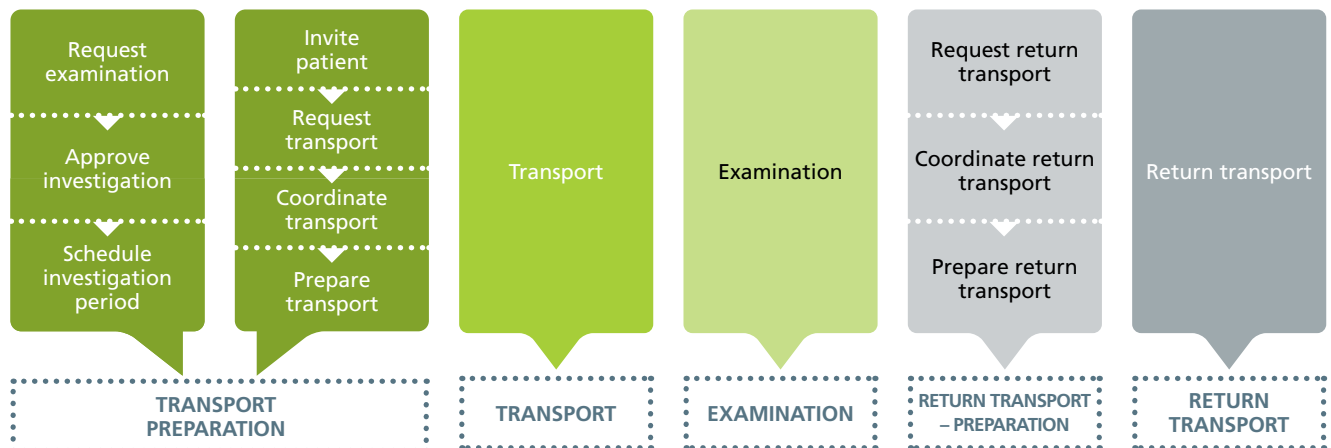


Fig. 1: The patient transport process as a typical patient-centric hospital logistics process.

Efficient ways of working are thus on the agenda – while acknowledging that this is a very sensitive environment with very high standards for the quality of the service. That is because we are talking about one of the most important resources of all: human health. A hospital is a very complex object to investigate, where various logistical and non-logistical processes must be taken into account. Patients are treated by doctors and nursing staff, materials and patients are transported through the clinic, and information is exchanged to accompany the processes.

### USING BENCHMARKING TO IMPROVE PROCESSES IN HOSPITALS

Optimizing processes in this environment is thus a difficult task, as many factors and people with varying levels of influence determine the procedure. In the first step, informative

process key figures that reflect current services are required for an appropriate analysis. And, in the best case scenario, there should be a comparison, so that hospitals do not only evaluate their own performance, but also learn from the best practices of others. A method that combines both of these aspects is benchmarking.

### EXAMPLE OF PATIENT TRANSPORT

Since 2013, for that reason, Fraunhofer SCS has carried out benchmarking for the patient transport (PT) process for clinics. Here, the performance of the process shown in figure 1 is determined by means of key figures on productivity, quality, and costs. Performance is considered from two perspectives (see figure 2): on the one hand from the point of view of process performance of the PT department and, on the other hand, from the point of view of performance across the entire

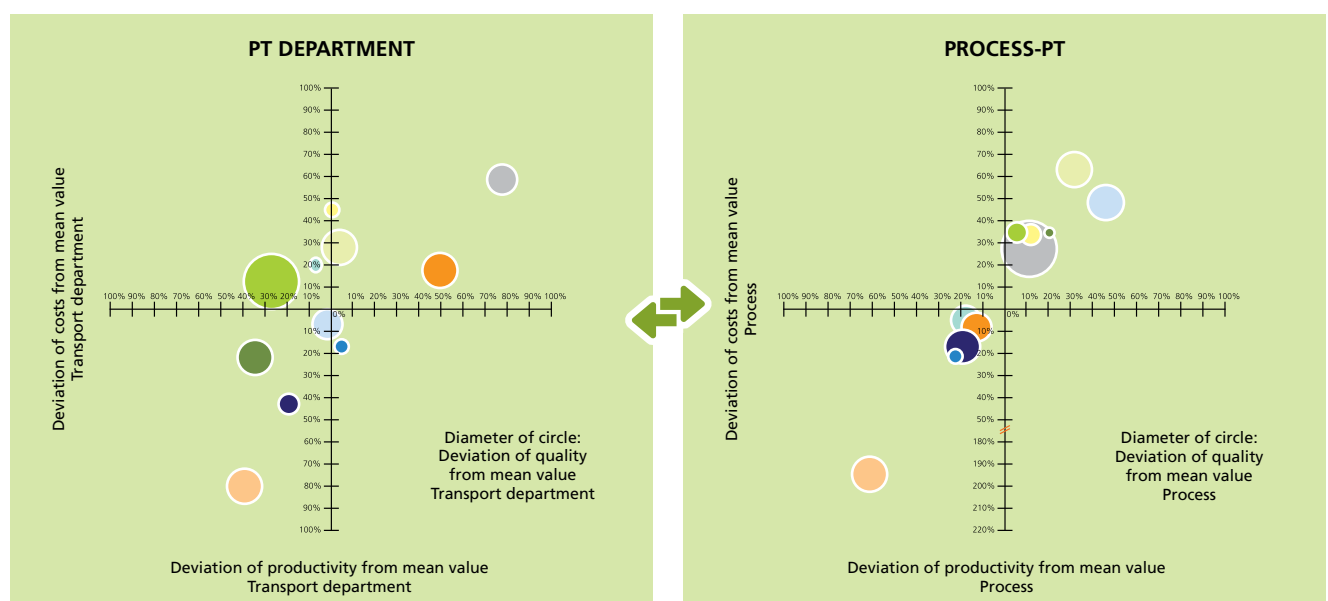


Fig. 2: Comparison of the performance of the patient transport process from two perspectives.

process, i.e. performance of the PT department with the addition of the cross-interface, process-related tasks on a ward and function basis. These two ways of looking at things provide a conclusion with regard to the cooperation between the professions in question.

It can be seen that patient transport can really use optimization. The lead time for requesting and scheduling transport by the ward or function employee alone consumes up to two thirds of the entire process time. A clear organization with precisely defined responsibilities and process structures can help enormously. Even the relatively high error rate in the request process of the transport can be minimized by means of improved communication between the interfaces and a uniform definition of the process steps. And, knowing that load peaks can be expected in the mornings, correct personnel planning is at least as important.

From an economic point of view, these process improvements make sense. Clinics from the benchmarking group were – due, for example, to optimization of the request and scheduling processes – able to save millions and thus to reduce their existing process costs for patient transport by up to 50 percent.

### ✎ The faster patient – benchmarking in patient transportation

*Clinics can, at any time, take part in the benchmarking project with Fraunhofer SCS and thus optimize their patient transport. Everyone who would like to find out more about the topic is advised to read the study "The faster patient – benchmarking in patient transportation," on which Fraunhofer SCS is currently working. It will contain the results of the existing benchmarking participants and general recommended actions for patient transport for service-oriented and more economical patient logistics. This publication is based on an innovation study from 2009 about the same topic, and will appear at the end of this year.*



Contact: [info-prozesse@scs.fraunhofer.de](mailto:info-prozesse@scs.fraunhofer.de)

## BENCHMARKING CENTER NUREMBERG BMC

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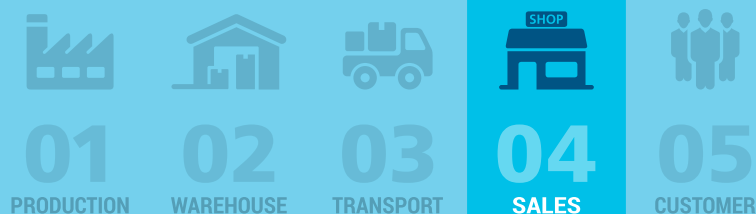
- Cross-company and cross-sectoral comparison of company processes and functions
- Science-based and efficient method for quick and valid discoveries
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- **Distribution benchmarking**  
for wholesalers and contract logistics service providers

- **Benchmarking in contract logistics**
- **Benchmarking in hospitals**  
Patient transport logistics



# SALES CONTROL IN CONTRACT LOGISTICS

OPTIMIZING SALES WITH KEY FIGURES AND BENCHMARKS



Every year in contract logistics, several billion euros of turnover are tendered by industry to logistics service providers. However, this does not happen via a publicly viewable data pool, but rather by direct request from the customer to individual logistics service providers.

The service provider must thus communicate his service portfolio and specific know-how in advance regularly and comprehensively in order to be known to the market and to receive a request to participate in a tender. Working on the tender itself, which is generally a highly individualized process of offer creation and negotiation with the customer, also uses up a lot of resources.

#### SALES IN CONTRACT LOGISTICS:

##### A LOT OF POTENTIAL TURNOVER, A LOT OF WORK?

According to its own initial calculations, Fraunhofer SCS believes that more than **200 Mio. €** in sales costs in Germany per year are spent on contract logistics service providers [1], although the chances of success are relatively low: It is rare that more than **10 – 20 Percent** of tenders that are worked on really lead to being offered the job [2]. Project initiation in contract logistics is thus a double-edged sword for logistics service providers: The market volume of almost **91 billion €** [3] may offer great potential turnover, but the chance of success after taking part in the tendering process is difficult to calculate and a great deal of work is required.

#### SALES CONTROL WITH KEY FIGURES:

##### MORE TURNOVER, LESS WORK?

A remedy is provided by key figure-supported control along the sales pipeline. If you know the implementation and success rates in each process step and – even more importantly – if you can accurately estimate these rates, it is easier to judge the chances of success in each phase of the sales process and thus to increase turnover in a targeted manner or use systematic filtering to reduce the work involved (see also figure 1).





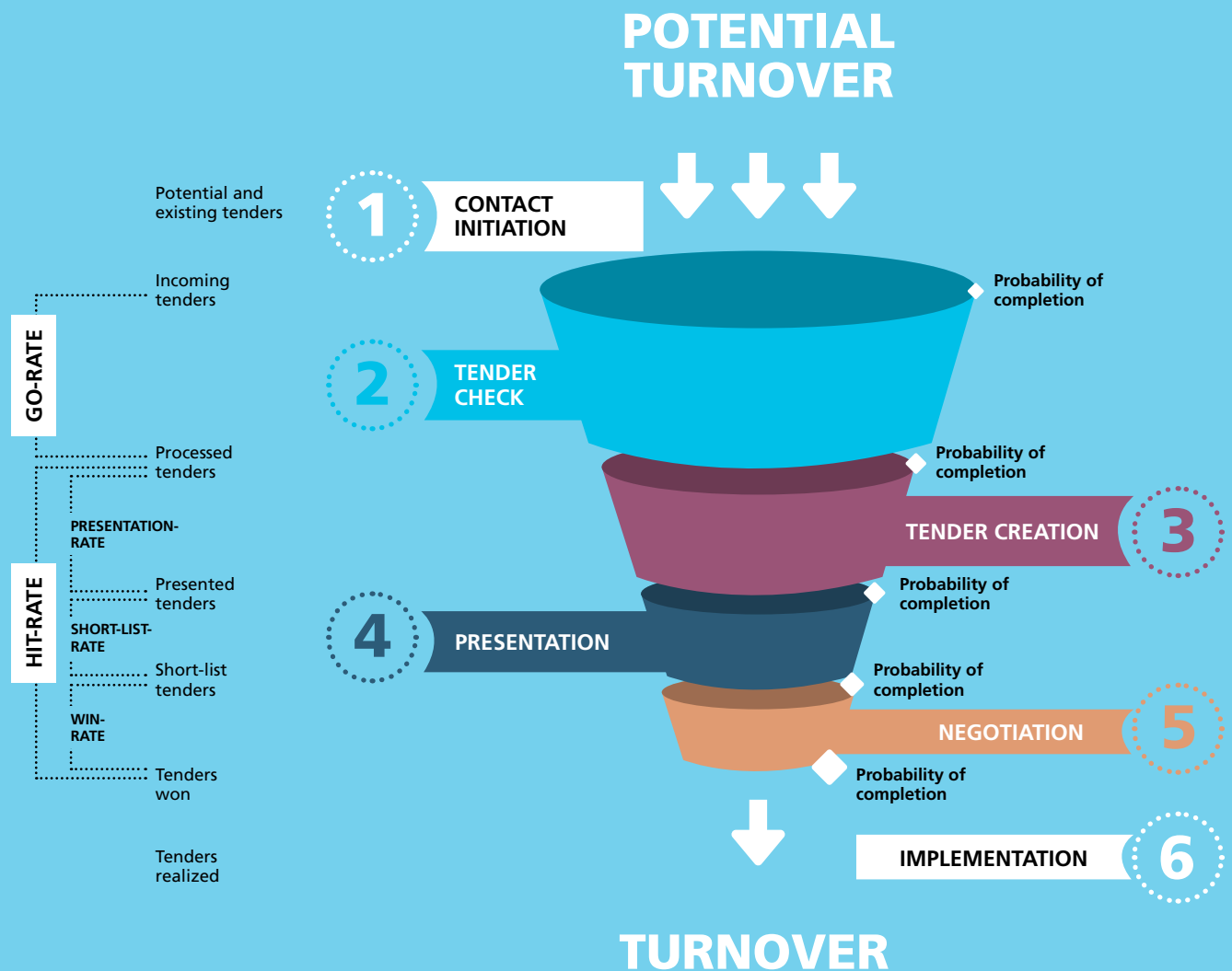


Fig. 1: Distribution pipeline and key figures in contract logistics [2]

### THE INDIVIDUAL PHASES OF THE SALES PROCESS

The sales process in contract logistics starts with the initial contact between the service provider and potential customers. The service provider then checks the incoming tenders and decides whether or not to process them. The service provider then works out individual concepts for the selected tenders and transmits them to potential customers. The service provider then presents the concepts selected by the customer, may then make the short list depending on the customer's selection, and then enters the negotiation phase. The tenders won are then realized in the implementation phase. The entire process, from initial contact with the customer to realization of a concept, often lasts 3–6 months.

### SUCCESS CAN BE MEASURED AND CONTROLLED

Along the pipeline, potential projects and turnovers are reduced, but the chances of being awarded the tender increase. The specification of a turnover target and the definition of the probability of being awarded the tender means that the pipeline can be filled in a well thought out manner and the contract logistics sales can be controlled in a targeted manner. The implementation and success rates between the stages can be measured using rates. The important performance measures include, in addition to turnover in contract logistics sales, the go rate, i.e. the ratio of processed to received tenders, and the hit rate, i.e. the ratio of processed to awarded tenders, as these have a significant influence on efficiency and effectiveness.

**»The sales costs are much higher when acquiring new customers than they are for retention and further development of existing customers. For this reason, sales control should always consider both aspects – and, if possible, in comparison with others.«**

*Karen Klement, Senior Manager Sales & Business Development for Contract Logistics, Kühne + Nagel (AG & Co.) KG*

While the hit rate should be as high as possible it should be ensured that the go rate is of a suitable dimension. A high go rate can lead to fragmentation and below-average turnovers. Too low a go rate, on the other hand, can mean that promising opportunities are missed. According to the Fraunhofer study »Project initiation in contract logistics,« an average of **20–30 percent** of tenders are winnowed out; a few service providers are more rigorous in their decisions and only process less than **50 percent** of the tenders they receive [4].

For contract logistics sales, however, there are hardly any benchmarks to classify one's own performance and rates along the sales pipeline. One's own key figures are therefore not much use if one does not know where one stands in comparison to the competition and what successful logistics companies are doing better.



## BENCHMARKING IN CONTRACT LOGISTICS SALES: LEARN FROM THE BEST!

Fraunhofer SCS is currently working on setting up benchmarking for contract logistics sales. In a direct comparison with others, logistics service providers should be able to classify their own performance as part of a benchmarking study and learn from the best practices of others. As a result, costs in the sales process are reduced and turnover is increased. The remaining market potential that could be outsourced to service providers – about **€ 25 billion**, more than a quarter of the entire market volume in contract logistics – can then be more efficiently and effectively tapped into.

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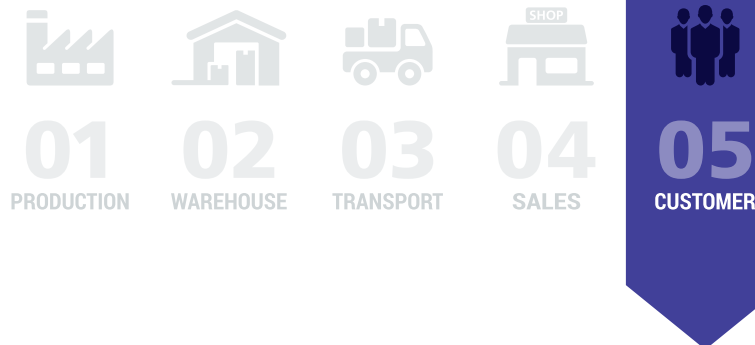
[5] Buck, M.; Wrobel, H. Branchenanalyse Kontraktlogistik: Eine Markt- und Beschäftigungsanalyse in Deutschland, Hans-Böckler-Stiftung, 2015.

## ➡ Sector analysis contract logistics

*At the request of the Hans-Böckler-Stiftung, the authors Moike Buck and Dr. Heiko Wrobel from Fraunhofer SCS analyzed the central market characteristics, employment, and trends and developments in contract logistics in Germany. The study appeared at the end of 2015 and can be downloaded for free from <http://www.scs.fraunhofer.de/de/studien/kontraktlogistik>.*



**CONTACT:**  
MOIKE BUCK  
[INFO-PROZESSE@SCS.FRAUNHOFER.DE](mailto:INFO-PROZESSE@SCS.FRAUNHOFER.DE)



CO-CREATION IN THE OPEN  
INNOVATION LAB JOSEPHS®

# THE USER AS A DATA PROVIDER

Every company wants to be closer to its customer and develop its products or services in accordance with customer requirements. That is why internal developers and engineers work together on projects with their potential customers. But how do companies reach out to the right customers; the ones with the really good ideas?

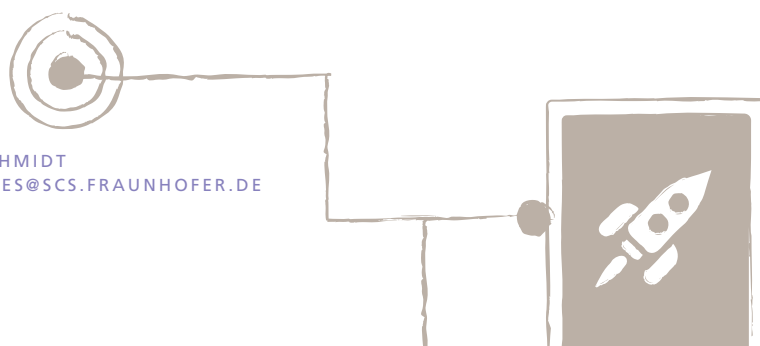
Science and practical application have agreed that efficient management of innovation represents a clear competitive advantage. An established procedure to allow companies to turn ideas into market-ready solutions is the so-called stage-gate process, which was developed by Robert Cooper (figure 1). The process contains important statements regarding the question of **how** we should work on and process developments and innovations, but not about with **whom**, **with which ideas**, and **why**. Here, professional co-creation approaches – i.e. methods that work with the inclusion of customers – close the gap.

## DEVELOPING IN THE STAGE-GATE PROCESS

The central area of the innovation process (from gate 2 to gate 4 in figure 1) represents efficient processing and development of existing information into appropriate initial prototypes. This part of the stage-gate model follows clear process logic. Companies with the right employees and development environments are very good at carrying out these steps independently. The first and last steps look different, however. Here, work must be continuously carried out with assumptions regarding the conditions in new markets, the mechanism of the innovation, the requirements, and the customer's behavior. At the beginning it is often not (yet) clear to the company what the needs of customers »out there« really are. In the end, it remains to be seen whether the almost marketable product or service satisfies actual customers' requirements.



**CONTACT:**  
REBEKKA SCHMIDT  
INFO-SERVICES@SCS.FRAUNHOFER.DE





## BEGINNING AND END DECIDE ON SUCCESS AND FAILURE

Although these development steps do not consume the lion's share of the organizational development and innovation work, they have a large influence on the success and efficiency of innovation. If a development process is started based on unsecured needs, usually several additional and expensive development loops are necessary in order to overcome these uncertainties. What is more, launching a project onto the market is expensive. If it does not fit right, the investment was in vain, which increases companies' general innovation costs. Moreover, the probability of failing is very high: According to a study by Nielsen (2014) on groundbreaking innovations that

is based on an analysis of the market launches of 12,000 consumer goods for everyday use in Western Europe since 2011, actually 76 percent of product launches fail within a year.

## THE CUSTOMER IS PART OF THE DEVELOPMENT – CO-CREATION AS A SOLUTION

One way of facing this challenge and better motivating both customers and one's own employees is to involve customers directly; in literature, this is often referred to as »open innovation« or »co-creation of innovation« (e.g. von Hippel 1978/1994; Chesbrough 2003; Witell/Kristensson/Gustafsson/Löfgren 2011).

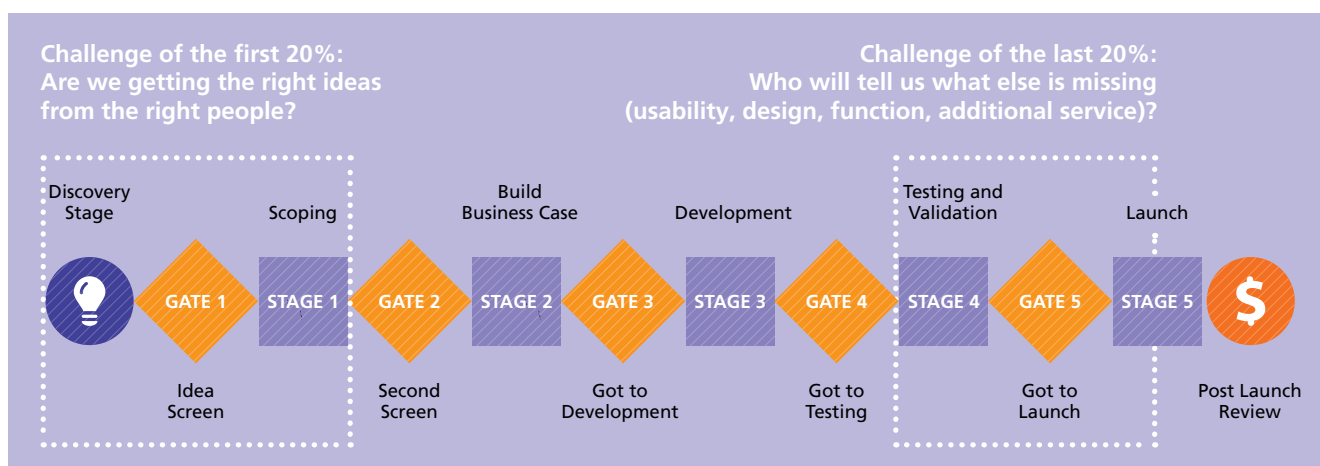


Fig. 1: Stage-gate process



Therefore, it would suggest itself that companies directly include customers with all their needs, their knowledge, and their passion. But it is not that easy to detect this special customer. As aids, the scientific community recommends a search for the lead user (von Hippel 1986), the emergent nature consumer (Hoffmann, Kopalle and Novak 2010) or the cooperator (Levine and Prietula 2013) (figure 2): A potential user and developer who has early yet representative needs, who may have even realized these in whole or in part in his own solutions, who has specific knowledge, and who is also ready to help shape new solutions.

### HOW DO I FIND THE RIGHT CUSTOMER?

The best way is to approach the right co-developer as directly as possible and then to count on his willingness to practice self selection and identification. Companies, however, generally do not have a direct »line« to this important person. It is therefore recommended that as wide a range of interested parties as possible is provided with information on the topic in order to make them curious and to invite them to join the discussion. This difficult procedure is known as »problem broadcasting«. Through a self-selection process, relevant co-developers identify themselves by following the invitation.



The entire process of »problem broadcasting – self-selection – identification« is not intended to be representative. The process is just looking for **a single idea** that will make the development into a successful innovation. The problem is shown in figure 3: The loss rate during the process is enormous. Even once the topic was successfully circulated through the press and media, companies lost approximately 99.9 percent of the customers who were initially addressed – and thus potential co-developers – due to identification and self-selection processes.

### JOSEPHS® AS A POOL FOR CO-CREATORS

This means that companies are looking for the proverbial »needle in a haystack«. One way to channel this search and thus to find a solution faster and in a way more closely related to practical applications is the open innovation laboratory JOSEPHS®. In a kind of shop in the middle of Nuremberg city

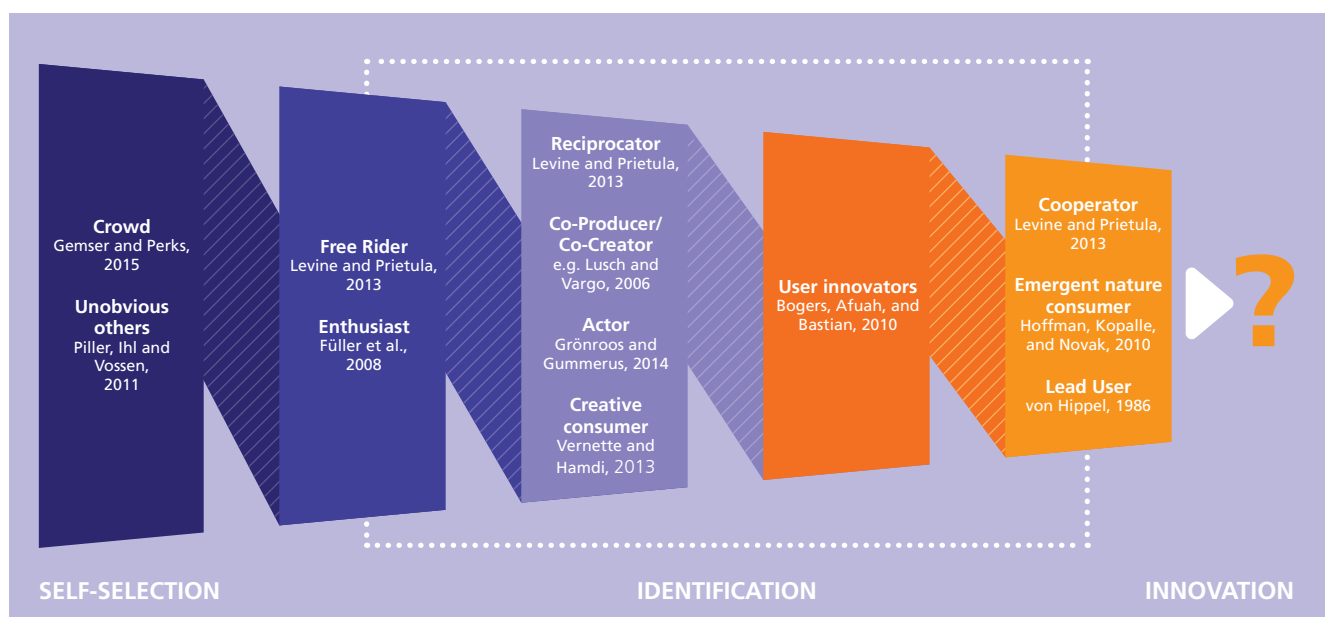


Fig. 2: Search for lead user

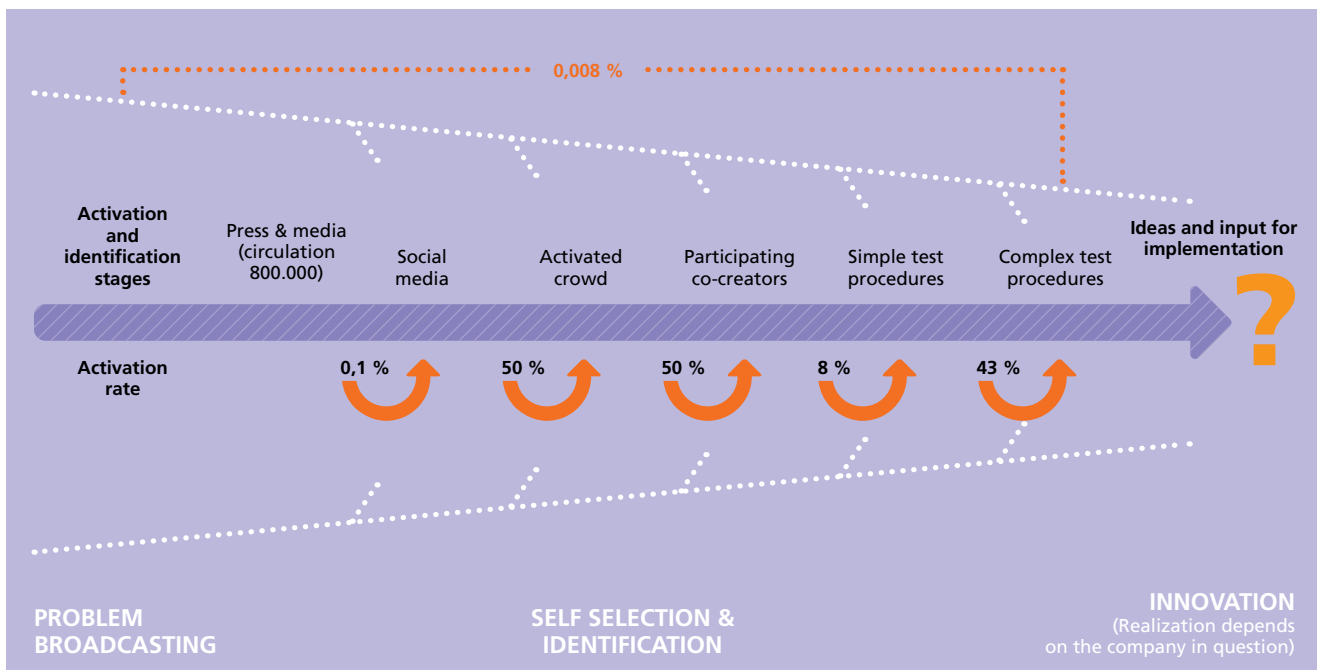


Fig. 3: Conversion rates in voluntary, non-monetarily incentivized co-creation processes.

center, companies can involve potential customers directly in their own development and test processes. They can do so by having their products and services tested by visitors for everyday practicality, often with very surprising results, which then demand appropriate further developments.

In alternating three-month test cycles, the visitors to the shop are actively involved in the development, introduction, and marketing of the ideas exhibited. The use of various observation methods and the support of the most modern Fraunhofer technologies (e.g. awiloc® and SHORE™) provides companies with direct feedback from potential customers as early as possible, in a data-based manner, and with a low risk. JOSEPHS® clearly sets itself apart from conventional market research.

**»It is great to get statements from people who are not wearing a banker's hat or are thinking from a company point of view. It is a great advantage to be able to show our newly developed product to a wide public and to obtain feedback.«**

Felix Fiedler, Product Manager Mobile at fymio, an intelligent financial app developed by TeamBank, on the opening day of the research island in July 2016

#### ☛ PerHEPS – Personal shopping advisor at the supermarket shelf

The »Personal Helper for Decisions at the Point of Sale« (PerHEPS) is intended to simplify decision making for consumers selecting a product in stationary retail in the future. The consumer will scan the barcode on the packaging using a smart device, e.g. a smartphone, in order to receive a product evaluation in accordance with his set profile. As part of the topic session »The Future of Retail,« the visitors to Josephs® were able to test and give feedback on the PerHEPS app, which was developed as part of a research project at Fraunhofer SCS. In the »Design Thinking« workshop, visitors and developers worked together on new ideas how to further develop the app or which additional apps would be desirable in this field.



THOMAS HARMES  
CEO OF MIFITTO GMBH

# LESSONS LEARNED – WHEN PRACTITIONERS REPORT

Since May 2014, over 50 companies have carried out development projects in the JOSEPHS® open innovation lab. One of these was mifitto. mifitto GmbH offers an individual and custom-fit size consultancy for shoe and clothing retailers in online and stationary retail. This consultancy prevents returns due to incorrect sizing. The technology with which the dimensions of the foot (app and 3D foot scanner) and the internal dimensions of the shoes can be measured precisely and compared was developed in conjunction with the Fraunhofer Institute for Integrated Circuits IIS.

## *Why did you have your 3D foot scanner tested in JOSEPHS®?*

Fraunhofer IIS joined us as a technology partner. Dr. Thomas Wenzel told us about their own open innovation laboratory, JOSEPHS®, based in Nuremberg's city center. Because we were still at the beginning with our technology, this was a good platform for us to learn from a customer's point of view. We wanted to know where we could find improvements and where exactly problems with the product were arising. We wanted to see and observe our potential customers live.

## *Where there particular challenges during preparation?*

To begin with, we measured Jaimie Jacobs shoes and made it possible to connect to the SportScheck merchandise management system. That all sounds quite simple, but it involved a lot of work in advance because we were dependent on other people's systems.

**And what did you learn?**

The best thing I learned from JOSEPHS® was criticism of the corners our scanners had.

That was criticized by visitors as it was easy to knock into. With these lessons, we were able to improve our products and adapt them to customers' requirements.

**So the time spent in JOSEPHS® was worth it?**

The research project in JOSEPHS® exceeded my expectations. I am very happy that our product was so widely accepted by the visitors and that we were able to learn some lessons from it. We also implemented a couple of technical issues and found

**»The research project in JOSEPHS® exceeded my expectations.«**

a future business partner:

SportScheck Nuremberg.

They were very interested in the mifitto system, checked out our system on site, and

gave us tips for daily use. We and our mifitto scanner are now located on their third floor near the hiking gear.

Since our research work in JOSEPHS® in summer 2014, a lot has happened. We are now in the second generation of the foot scanner and have also further developed the app. The work we did in JOSEPHS® was thus more than worth it.

*Mr. Harmes, thank you very much for talking to us.*

## HOW DOES A PROJECT WORK IN JOSEPHS®?







01

PRODUCTION



02

WAREHOUSE



03

TRANSPORT



04

SALES

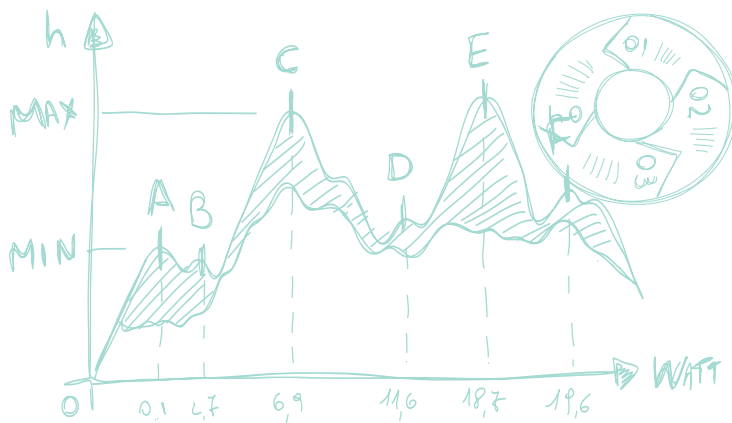


05

CUSTOMER

# MORE BUSINESS THANKS TO THE RIGHT DATA

## HOW PROCESS DATA CHANGES BUSINESS MODELS



Used intelligently, data can design new value-creation processes and thus change business models: But how, and with which consequences? Fraunhofer SCS has spent years exchanging ideas with industrial companies about their experiences of data usage and the effects on the original business model. The quintessence from the discussions is clear: **More business thanks to the right data.**

A prominent concept for a new business model, for example, is »predictive maintenance.« The main intention is to predict errors and carry out preventing maintenance of machines and systems using IT communication networks. The advantage of this is that the evaluation of relevant process data and the comparison with past values allows predictions to be made about failure probabilities or even production standstills. The aim is to act proactively about these kind of events in order to derive appropriate measures such as repair work.



**CONTACT:**  
CHRISTOPH JAHN  
INFO-GESCHAFTSMODELLE@SCS.FRAUNHOFER.DE

### USING RAW DATA TO GENERATE ADDED VALUE

For this kind of predictive status detection, data is collected, processed, and evaluated in an automated way as possible. In order to generate the desired added value from the raw data, however, a structured procedure (see figure 1) is required, both from a technical and a business point of view. If you would like to do more business with all of this new data, you need to give your data value-creation process a clear aim and take the right technological and process-related approach.

### COLLECTING CORRECTLY

Initially the raw data is collected. In many producing industries, this takes place by means of the use of certain sensors or standardized interfaces on machines. Alternatively, raw data or additionally required data can be bought in from data marketplaces or external service providers.

### PROCESSING CORRECTLY

The raw data is processed to ensure that continued use is possible. This includes cleaning the data records or unifying and standardizing various data formats. Cloud platforms are nowadays a widespread solution when it comes to aggregating data.

### EVALUATING CORRECTLY

With the use of methods and tools, largely comprising complex algorithms, added value is generated from data. Depending on the type of algorithm applied, this data analysis



can be intended to be descriptive, predictive, or prescriptive. Descriptive analyses process past values in order to provide understanding as to how things work properly, a method that has been used for years to help with decision making. Predictive analyses go a step further by allowing the derivation of past values to predict results that can be expected in the future, for example the status of a machine. These Types of data evaluation enable applications such as »predictive maintenance«. This approach can be considered a classic Industry 4.0 application. Prescriptive analysis are currently the be-all-and-end-all of automated data analysis. They give not only a descriptive and predictive view of what has happened or soon will, but even recommended strategic actions for a more distant timescale based on data recorded. They may even trigger these actions automatically.

#### DISPLAYING CORRECTLY

The interpreted data is then visualized on various user interfaces and it made available to the appropriate target group. For example, a worker can be shown on a tablet PC which system will soon need to be maintained in order to avoid a machine standstill.

#### UTILIZING CORRECTLY –

#### ADDED VALUE IS CREATED HERE!

The example of »predictive maintenance« only shows one way of making internal company value-creation processes more efficient. What has here been implemented as an internal value-creation process, in the future will be marketed frequently as an external service. On the one hand, there will be machine and systems builders who not only design their internal value creation processes more efficiently, but can also offer their experience as a service to customers. On the other hand, IT system providers, legitimized by their experience in the area of data analysis and processing, will specialize in pushing their way onto the market with similar service offerings. Traditional sector boundaries will soften up and be moved. The adjustment of business models due to changed market conditions and sophisticated technology solutions is necessary. The effect of data on business models will become even greater in the future as (even) more data means (even) more business.

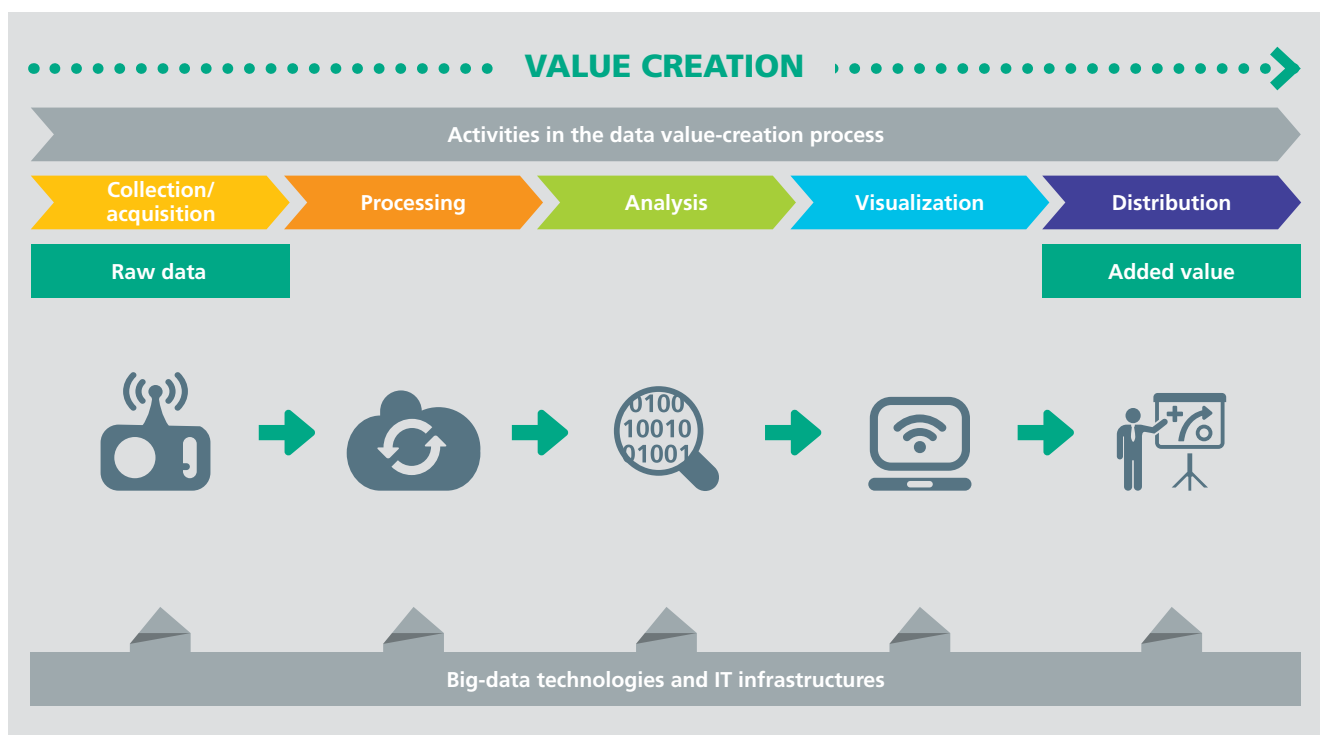


Fig. 1: The data value-creation process



# A LOOK INTO THE FUTURE

THE IMPORTANCE OF DATA IN THE VALUE  
NETWORKS OF TOMORROW



This SCS Special has shown many times, that in an increasingly digitized world, data will become a central production factor. Now we know, or can at least guess that without digitization, it will become more difficult to be successful on the market in the future. But what does that mean, and how do we prepare ourselves and our companies for it?

Researchers, journalists, politicians, and entrepreneurs wax lyrical about completely digitized value chains in which individual work items control themselves autonomously through complex, decentralized production networks and put themselves together to form a highly individualized product – optimized in accordance with cost, quality, and time aspects.

#### DATA AS THE FUEL OF THE 4TH INDUSTRIAL REVOLUTION

But whether the much-invoked 4th Industrial Revolution will turn our world on its head suddenly, or whether we are in a continuous process of digitization that started with the first electronic calculating machines in the 1970s, is something we will realize only in retrospect. Changes often come sneakily, but with hindsight we can tell the extent and the speed of change in fast motion. When was the last time you went to a video store? When was the last time you went to a bank, and not just to the ATM but to the counter? Do you still use the Yellow Pages? When was the last time you looked something up in a 24-volume encyclopedia? Do you still go to a department store to buy music?

All of the changes mentioned were driven by data provided by innovative technologies. Digitization in combination with suitable standards allows increases to productivity and flexibility – in the case of suitable ecosystems, it also allows the development of disruptive business models that completely replace the existing ones. This allows the development of new business models that can sweep established companies in whole sectors completely from the market. These data-driven developments will move sector by sector through entire economies.







### MORE AND MORE DATA TO TAKE US TO THE WORLD OF TOMORROW

We do not want to give a precise date for when self-driving electric fleets, drones, ride-sharing agencies for transport goods, and 3D printing will revolutionize goods transport into Transport 4.0, because we would otherwise have to smirk in twenty years when looking back. But there is one thing that we can say today with a high degree of probability: we are going in the right direction! What's more, data and key figures along the way will become ever faster, ever more important, and ever more numerous. The volume of digital data currently doubles every two years. Because humans think in linear terms, however, it is difficult for them to imagine an exponential development of this kind. Anyone who remembers the story of the chessboard and the grain of rice, however, can quickly gain an idea of the direction in which we are slowly but surely going. If we take into account the fact that the figurative »game« does not start with two grains of rice, but rather with 4.4 zettabytes, we will soon reach dimensions that generations before us would have seen as almost infinite.

### WHAT LIES AHEAD

However, we should not be afraid of this new level of complexity and switch to »wait and see« mode. On the contrary: there is a lot to do if we want to take advantage of the opportunities presented. We need:

- intelligent data protection regulations that maintain the privacy of the individual but do not unnecessarily burden economic dynamism,
- uniform standards for data and interfaces across economic areas in order to make complexity controllable,
- better instruments for IT security in order to minimize the risks of system failures and criminal activities,
- funding conditions that focus not only on the development of technologies, but also on the development of new services and business models,
- better IT skills among employees in order to design the digital processes of tomorrow,
- and an ongoing social discourse that takes people's concerns about too much digitization and surveillance seriously.

We all need to learn about all of that: as individuals, as companies, and as a society. But you don't reach a summit in a single leap. Rather, what we need is a clear destination right at the top, a strong will, and – most of all – plenty of small steps.

**We hope that this magazine has given you a few initial suggestions about what those steps might look like. Don't worry, this isn't the last of this topic – you can start looking forward to the next issue of our SCS Special!**



**CONTACT:**  
DR. HEIKO WROBEL  
INFO-PROZESSE@SCS.FRAUNHOFER.DE



**CONTACT:**  
CHRISTOPHER KAFFENBERGER  
INFO-TECHNOLOGIEN@SCS.FRAUNHOFER.DE

# WHAT WE'RE READING



Heiko Wrobel is Director of the Processes group and a real home-grown Fraunhofer man, as he has been since he started working in the Fraunhofer SCS Benchmarking Center, when he was studying business administration with a focus on logistics and industrial administration. For almost 20 years, he has also directed a benchmarking group in wholesale in which companies can compare themselves to one another at the top level, both quantitatively and qualitatively, in order to identify success factors and to learn from one another systematically. His research work is based on the collection, analysis, and interpretation of data – the raw material of the future.

## DR. HEIKO WROBEL RECOMMENDS THE FOLLOWING:



Steven D. Levitt /  
Stephen J. Dubner,  
**Freakonomics**,  
ISBN: 978-3442154517

»The discussions around Industry 4.0 give some people reason to fear that machines, robots and autonomous systems will make us unnecessary in the near future. Levitt and Dubner's book, however, shows how difficult it really is to solve complex phenomena using data. In *Freakonomics*, questions from various areas of life are answered, misconceptions are corrected, and links are established that one often would not even think of. Even in the future, the human mind will be needed in order to draw useful conclusions from amongst the fast-growing flood of data.«



Christoph Keese,  
**The Silicon Valley  
Challenge:  
A Wake-up Call  
for Europe**,  
ISBN: 978-3813505566

»Silicon Valley excites and worries us at the same time. On the one hand, we are happy to have i-watch, airbnb, Uber, and the largest digital department store in the world: Amazon. On the other hand, in just a few years, small start-ups become powerful global concerns that are pushing companies in sector after sector into a fight for survival. Christoph Keese went to Silicon Valley for several months in order to decode its DNA. He shows how the ecosystem there works and what we need to learn in order to survive competition in the future. A book about business could hardly be more gripping and informative!«



Matthias Horx,  
**Das Megatrend-  
Prinzip**,  
ISBN: 978-3421044433

»Megatrends represent the great changes in a society. They have a global, long-term, and deep impact. Matthias Horx describes the inner dynamism of these drivers of change, and explains their role in progress among the complex conditions of the modern world. With depth, and yet in an entertaining way, Matthias Horx combines an analysis of the forces of change with a look at the most important megatrends of our time. Whether everything will really happen that way is unsure. Anyone who would like to prepare for tomorrow should be familiar with Horx's ideas.«

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**WWW.SCS.FRAUNHOFER.DE**

**Fraunhofer Institute  
for Integrated Circuits IIS**

Director of institute  
Prof. Dr.-Ing. Albert Heuberger  
Am Wolfsmantel 33  
91058 Erlangen / Germany

**Fraunhofer Center  
for Applied Research on  
Supply Chain Services SCS**

Head  
Prof. Dr. Alexander Pflaum  
Managing Director  
Dr. Roland Fischer

Nordostpark 93  
90411 Nürnberg / Germany  
Phone +49 911 58061-9500  
[info@scs.fraunhofer.de](mailto:info@scs.fraunhofer.de)  
[www.iis.fraunhofer.de](http://www.iis.fraunhofer.de)  
[www.scs.fraunhofer.de](http://www.scs.fraunhofer.de)