

# UdZ

/ Edition 02.21

## The Data-driven Enterprise

### Bridging The Gap between Science and Industry

Research for and with Industry

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"Dienstleistungswende" –

*New Opportunity for Germany as a Business Location?*

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# Foreword

Faster, better, higher, further... aiming for superlatives is typical of our economy and society today. Rapid technological developments, digitalization and globalization bring enormous advantages. However, the multitude of challenges associated with these trends often makes it difficult for us entrepreneurs to keep up.

*FIR* has always been committed to opening up and leveraging the potential of progress for companies with its application-oriented research. Today more than ever, this ambition to be practically relevant requires close working ties between industry and research. *FIR* is committed to this approach with every fiber of its being. It provides companies with many points of connection to exchange ideas and develop solutions to successfully implement processes and strategies for the future-proof organization. I myself have experienced this for more than 20 years, during which we, as an active member of the *FIR e. V.* network, have been closely involved with the Institute. Since 2015, when I became chairman of *FIR e. V.*, I have been particularly involved in further developing the Institute and its activities.

The *FIR e. V.* association is also one of the points of connection mentioned above and, in my view, a very special one, because it directly involves companies in *FIR's* activities. The association is not only the founding and administrative body of *FIR*, but has grown into a lively, continuously expanding network of currently more than 245 companies, associations and individuals. They all have joined forces to benefit from the proximity to *FIR's* research activities to gain new ideas for their business, have access to cutting-edge expertise, and exchange ideas and with other network members. As the cluster-leading institute of the *Smart Logistics Cluster on RWTH Aachen Campus*, *FIR* offers a unique infrastructure in which science and business complement each other in a special way and work together on visionary approaches and solutions.

The new concept of “UdZ – The Data-driven Enterprise”, with its combination of contributions from research and industry, reflects the key mission of *FIR*, namely to bridge the gap between business and research. I am looking forward to reading this second edition of this year, with numerous examples of how future-proof solutions for increased productivity and competitiveness are developed by linking theory and application. The *FIR e. V.* network is an essential part of *FIR's* success story. As Chair of the Executive Board, I am looking forward not only to actively contributing to this success story, but, above all, to welcoming new members who are committed to shaping the future of industrial management in the network.

Sincerely,

Ingo Kufferath-Kaßner  
Chairman of the Board of *FIR e. V.*



Do you have any questions or suggestions about our magazine or would you like more information?

Then please send us an e-mail to:

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# Dear Readers,

Do theory and practice contradict each other, and are engineering findings therefore not suitable for practical application? We answer this question with a clear “no” and the work of the *FIR* proves this for decades. In this issue of “UdZ – The Data-driven Enterprise”, you will learn how science and industry are currently cooperating with each other, how research becomes application and how “both sides” benefit from each other under the motto ‘Bridging the Gap between Science and Industry’. In the article of the same name, read more about the *FIR*’s claim and the various cooperation opportunities for companies.

We also show how application-oriented research really works and how it bridges the gap between science and industry in a beneficial way. Models and methods, processes and applications connect the seemingly so different worlds. For example, the study “Value Networks in Times of Infectious Crises” gives companies direct support in preparing for future crises. It was conducted by the *FIR* and the *Industrie 4.0 Maturity Center* on behalf of the research advisory board of *acatech*’s ‘Plattform Industrie 4.0’. In the same context, the *FIR* is developing an AI-supported platform in the ‘AIRS’ project that helps companies to identify and observe crisis situations at an early stage and to evaluate response strategies (p. 92 et seqq.).

The current development of the business environment not only accelerates change processes in companies, it above all increases the complexity of strategies, organizations and processes. Structured approaches help to unlock this complexity. Read on page 83 how the OKR (Objectives and Key Results) management system can also be used by SMEs and how you, as a small or medium-sized company, can approach the selection and implementation of your project management system in a structured way.

With the increasing volatility of the markets, it is becoming more and more difficult to predict events. In this context, *FIR* is developing a platform to improve the forecasting capability and increase the capacity utilization of SMEs in the German stone and earth industry (p. 68 et seqq.) and – completely different industry, same forecasting needs – a platform to establish electric mobility in multimodal logistics chains (p. 56 et seqq.). The ‘FLEMING’ project is developing an information logistics concept based on predictive maintenance to ensure that stressed distribution networks remain stable even as e-mobility increases (p. 105 et seqq.). In view of the multitude of new challenges in an ever faster-changing world, in-house entrepreneurial resources easily reach their limits.

The aim of numerous research projects is to provide relief in the form of data-based decision-making aids. Data quality is essential in this context: *FIR* is therefore investigating the extent to which data fusion methods increase the quality of operational feedback data. (Project ‘DaFuER’, p. 76 et seqq.). Robotic Process Automation (RPA), an automation technology for internal administrative processes, is also considered an efficiency lever. The ‘RPAcceptance’ research project (p. 48 et seqq.) looks at how to gain the necessary acceptance among the workforce. The ‘GALA’ project, which examines “Learning and working in the Aachen healthcare region” and takes a close look at work in the healthcare sector, is concerned with work design and competence management (p. 100 et seqq.).

As you can see, research and practice go hand in hand at our company, always with the aim of supporting users in their work and making companies fit for the future.

With this in mind, we hope you enjoy reading this stimulating reading.



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FIR e. V. an der RWTH Aachen



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Direktor  
FIR e. V. an der RWTH Aachen

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### Value Networks in Times of Infection Crises

The COVID-19 pandemic has impressively shown the vulnerabilities of today's value networks. Together with the *Industrie 4.0 Maturity Center*, the *FIR* has investigated on behalf of the research advisory board of the 'Plattform Industrie 4.0' how vulnerable today's value networks are to crises and which measures serve as preparation for disruptions. The expertise now published shows potentials and measures for the design of resilient value networks.

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The goal of this research project is the development and experimental validation of a model that can be used to identify and adequately address the factors that influence employee acceptance.

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Research for and with Industry

# Bridging the Gap between Science and Industry

The opposite of theory is practice. This widely held notion often implies that scientific findings are not always suitable for everyday use. But the fact that not all theory is the same and that science and practice are dependent on each other, despite all their differences, is already captured by *FIR at RWTH Aachen University's* motto: "Research. Innovation. Realization."<sup>1</sup> At *FIR*, all research activities aim to create implementable solutions for real challenges from practice. To this end, it is essential to bridge the seemingly different worlds of theory and practice, and *FIR* achieves this through collaboration with industry, knowledge and technology transfer, and further education offerings on many levels. Last but not least, *FIR* has positioned itself as the leading institute of the *Smart Logistics Cluster* on RWTH Aachen Campus and has been successfully fulfilling this role for over 10 years.

**I**ncreasing globalization and rapid technological progress make it ever more important to communicate new findings on processes and applications and to provide models and methods. The current development of the business environment does not only accelerate corporate change processes, it also increases the complexity of strategies, organizations and processes. With the increasing volatility of markets, it is also becoming more and more difficult to predict events. In view of the multitude of new challenges in a world that is changing ever faster, a company's resources easily reach their limits.

This is where *FIR* comes in with its application-oriented research in the field of business organization, corporate IT, and information logistics. Practical problems are transformed into solutions for the digital interconnection of the economy, serving as a basis for innovations in the manufacturing industry. Under the rubric of Industrial Management, *FIR* undertakes research, teaches and provides qualification programs in the areas of [Business Transformation](#), [Service Management](#), [Information Management](#), and [Production Management](#). It explores digital networking topics as well as new technologies and business models with their impacts on the strategic, organizational and operational transformation of industrial companies. The Aachen-based research institute shares this knowledge within the research community and with companies alike.

The institute's activities serve the goal of sustainably increasing the productivity and competitiveness of businesses. *FIR* supports companies in the *Smart Logistics Cluster* by tapping the optimization and value creation potential that digitalization, global networking, and new technologies offer at many levels. The focus is on questions of data processing and the optimal provision

of information, because as digitalization continues to advance, the company of the future will largely be an information-processing system. The ability to generate information from data and make the right decisions faster based on this information will be decisive for the future success of a company.

## Gaining, Applying and Providing Knowledge

How does *FIR* ensure a high level of practical relevance and thus the economic benefit of its activities? The basis of *FIR's* success is its business model, which reflects the virtuous cycle between research achievements and practical successes that is typical of *FIR's* approach. Research projects address and solve problems that have been identified as recurring, structural problems in the context of industrial contract research. The research results are subsequently applied in practice. Equipped with the knowledge and insights generated in this interplay of research and application, *FIR* trains industry professionals in events and continuing education courses, develops these insights further into manageable methods and standards, and transfers them into real-world applications together with the centers in the *Smart Logistics Cluster*.

## Networking With Partners Opens Up Potential

This interaction between science and industry takes place on many levels, involving companies, associations, research institutions and, not least, politics and research institutions as sponsors of applied research. For example, as a founding member of the *Johannes Rau Research Association*, *FIR* strengthens the research strategy of the federal state of North Rhine-Westphalia. Furthermore, it is a member of the *Zuse Association*, which represents the interests of privately organized research institutions at the federal level. As a research center of the *German Federation of Industrial Research Associations (AiF)*, *FIR* is involved in projects charting new directions for the future of industry. Not least, it benefits from

<sup>1</sup> Founded in 1953 as the Research Institute for Rationalization (FIR) e. V., the institute interprets "FIR" today as "Research. Innovation. Realization." ("Forschung. Innovation. Realisierung," in German).

# “Learn From The Best.”

the close collaboration with *RWTH Aachen University* within a cooperation agreement, which defines *FIR* as an affiliated institute of the University. In dialog with partners from industry and services, *FIR* is active at many interfaces in order to recognize and exploit the opportunities of digitalization for industry in all facets. This includes numerous memberships in associations, for example in the *German Logistics Association (BVL)*, the *Club of Logistics*, the *Customer Service Association Germany (KVD)*, or *VDI*, the *Association of German Engineers*. In order to allow the broadest possible target group to benefit from *FIR*'s research results, transfer activities such as developing recommendations for action, guidelines, or specifications and standards are essential. For this reason, *FIR* closely collaborates with the *German Institute for Standardization (DIN) e. V.* and generates DIN standards and DIN SPECS.

## Smart Logistics Cluster: Bridging the Gap Between Science and Industry

Since 2010, *FIR*, represented by Professor Volker Stich, has been heading the *Smart Logistics Cluster on RWTH Aachen Campus*. Here, visionary innovations for business models and applications to advance sustainable production and logistics are being developed, which impressively demonstrate the added value of close working relationships between industry and research. In a unique experimental environment offering access to a demonstration factory (Digital Experience Factory), innovation labs, and a theme park, scientists and industry representatives explore and test the potential of digitalization and interconnectedness. An innovative real-world production environment offers companies the opportunity to test the latest technologies and processes in a compact, yet realistic setting. This helps to quickly bring applications, business models, and products to market maturity, including through the development of prototypes into primotypes<sup>2</sup>. This results in extremely short paths from the idea to proof of effectiveness. The concept is fully in line with the new technology readiness

levels, where the aim is to transfer new developments into prototypes and primotypes<sup>2</sup> within an experimental set-up so that they can be put to actual use in the field to provide proof of functionality. Opening up potential for application, the *Smart Logistics Cluster* closes the gap between the development of products and services and their market maturity.

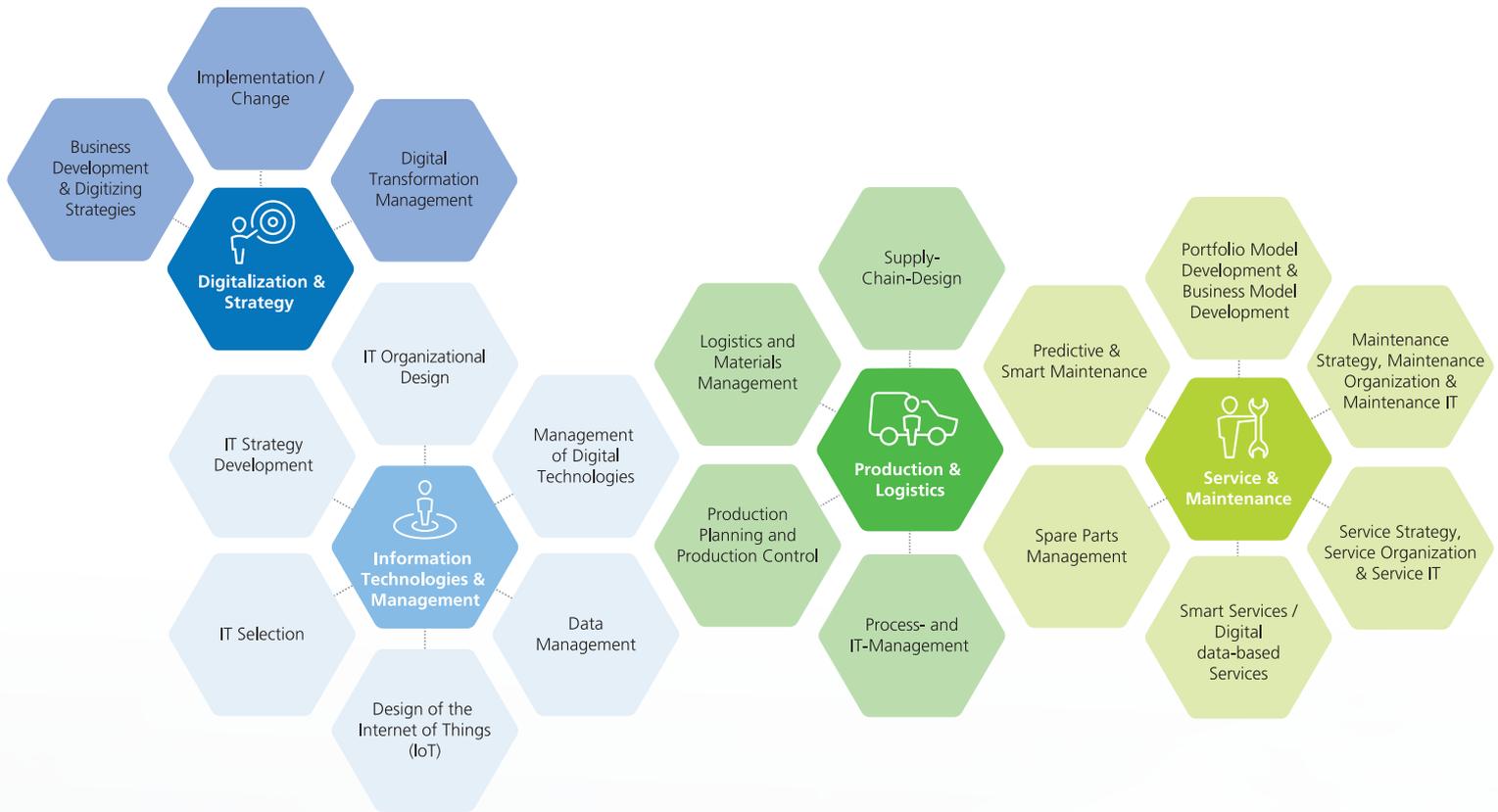
## Forms of Collaboration

With application-oriented research, *FIR* develops methods, structuring frameworks and applications for the further development of companies in the area of digital transformation. The involvement of companies as early as in the tendering phase and in the later implementation of projects ensures the practical relevance and the applicability of the latest knowledge in industry.

## Publicly Funded Projects

The transfer of knowledge to industry is the goal of all our research activities. *FIR* is experienced in leveraging funding opportunities and adept at identifying the right program for a company. The federal and state governments are currently making special efforts to strengthen local economic competitiveness and, in addition to existing funding programs, have improved many funding opportunities and launched entirely new programs. The experts at *FIR* are well-informed about current funding opportunities and

<sup>2</sup> These models, manufactured with tools close to series production, are not only used for pure functional validation and implement the concept of the "Minimum Viable Product". Customer feedback can be fed back during development, which significantly reduces implementation time at lower cost. Early failure and learning from mistakes have method in this approach. (SCHUH ET AL. 2020, p. 41)



support companies in identifying appropriate programs. The participation of companies in such programs ensures their practical relevance, and companies, in turn, benefit from obtaining the latest research findings, which inform their further development.

## Consortium Projects

Companies are often looking for solutions that lead to results more quickly than through publicly funded projects, which tend to run over several years. So-called consortium projects are ideally suited to this purpose – here, companies with similar questions and challenges join forces in a consortium and formulate concrete research questions under the leadership of *FIR* or one of the seven centers in the *Smart Logistics Cluster*. This approach usually leads to results within six months, as the participating companies gain far-reaching insights into other companies and benefit from the resulting recommendations for action and best practices. The consortium partners have the opportunity to specify their main areas of interest as questions in advance and thus “define” the topics jointly addressed in the consortium. Consortium projects are regularly offered by *FIR*, depending on the current needs of industrial practice.

## Consulting and Industrial Projects

With a focus on the topics of production & logistics, digitalization & strategy, information technologies & management, and service & maintenance, *FIR* offers to guide companies through their transformation process. With a comprehensive consulting portfolio, *FIR*'s experts support companies in identifying specific challenges and translating them into strategies and measures to optimize value creation. Frequently, a starting point for this process is the 'Industry 4.0 Maturity Index'<sup>3</sup> co-developed by *FIR*, which companies use to determine the maturity of their transformation capabilities and to define structured measures in a roadmap for driving this process forward.

## Membership in the Smart Logistics Cluster

Companies that opt for continuous collaboration, seek to align their company strategically for the long term, and want to stay up to date on the latest research, often decide to “enroll” in the Smart Logistics Cluster. This form of collaboration overcomes traditional spatial and institutional barriers. Within a strategically organized

<sup>3</sup> SCHUH ET AL. 2020, p. 41

collaboration taking place in modern buildings and with a state-of-the-art technical infrastructure, knowledge and resources are shared, new developments are developed and tested in rapid “sprints”; and innovations are quickly brought to market.

### Outlook

In the Smart Logistics Cluster led by FIR, around 100 scientists and project managers are involved in continuing the success story of RWTH Aachen Campus, which is one of the largest technology-oriented research landscapes in Europe on a site of around 800,000 m<sup>2</sup>. The goal is to create agile and learning companies that can quickly adapt and adjust to the changing requirements of the market. There are many opportunities and points of contact for companies, regardless of industrial sector or size. Essential to success are forward-looking company representatives who have recognized that success is primarily based on collaboration, according to the motto: “Learn from the best.”

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#### Literatur

SCHUH, G.; ANDERL, R.; DUMITRESCU, R.; KRÜGER, A.; TEN HOMPEL, M. (HRSG.): *Industrie 4.0 Maturity Index. Die digitale Transformation von Unternehmen gestalten.* acatech. München 2020. <https://www.acatech.de/publikation/industrie-4-0-maturity-index-update-2020/download-pdf?lang=de> (Link zuletzt geprüft: 17.05.2021)

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# “Dienstleistungswende” – New Opportunity for Germany as a Business Location?

The future potential of digital technology could decisively transform the service sector and thus give new impetus to the diminishing competitiveness of the German economy.

The ship of Germany as a business location is swaying in increasingly rough seas. It is swaying not so much because the traditional German pillars of value creation (especially its flagships, the automotive and mechanical engineering industries as well as the chemical and logistics sectors) have lost their capabilities and expertise; rather, it is the major technological breakthroughs of the last decades that have caused the “German virtues” – which ensured a leading position among the major economic powers for more than a century – to lose in significance. Perfectionism, quality workmanship, and the reliability and durability of products of all kinds made sure that the German economy has had an excellent reputation internationally for many decades. However, this has led to a certain complacency – the German economy, it seems, came to take its strong position in the world for granted. Infatuated with its own perfection (the strategy consultant and blogger Sascha LOBO dubbed this the “Spaltmaßfixierung” of entire sectors of the economy – alluding to the typically German fixation on minute details such as the clearance between parts<sup>1</sup>) and forever focused on purely incremental innovation, Germany is lagging dangerously behind the competition in important areas of future areas of value creation – especially in the area of digitalization, which is crucial for the future of the German economy.

## Need for Innovation in the Service Sector

However, large-scale digital transformation of both the private and public sectors is the key prerequisite for innovative service business models that will decide whether or not a business location will be successful in the future. All highly developed, complex societies made the transition from an agrarian to an industrial to a service society. This trend will accelerate further as digitalization and automation bring about the transformation into a knowledge society – which is, after all, a particularly sophisticated form of service society.

<sup>1</sup> LOBO 2016

Particularly when it comes to complex service concepts of this kind, Germany's widely lamented false start into the digital age could prove fatal. In terms of the importance of the tertiary sector for the volume of value added, the German economy is already mediocre at best on an international level. With a 69 percent share of value added and a 74 percent share of the number of employees, the sector clearly accounts for the lion's share of economic output.<sup>2</sup> This puts Germany in the middle of the pack in Europe, behind countries such as the UK, France, and Sweden. Globally, however, the service sector is growing much faster than in Germany, where annual output growth over the past ten years has been at an anemic pace of just one percentage point, far behind international competitors from Asia and North America. According to a study by the *Western Union Company*, the volume of traded services worldwide will increase by 31 percent between 2019 and 2025 (from 6.1 to 8.0 trillion U.S. dollars), which means that the service sector will once again gain considerably in importance.<sup>3</sup> The ability to design digital services, especially by integrating innovative technologies in the field of artificial intelligence (AI) or the Internet of Things (IoT), will thus become a crucial capability for maintaining Germany's competitiveness as a business location. Looking at the current state of development of the service sector in Germany, it becomes clear that without significant efforts, Europe's largest economy will fall behind in terms of economic performance in international comparison. So what needs to be done to ensure that the false start in digitalization is not repeated here?

## Germany 2030 – a Services Powerhouse?

The relatively young discipline of services research is striving to provide a systematic answer to this question. The research project "Digital Services as a Success Factor for Future Value Creation – DL2030," funded by the German Federal Ministry of Education and Research, is currently attracting attention in this context. The project seeks to "identify research and development needs, including suitable approaches, that contribute to the design of innovative technology-oriented service systems with high customer value – with the aim of paving the way for the future competitiveness of the German economy."<sup>4</sup>

The approach used in a study published as part of the "DL2030" project<sup>5</sup> is original in that it does not provide an analysis of technical or organizational perspectives only. Instead, it focuses equally on people as users in the design of innovative service systems. In the study, leading service researchers present development paths, research fields, and recommendations for future research as opportunities for science to contribute to mapping out a path for the successful transformation of the economy and society and to preparing them for the "value creation world" of the future. The authors of the study outline a vision for the service society in Germany in 2030. In this vision, businesses and public bodies have a sufficient knowledge base not only to master end-to-end digitized value creation, but also to make it internationally competitive. This includes, for example, the ability to tailor or adapt services for customers in real time and to develop and implement responsive, innovative solutions. Companies are able<sup>6</sup> to generate value creation on the basis of highly flexible software and intelligently processed data and to develop competencies in digital ecosystems with which to successfully scale this value creation processes for the international market. The prerequisite for this is that the companies themselves can rely on the integration of reliable digital services.

<sup>4</sup> BÖHMANN ET AL. 2020, p. 33

<sup>5</sup> The study can be found at the following link: [publikationen.fir.de](https://publikationen.fir.de)

<sup>6</sup> BÖHMANN ET AL. 2020, p. 30

*"The future is a service, services are the future. Services, continuously enhanced by the digital transformation, are both, a driver for margin and for sustainability, by getting the most out of products and processes."*

*Lennard Holst, FIR e. V. an der RWTH Aachen*

On the one hand, this brings economic benefits for companies, while at the same time strengthening Germany's competitiveness, as Dr. Jana Frank from *FIR at RWTH Aachen University*, co-author of the study, explains:

**“In this way, innovation and ongoing business processes are integrated in a self-reinforcing value creation system that brings new solutions to market in very short cycles – and not just the domestic market, but globally as well. Anyone who wants to survive in the dynamic market of the digital world must inevitably have such know-how.”**

This is a captivating vision indeed. But it cannot be implemented with purely technological and organizational strategies alone. In Germany in particular, the logic of the industrial age is still firmly entrenched in people's minds. People typically think in terms of machines and devices that require constant optimization and that also provide the dominant basis for the service society. This deeply ingrained mindset must fundamentally change, warns *FIR's* managing director, Professor Volker Stich:

**“It's not a matter of turning a knob here and there in Germany and we'll be among the leading economic nations of the next decades. For our economy, what is needed is a fundamental, research-led reorientation towards a value-added mentality consistently oriented towards services. What we need to implement is nothing less than a service revolution that fundamentally changes the character of German innovation culture and value creation philosophy. This revolution has important technological and structural aspects, of course, but quite crucial to ensuring that these aspects can be adequately addressed is a revolution in the minds of people.”**

Such a service revolution would join the growing number of transformation processes – or paradigm shifts – that have become known as “turns” or “transitions” in recent years, such as the mobility transition, the production transition or the energy transition. In each case, the characteristic feature is that it is not just a matter of applying technical solutions or organizational concepts, but of adopting a new way of thinking based on fundamental findings (such as from the environmental and climate sciences, a holistic view of value creation, new business model philosophies, etc.) which pursues innovative approaches to solving economic and societal challenges, almost all of which can only be implemented with the help of digital technologies. The position paper of the DL2030 researchers provides a scientific answer to the basic characteristics that the new way of thinking – the new mindset in the service sector – must have.

## There are Essentially Four Main Outcomes:

### 1. Consistent Customer Orientation through Digitalisation

In the service society, it is not technology as such, and not the attractiveness of a product or solution, that should be the driving force behind innovation, but exclusively customer value. Only what customers consider valuable is true value creation. All services must therefore be customized: configuration, delivery option, usage model, and cost structure will in future be tailored individually with the help of digital technology. Every service is fundamentally scalable and can be flexibly adapted to new circumstances and paid on a usage basis.

### 2. Digitalization Enables Interactive Value Creation

When value creation partners share resources such as expertise, skills, etc. in a mutually beneficial process, this is known as “interactive value creation.” This type of collaboration – enabled by digitalization - is indispensable for an economy that is optimally geared to customer needs, beyond mistrust and petty competitiveness. It is not just about the functionality of the services, but also about emotion, which has a decisive influence on customer satisfaction.

### 3. Everything as a Service – Discontinuous Value Creation

In contrast to traditional value creation with its relatively rigid product and service life cycles, the short-cycle/rapid-fire innovations of the digital world appear to be discontinuous and disruptive. Digital services can, in principle, be reinvented within minutes. With increasing digitalization, this pace of innovation is transferring to numerous other industrial and economic sectors. Key digital elements such as Internet platforms or cloud services enable the adoption of service models for a large number of areas of value creation, even in non-digital environments, and thus increase efficiency and profitability. Mastery and control of the digital components in the value network is thus becoming a decisive competitive factor.

#### 4. Service Research as a Motor for Innovation and Transformation

The system-relevant, citizen-focused service sectors are of particular importance for Germany as a business location - “Dienstleistungswende” not least because they are the sectors with the highest employment. These include the everyday areas of mobility, education, media, and health. When implementing the service revolution, the transformation of these areas through digital innovations is, therefore, of particularly importance. Solutions developed in these areas must ensure that European social and ecological standards are maintained without compromising global competitiveness. As Professor Volker Stich explains:

“This is where service research comes in, identifying how digital value creation models and processes can be shaped in line with our values and what service transformation strategies can be globally successful. In Germany, in particular, we are well positioned in this

research area, especially concerning the service design and innovation sectors. I think the most important research goal is to align the design of innovative services with the concept of interactive value creation, which is ever growing in importance.”

There is no doubt that science and academia need to be even more committed to this objective than so far. However, the success of the service revolution and of securing Germany’s competitiveness as a business location are, ultimately, determined by the adaptive and innovative capabilities of companies, public institutions, and citizens. Raising people’s awareness should therefore accompany each and every step of the transformation process. Visions can only be realized if they are understood and supported by the citizens. There is no shortage of cautionary tales about academically well thought-out concepts that have then failed in reality - and digitalization is perhaps the most important of all. In terms of the “service world of tomorrow”, such a failure must not be repeated.

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## RWTH Establishes the German-Emirati-Institute in Aachen

RWTH Aachen University is establishing the new German-Emirati Institute in Germany to promote scientific and economic exchange between the United Arab Emirates (UAE) and the Federal Republic of Germany. The cooperation stems from an exchange between German Chancellor Angela Merkel and Crown Prince HH Mohamed bin Zayed Al Nahyan in 2019, during which technology cooperation was agreed, particularly with a view to Industry 4.0. The new institute, which will act as a project management organization, is accordingly called “German-Emirati Institute – Technologies 4.0” (GEI) and is based on the RWTH Aachen campus.

## “Smart Manufacturing” Practical Circle Offers Multifaceted Insights

The digital practice circle in cooperation with “European 4.0 Transformation Center(E4TC)”-member company galtitudes offered insights on 18.05.2021 into various practice-relevant aspects of digitalization. After an inspirational talk on the benefits of a holistic IT architecture with the Internet of Production and insights into roadmapping of transformation activities, the technical track offered insights into operational solutions with three presentations. Digital twins in Next.e.GO production. *Mobile SE*, AI-based optimization, *PTC*’s hands-on demonstration of the end-of-line quality control app, and Connected Quality showed the importance of data for smart manufacturing using industrial examples. After a presentation on the importance of change management for the store floor, two looks at implemented transformation solutions rounded out the program. The IoT Connector Box conceptualized in an E4TC Sprint and implemented in the demonstration factory was presented by *Liebherr*.

## New e.Go CEO since June 2021

e.GO was founded in 2015 by Professor Schuh in Aachen. The goal was to develop attractive and particularly durable electric vehicles and eventually produce them in series. e.GO now has about 400 employees and benefits from a unique network of research and technology companies at the RWTH Aachen Campus. Professor Schuh left the start-up company in June 2021. Ai Vezvaei, confidant of investor Nazif Destani who joined in 2020, is Schuh’s successor as e.Go CEO.

## Center Connected Industry Launches a New Format: TechSessions

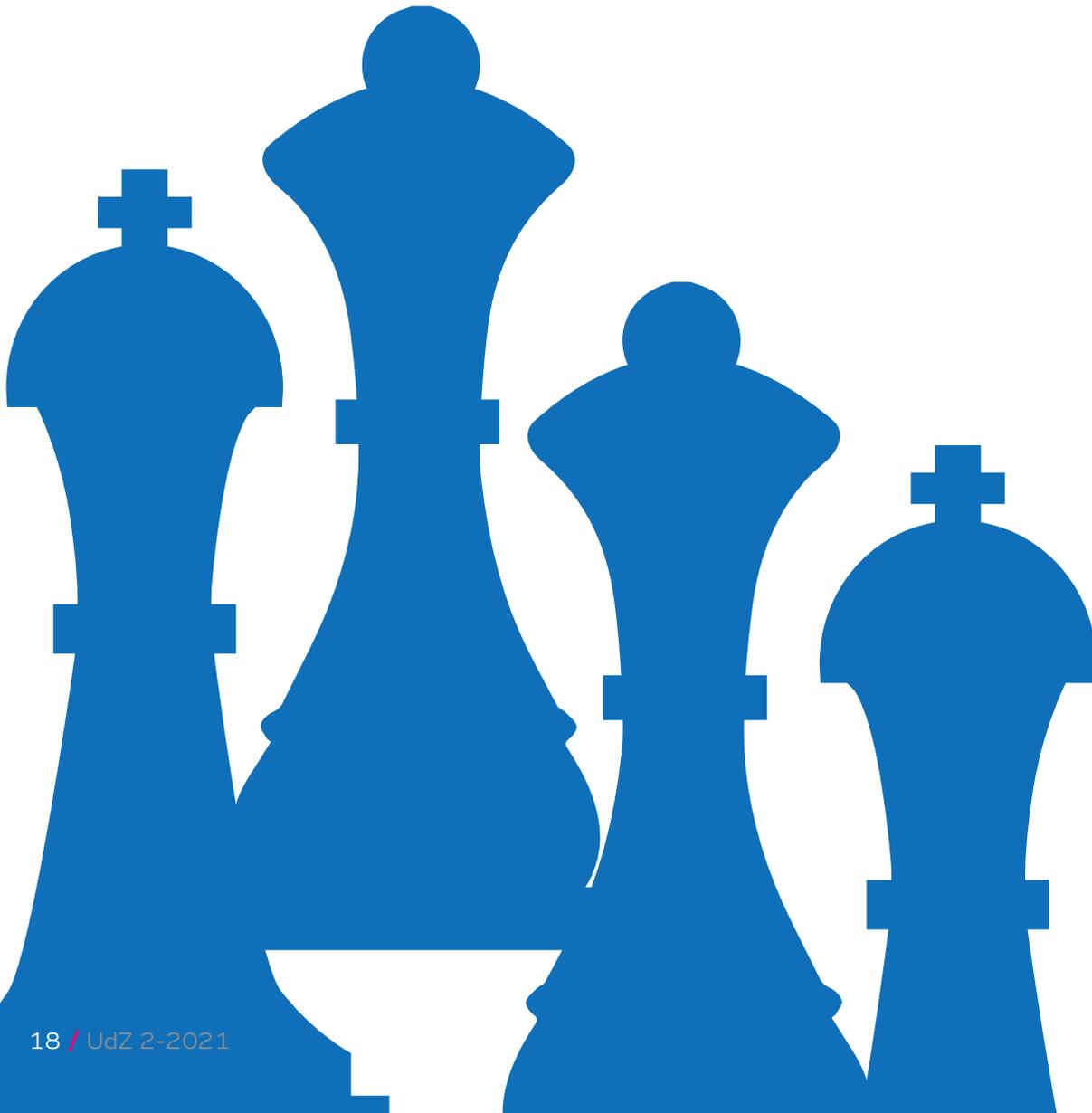
Concise videos highlight and explain terms, topics and projects relating to digitization, Industrie4.0 and New Work. The learning videos start with two videos on the topic of data science. Together with Deutsche Bahn experts explain data science from the perspective of theory and practice. Michael Mielke from *Deutsche Bahn* explains the process of Data Science in the first video of the “TechSession”. Center Director Christian Maasem complements this input in the second video from a practical perspective: Data Science in manufacturing companies. The new format was developed within the Center community together with Deutsche Bahn as a center member. The first “TechSessions” as well as all future videos of this format will be published on the center Youtube channel at regular intervals. We are looking forward to the start of the series, many more videos and your suggestions for other possible topics.

Expert Circle Digital Leadership  
Successfully Established



# What Companies Today Must Be Able to Do in Order to Shape the Future

With the successful implementation of the third Expert Circle, the Business Transformation department of *FIR e. V. at RWTH Aachen University* has established a new discussion format on the topic of digital leadership. In the meetings, current and future-oriented topics are examined. Presentations from practice and research create the basis for exciting discussions.



The current economic, ecological and social changes demand strategic knowledge and skills from decision-makers today more than ever before. The transformation to sustainable value creation or the disruptive changes in process chains and modes of operation in the business world, partly caused and accelerated by the global Corona pandemic, are examples of the complex and difficult-to-predict situations with which executives worldwide are confronted. Under such unprecedented conditions, it is elementary to recognize strategically important skills as a need and to be able to build them up at an early stage. Only if companies and their executives succeed in successfully establishing innovations and core competencies, even in increasingly changing markets, will this be a source of lasting competitive advantage. The aim of the Expert Circle is to identify and promote these skills.

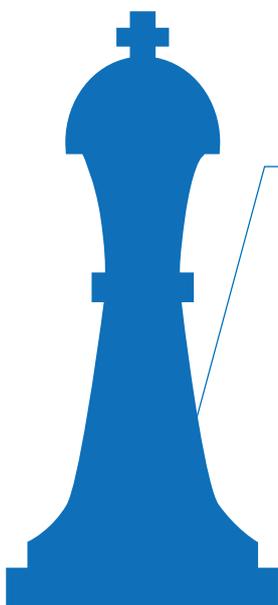
The Expert Circle Digital Leadership, moderated and hosted by experts in business transformation, offers the opportunity for networking in an exclusive atmosphere. The focus is on the mutual transfer of current research knowledge and insights from the industry. The format offers all participants a variety of opportunities for exchange and discussion of relevant trend topics. In this way, concrete assistance is passed on that can be directly implemented in the companies in order to identify trends and build up the necessary skills to address these trends accordingly. To

this end, key topics are identified together, which are then discussed in greater depth in individual meetings. In addition, solutions are developed in joint industry and research projects.

The Expert Circle Digital Leadership was successfully launched in November 2020. The kick-off event focused on the question of how a transformation of companies can be strategically designed and how the change can be implemented. In particular, the role of the executive in the digital transformation and his or her task of proactively shaping it were focused on and discussed. The roles, tasks and characteristics of an innovative manager were discussed. The concept of “return on transformation” was discussed and presented for the first time. This approach describes the success of the transformation and provides a tool for executives to evaluate the progress of the transformation.

From the lively discussions at the first meeting, the topic “Performance Management 4.0 – Using Objectives and Key-Results to Achieve Transformation Success” became the defining theme for the follow-up meeting. The turn to new management concepts ultimately led to the topic of the third meeting, how the concept of Purpose can be successfully anchored in companies and not just applied as a buzzword in company brochures.

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### Join it now!

The Expert-Circle *Digital Leadership* will continue to take place quarterly in a digital format. The addressees of the Expert Circle are executives and transformation leaders from the industry. [Participation in the digital format is free of charge.](#)

Interested parties are cordially invited to contact us if they are interested in participating in the Expert Circle Digital Leadership.

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How Companies Can Prepare for Future Crises

# Value Networks in Times of Infection Crises

The COVID-19 pandemic has impressively shown the vulnerabilities of today's value networks. Together with the *Industrie 4.0 Maturity Center*, the *FIR* has investigated on behalf of the research advisory board of the 'Plattform Industrie 4.0' how vulnerable today's value networks are to crises and which measures serve as preparation for disruptions. The expertise now published shows potentials and measures for the design of resilient value networks. Through a combination of concrete options for action to increase resilience in the long term and a framework for deriving short-term responses in the event of a crisis, the expertise supports companies in preparing for future crises. >

The COVID-19 pandemic demonstrated how dependent companies are on functioning supply chains and exposed the vulnerabilities of today's value networks: Companies across industries struggled with curtailments to shutdowns in production, challenges in importing supply parts, and a decline in new orders. The global network of producers and suppliers faltered, products were delivered late or not at all, and economic and private life came to a standstill. In an empirical analysis, FIR and the 'Industrie 4.0 Maturity Center' investigated the vulnerability of companies to crisis situations using the COVID-19 pandemic as an example. In the period from mid-November 2020 to mid-January 2021, companies were able to give their assessment in a questionnaire study regarding the effects of the COVID-19 pandemic as well as the relevance and current implementation status of potential measures to increase resilience. The target group of the questionnaire study was predominantly manufacturing companies of different industries and sizes.

The results of the study illustrate a high susceptibility of companies to such crisis situations: Less than 3 percent of the companies surveyed stated that they had not suffered any of the disruptive effects queried. The disruptions affect different areas of the value network. Both company-specific service production and procurement and sales are affected. Whereas on the procurement side difficulties can arise in obtaining input products, a sharp drop or sharp increase in demand and falling on-time delivery are examples of disruption effects on the sales side. Within the company, plant closures or employee absences are possible disruption effects. Far-reaching consequences such as a production standstill, short-term plant closures or liquidity bottlenecks, which occurred in just under half of the companies surveyed, illustrate that companies are currently inadequately prepared for such crises and the disruptions they cause.<sup>1</sup> These findings thus illustrate the need for companies to prepare for disruptions. In addition, it is assumed that the frequency of disruptions will increase, e.g. due to the increasing number of extreme weather and environmental events as well as political instabilities, and that similar epidemics will also occur more frequently in the future<sup>2</sup>.

## Resilience in Value Networks

Resilience is an important element in ensuring competitiveness in an uncertain environment. Resilience aims to ensure that, in the event of a disruption, the network is affected as little as possible and can quickly return to its original state or a better one. Resilience thus includes, on the one hand, preventive measures before a disruption occurs, which ensure that a company prepares itself as well as possible for potential disruptions. This is summarized under the term robustness.<sup>3</sup>

On the other hand, resilience influences the reactions after a disruption has occurred. The aim here is to recover as quickly as possible or even to generate competitive advantages from the changed conditions. This aspect is referred to as agility. To create robustness, potential changes in the future must be predicted and resistance to these predicted changes must be developed<sup>4</sup>. Possible measures to increase robustness include creating redundancies, e.g., by using multiple sourcing concepts or building up capacity reserves. Transparency and speed support the agility of a company. Creating transparency to perceive current changes is an essential prerequisite for fast reactions.<sup>5</sup> Transparency and speed can be improved through targeted information exchange and communication, among other things. The results of the study show potential in building robustness and agility: Around one in two companies still sees room for improvement in implementing the necessary capabilities.<sup>6</sup>

Robustness and agility are implemented in practice with the help of various measures. In the study, the measures considered are divided into the fields of action network design, data integration and Industry 4.0 technologies. Companies consider collaboration and data exchange with value creation partners and the implementation of a multiple sourcing concept to be particularly important. Measures assigned to the 'Industry 4.0 technologies' field of action, on the other hand, are rated as less relevant. Examples of measures from this field of action include the use of big data analytics, artificial intelligence and digital twins. This trend is also evident with regard to the current implementation status of the measures (Figure 1, p. 22).

Companies are addressing the resilient design of their value network and are implementing individual measures. The focus here is on already familiar methods, such as continuous supplier evaluation, multiple sourcing or collaboration in the network. However, there is currently restraint in the use of new technologies; their use is planned more for the long term.<sup>7</sup>

## Recommendations for Companies

A holistic view of the value network makes it possible to shape resilience over the long term. This requires strengthening both robustness and agility. The report identifies options for action in the three areas of **network design, data integration**

<sup>1</sup> STICH ET AL., pp. 13 – 15

<sup>2</sup> LUND ET AL. 2020, p. 2; PETERSEN AND BLUTH 2020, p. 43

<sup>3</sup> WIELAND AND WALLENBURG 2012, p. 890

<sup>4</sup> WIELAND AND WALLENBURG 2013, p. 303 et seq.

<sup>5</sup> WIELAND AND WALLENBURG 2012, p. 890 et seq.

<sup>6</sup> STICH ET AL. 2021, p. 17

<sup>7</sup> STICH ET AL. 2021, p. 25 – 29

and **Industrie 4.0 technologies** that support the targeted enhancement of resilience. Consideration of entire value networks and the interdependencies between the various players is part of the **network design** field of action. In this context, companies should, for example, map and analyze their current network structure and consider resilience as a design target variable when optimizing the network structure and cooperation with partners. The recommendations in the **data integration** field of action relate to the handling of data. Building competencies in data management and increasing data exchange with value creation partners create the foundations for increasing resilience. In addition, companies should consider external data in their risk analysis. In the **Industrie 4.0 technologies** field of action, technologies and their impact on dealing with disruptions are outlined. For example, digital data marketplaces strengthen collaboration between value creation partners; moreover, the use of complex data analyses leads to improved forecasting capabilities.<sup>8</sup>

In addition to recommendations for long-term design, short-term responses during crises are critical to success. For this purpose, a framework<sup>9</sup> has been developed to support the derivation of short-term response tactics<sup>10</sup>. Along the three areas of a value network from a corporate perspective - procurement, internal service provision and sales - the framework highlights response tactics and practical examples

from industry which can be taken in the event of impairment in one or more of the areas.<sup>11</sup>

For example, if sales are impaired, the targeted use of the company's own core competencies can help to open up new markets with new products and thus reduce the impact of disruptions. For example, during the pandemic, *Eterna* and *Van Laack*, among others, converted their production to manufacture masks<sup>12</sup>. The trade fair article manufacturer *Schönberg GmbH & Co.* produced partitions made of Plexiglas for retailers instead of display stands and counters and was thus able to restore its impaired sales<sup>13</sup>.

Overall, the expertise illustrates the lack of resilience of companies and their value networks. The options for action identified can support companies in building resilience. In addition to the targeted design of the network, the use of new technologies and the possibilities for data processing and analysis are particularly important.

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<sup>8</sup> STICH ET AL. 2021, pp. 30 – 39

<sup>9</sup> STICH ET AL. 2021, p. 42

<sup>10</sup> STICH ET AL. 2021, p. 41 et seq.

<sup>11</sup> STICH ET AL. 2021, p. 41 et seqq.

<sup>12</sup> DPA/LBY 2020, PROKASKY 2020

<sup>13</sup> WLW (EDS.)

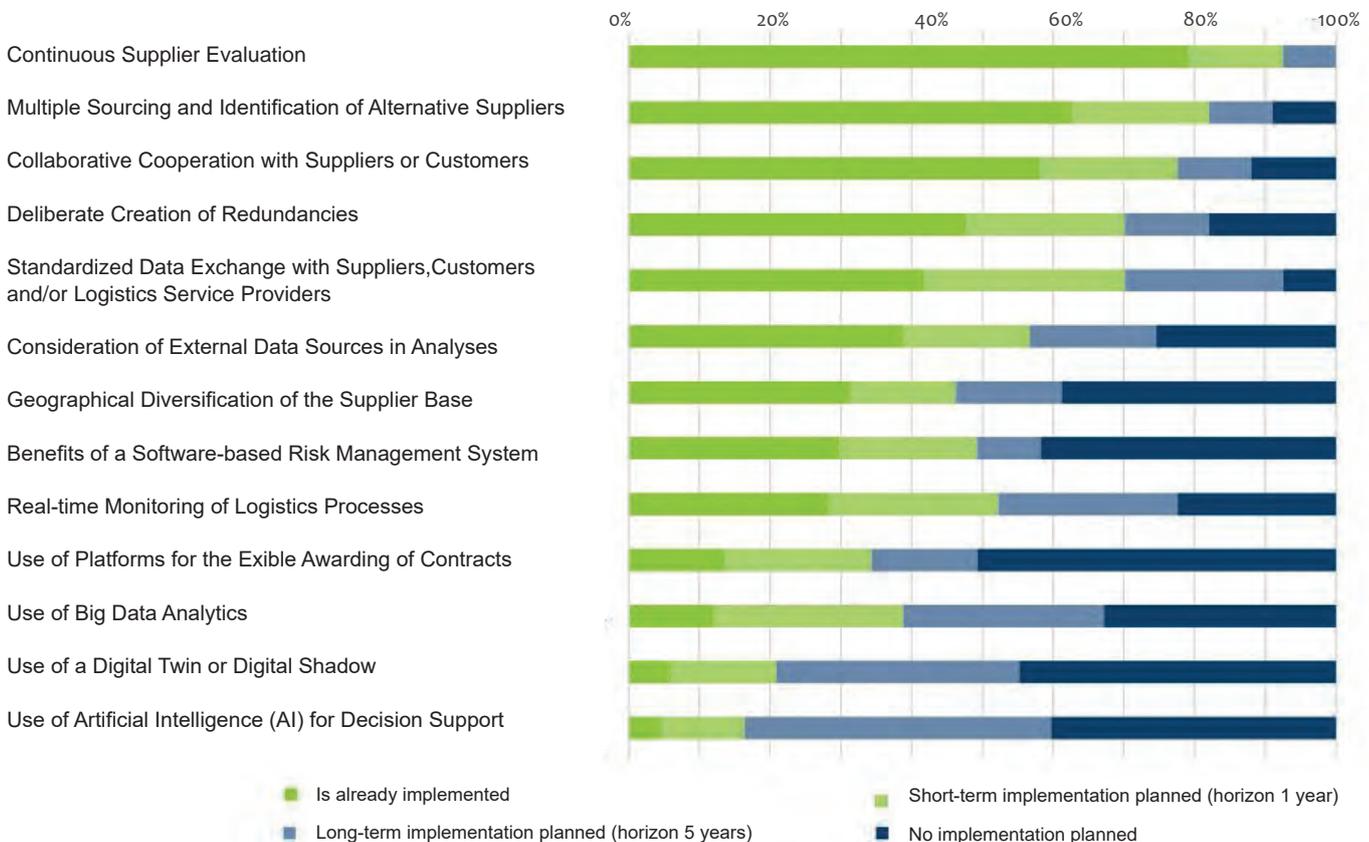


Figure 1: Assess the implementation status of measures to reduce the impact of potential Infection Crises (STICH ET AL. 2021, p. 27)

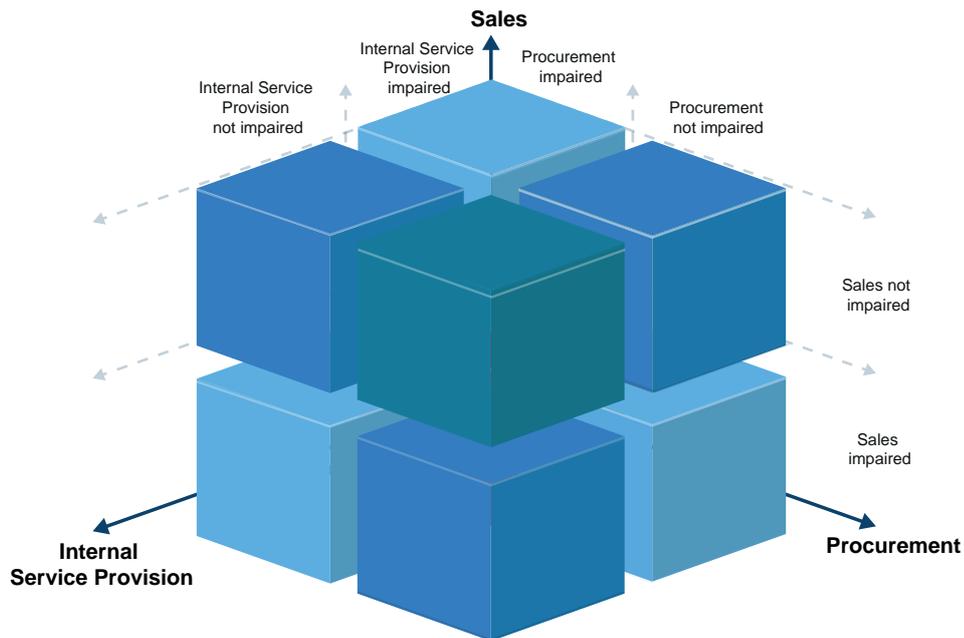


Figure 2: Framework for deriving response tactics in times of crisis (STICH ET AL. 2021, p. 42)

#### Literatur

DPA/LBY (HRSG.): Hemdenhersteller produziert Gesichtsmasken. SZ online, 20.03.2020. <https://www.sueddeutsche.de/gesundheit/gesundheitspas-sau-hemdenhersteller-produziert-gesichtsmasken-dpa.urn-newsml-dpa-com-20090101-200320-99-411786> (Link zuletzt geprüft: 17.06.2021)

LUND, S.; MANYIKA, J.; WOETZEL, J.; BARRRIBAL, E.; KRISHNAN, M.; ALICKE, K.; BRISHAN, M.; GEORGE, K.; SMIT, S.; SWAN, D.; HUTZLER, K.: Risk, resilience, and rebalancing in global value chains. San Francisco [u. a.] 2020. <https://www.mckinsey.de/-/media/McKinsey/Business%20Functions/Operations/Our%20Insights/Risk%20resilience%20and%20rebalancing%20in%20global%20value%20chains/Risk-resilience-and-rebalancing-in-global-value-chains-full-report-vH.pdf?shouldIndex=false> (Link zuletzt geprüft: 17.06.2021)

PETERSEN, T.; BLUTH, C.: Megatrend-Report #02: Die Corona-Transformation. Wie die Pandemie die Globalisierung bremst und die Digitalisierung beschleunigt. Gütersloh 2020. [https://www.bertelsmann-stiftung.de/fileadmin/files/user\\_upload/MT\\_MegatrendReport2\\_Web\\_2020\\_DT.pdf](https://www.bertelsmann-stiftung.de/fileadmin/files/user_upload/MT_MegatrendReport2_Web_2020_DT.pdf) (Link zuletzt geprüft: 17.06.2021)

PROKASKY, A.: Masken und Kittel besorgen von Laack Umsatzsprung. TextilWirtschaft online, 01.12.2020. <https://www.textilwirtschaft.de/business/news/produktion-von-schutzausruestung-masken-und-kittel-be->

[scheren-van-laack-umsatzsprung-228404?crefresh=1](https://www.wlv.de/de/inside-business/aktuelles/folgen-der-corona-krise-so-haben-unternehmen-ihre-produktion-umgestellt) (Link zuletzt geprüft: 17.06.2021)

STICH, V.; SCHRÖER, T.; LINNARTZ, M.; MAREK, S.; HERKENRATH, C.; HOCKEN, C.; KAUFMANN, J.: Expertise des Forschungsbeirats der Plattform Industrie 4.0. Wertschöpfungsnetzwerke in Zeiten von Infektionskrisen. Hrsg.: Forschungsbeirat der Plattform Industrie 4.0; acatech – Deutsche Akademie der Technikwissenschaften e. V. München, Juni 2021. <https://www.acatech.de/publikation/wertschoepfungsnetzwerke-in-zeiten-von-infektionskrisen-expertise/download-pdf?lang=de> (Link zuletzt geprüft: 17.06.2021)

WIELAND, A.; WALLENBURG, C.: Dealing with supply chain risks. In: International Journal of Physical Distribution & Logistics Management 42 (2012) 10, S. 887 – 905.

Wieland, A.; Wallenburg, C.: The influence of relational competencies on supply chain resilience: a relational view. In: International Journal of Physical Distribution & Logistics Management 43 (2013) 4, S. 300–320.

WLW (HRSG.): Folgen der Corona-Krise: So haben Unternehmen ihre Produktion umgestellt. wlv inside business. WLW online, ohne Datum. <https://www.wlv.de/de/inside-business/aktuelles/folgen-der-corona-krise-so-haben-unternehmen-ihre-produktion-umgestellt> (Link zuletzt geprüft: 17.06.2021)



Die gesamte Expertise ist kostenfrei unter folgendem Link abrufbar:

[fir.rwth-aachen.de/fileadmin/publikationen/download/Studie\\_Wertschoepfungsnetzwerke-Infektionskrisen.pdf](https://fir.rwth-aachen.de/fileadmin/publikationen/download/Studie_Wertschoepfungsnetzwerke-Infektionskrisen.pdf)



## German Demography Award 2021 for LidA

The project 'LidA - Learning in the digitalized world of work' is the winner of the German Demography Prize 2021, awarded by Demographie Netzwerk e. V. (ddn). LidA was awarded in the category "Opportunities of digitalization". The content and goals of the project were presented by Korhan Zeyrek, commercial manager of *Mauser + Co. GmbH*, which also initiated the application for the award as a partner in the project network. The results presented convinced the jury with a clear focus on digital learning platforms, the inclusion of different target groups, the reduction of fears of digitization, and an overall didactic concept that meets needs. The research project, which is funded by the *Federal Ministry of Education and Research*, is being implemented by a consortium of scientists and companies. Participants include the *International Performance Research Institute (IPRI)*, the *FIR at RWTH Aachen University*, *Databay AG*, *leifos GmbH*, *Volkswagen AG*, *Mauser + Co. GmbH*, *TRUMPF GmbH + Co. KG* and the *Ulm University*.

## Change of Head of Department in the Service Management at FIR

Lennard Holst will take over from Dr. Jana Frank as head of the Service Management department at FIR in August 2021.



## Take Part in the Survey Now: How Does IT Support Production Planning and Production Control?

With the PPS survey, we want to gain an insight into the everyday life of production planners and controllers. The results are intended to create transparency about the lived tasks and responsibilities and to identify opportunities for better decision support by IT systems. The results are intended to create transparency about the tasks and responsibilities that are lived and to identify opportunities for better decision support through IT systems. You are welcome to provide your email address at the end of the survey to receive the results of the study.

## Research Project 'BlueSAM' Launched

In the research project 'BlueSAM', which started on 01.05.2021, the FIR together with the Belgian partner Sirris examines existing IT architectures for the realization of intelligent products in order to transfer them into a reference architecture.

## Consortium meeting has taken Place successfully

The first consortium meeting within the research project 'KI-LIAS – Artificial Intelligence for Learning Supportive Industrial Assistance Systems' was successfully held on 8 July 2021. With respect to the ongoing Corona situation the partners from industry and research came together in the digital space. Representatives of the companies and research institutions reported and discussed the results of the last months. Since the start of the project, these have been jointly developed in over 40 workshops with more than 30 participants from 24 different roles. As a result, the project has already identified 22 use cases for AI applications at the partner companies. The project meeting was also complemented by an exciting keynote speech on the topic of "Change Management in Digital Transformation" (speaker Roman Senderek, FIR) as well as three workshops on the topics of "Acceptance", "Potential Analysis", and "Competencies & Qualifications". Great thanks go to all partner companies and participants for the good cooperation in the last months. The FIR is looking forward to the next common steps within the project.

## Your opinion is needed!

On behalf of the research advisory board of Acatech's "Platform Industry 4.0", the FIR is currently conducting a study on the development, use and monetization of an industrial database. The aim is to identify measures that contribute to the better use and monetization of data in industrial companies. Your participation in the approx. 20-minute survey will help us to put the results on an even broader basis. As a thank you for your participation, you will receive an exclusive analysis of the study results by winter 2021, which will go beyond the publication in the guide. We would appreciate your participation by September 30.



Congress on  
Business  
Applications  
Aachen

## Successful Start for “Congress on Business Applications”

# Only Those Who Change Remain Stable

June 23<sup>rd</sup> marked the premiere of the “Congress on Business Applications Aachen – Solutions for Production and Logistics” (CBA Aachen) at *FIR at RWTH Aachen University*. With an expanded view of the entire field of business applications, the new trade event replaces the traditional Aachen ERP Days. The leap to the next level comes at exactly the right time, as the system structure in companies is also changing in the course of the digital transformation. Companies are increasingly relying on different systems to meet the diverse requirements of order processing. Questions about the interaction between IT and processes for value-added end-to-end order processing are therefore more topical than ever.

More than 150 participants followed presentations and field reports in the live stream, learned about new technologies, used the chat to exchange experiences and discussed their concerns in breakout sessions. Partners presented their services and solutions, including the Exclusive Partners of CBA Aachen 2021, *Abas Software GmbH* and *Asseco Solution AG*.

Volker Stich, Professor and Managing Director of *FIR*, spoke about the digital transformation and its effects in his introductory keynote speech, thus once again demonstrating the expansion of content realized with the new event concept of the CBA Aachen realized contentwise extension on all operational application systems. The change takes place on many levels: Purely monolithic systems are increasingly being replaced by modular system structures that enable flexible and efficient integration into companies' individual IT landscapes, the market is no longer dominated by just a few vendors, and the focus has also changed: Whereas the focus used to be on the transformable factory and, at its core, on the design of available resources, today, in addition to machines and systems, the organizational

structure, corporate culture and IT are also moving into the area of consideration. They all have to be integrated in order to achieve the overriding goal of customer centricity. Because that's what it's all about in the end – absolute orientation to customer needs is becoming the factor that determines success. The ADAM<sup>®</sup> framework developed by *FIR* integrates all of the above aspects and aligns the technology infrastructure with business development. In this way, all activities derived from ADAM<sup>®</sup> pay off in terms of customer benefits and help to deploy suitable technical options.

The importance of an integrating approach was also shown by best practices for the implementation of order processing as well as for the organization of system introductions. Gaby Droll, *TÜV-Rheinland GmbH*, also referred to this fact in her presentation title “IT harmonization: technology, people and processes using the example of Order2Cash”. She considers it indispensable to prepare employees for changes through targeted communication and to involve them in the project from the very beginning. Jens Wulff, *Neumann & Esser Group*, also experienced during the digital transformation of his company that a clear common vision, the early involvement of those affected and the celebration of visible successes contribute significantly to the success of the implementation of business applications. However, it is also important not to focus on the big picture, but to start at the core of what is happening first. In their joint project “Intelligent Process Automation in Purchasing”, Christian Leopoldseeder, *Asseco Solutions AG*, und Yvonne Ache, *Springer Maschinenfabrik GmbH*, identified data quality as well as data and process understanding as core variables for the success of change projects, in addition to the elimination of insular thinking.

Today, business applications must be networked in such a way that information is quickly accessible and supports

employees in their decisions - even across company boundaries. This is becoming more important against the background of rapidly changing markets with many unpredictable risks. Transparency, flexibility and functionality are the key requirements that companies place on business applications today in view of customer demands and market changes. According to Volker Stich, a mixture of robust monolith and modular agility is the best way to successfully counter potential risks. It provides a stable basis for data and processes and at the same time takes agile structures into account.

This was also confirmed by Karsten Sontow, CEO of Trovarit AG, in his presentation “Operational software landscapes - status quo and perspectives”. ERP still plays a connecting role today. As a central hub, the system ensures vertical integration of applications. Sontow spoke of the “single source of truth”: ERP systems form the basis for filtering, classifying and passing on data to other systems and provide semantic information to enable data to be interpreted correctly. He sees the future of operational software landscapes - significantly expanded - in the cloud. In addition to ERP, best-of-breed software, proprietary developments, office and low-code/no-code applications will contribute to the efficient regulation of the overall system and increase the added value of manufacturing companies. This development is influenced by significant trends such as process mining, cloud computing and artificial intelligence, which place new demands on the performance and features of business applications. During the event, participants were also able to learn about models and methods for

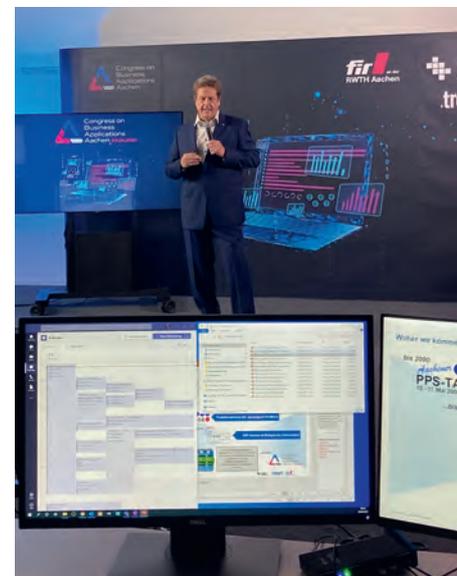
organizing the order processing process. Together with experts from the FIR, the Center Integrated Business Applications and the Institute for Production Technology (wbk) at the Karlsruhe Institute of Technology (KIT), they discussed questions about change management in business software projects, the benefits of the digital twin in production and the need for innovation and research in production and logistics in interactive breakout sessions.

The day concluded with a panel discussion. Representatives from associations, companies and system integration discussed their perspectives on the change of operational software solutions in a quite controversial way. However, there was also consensus here on what VOLKER STICH stated at the beginning of the day and which was the common thread running through the entire day: Only those who change remain stable.

After a successful start also the continuation date is already certain. On June 8 and 9, 2022, everything will again revolve around digital solutions for production and logistics at CBA Aachen 2022.

For more information, please visit: [cba-aachen.de](http://cba-aachen.de)

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RPAcceptance:

# Development of a Change Management Concept

The focus of the ‘RPAcceptance’ funding project is on employee acceptance of robotic process automation (RPA) in small and medium-sized enterprises (SMEs). The employees concerned and their acceptance play a decisive role in the sustainable use of the efficiency potentials associated with the automation of administrative processes through RPA. The goals of this research project are the development and experimental validation of a model that can be used to identify and adequately address the factors that influence employee acceptance. The resulting design of a change management concept that promotes acceptance is intended to enable SMEs to gradually introduce their workforce to the use of RPA and convince them of the benefits. >

**R**obotic Process Automation (RPA) has proven to be an efficiency-increasing automation technology in companies and makes it possible to automate large parts of internal administrative processes through standardized data processing. In this process, a software bot virtually imitates the work steps of employees and interacts with existing standard software across systems just like a human actor<sup>1</sup>. Various studies show that companies benefit from different potentials raised by RPA. Efficiency and time gains are at the top of the list, closely followed by quality increases, more comprehensible processes and the optimization of interfaces<sup>2</sup>. A showcase example of the successful application of RPA is *Telefónica O<sub>2</sub>*, which in 2015 deployed

approximately 160 software robots in 500,000 transactions from 15 core processes. The company was thus able to automate 35 percent of its internal administration through RPA<sup>3</sup>. Companies such as *Coca-Cola*, *Siemens* and others are also exploiting the enormous efficiency potential of this technology<sup>4</sup>.

## Technology Acceptance as a Success Factor For RPA Deployment

The workforce involved and its acceptance play a decisive role in the sustainable exploitation of the potential associated with the automation of administrative processes through RPA. Process automation has also undergone a major transformation in recent years: Where partially automated systems (e.g., robotic desktop automation) were used some time ago, processes are now predominantly processed end-to-end by RPA. In addition, the increased use of artificial intelligence is contributing to the fact that RPA will develop in the direction of intelligent systems such as cognitive process automation (CPA) in the future (Figure 1, p. 30).

<sup>1</sup> VAN DER AALST ET AL. 2018, p. 269

<sup>2</sup> PwC 2020, p. 15

<sup>3</sup> LACITY AND WILLCOCKS 2016, p. 25

<sup>4</sup> KPMG 2021, p. 10



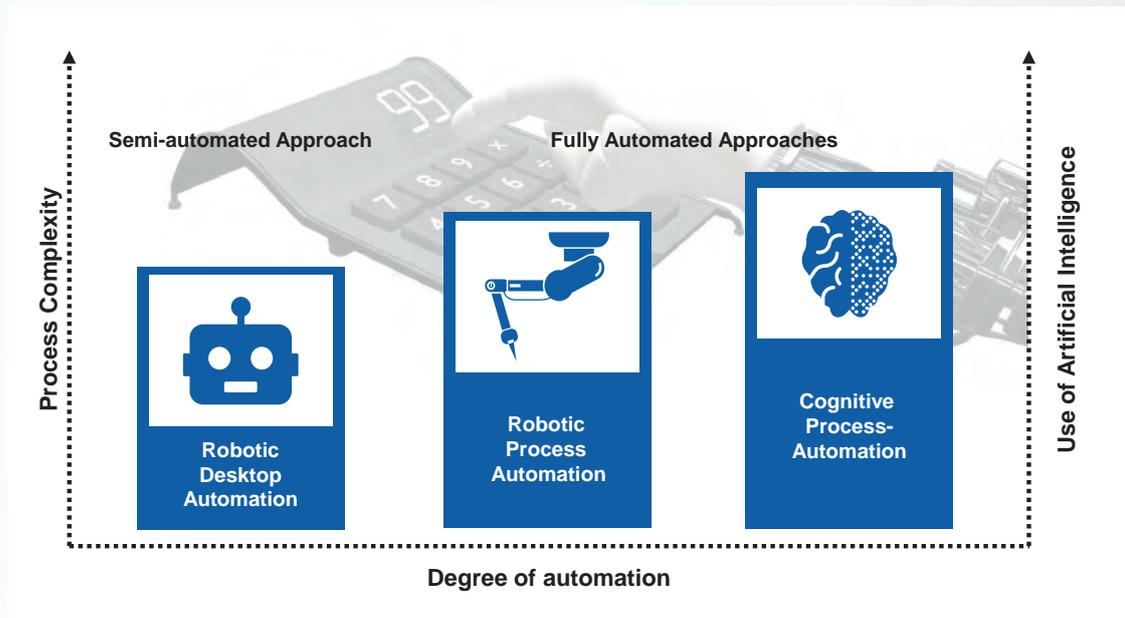


Figure 1: Evolutionary stages of process automation (GÖTZEN 2020, p. 3)

## Various Types of Cognitive Biases Inhibit the Use of RPA

Companies face the challenge of ensuring acceptance of RPA deployment while taking increasing AI into account. According to a KPMG study, adoption decreases as AI use increases<sup>5</sup>. In many companies, it can be seen that decisions are made on the basis of subjective criteria, despite the presence of automated insights<sup>6</sup>. Two specific influencing factors cause this circumstance: On the one hand, it is the conscious disregard of the knowledge gained due to a lack of acceptance of the same and unconscious prejudices. On the other hand, there are cognitive distortions, so-called biases, which inhibit the acceptance of automated decisions. Such biases can occur individually or in combination in different forms. Lack of acceptance can be explained, among other things, by managers and employees overestimating themselves (overconfidence bias) or by the complexity of automated decision-making<sup>7</sup>. Decision-makers are often unaware of how the results are determined with the help of complex algorithms. Unconscious influences in the context of RPA also include an excessive preference for the status quo over change (status quo bias), an inability to adapt one's own thoughts to new evidence and information (conservatism bias), or a selective perception in which one's own experiences and background create 'tunnel vision'<sup>8</sup>.

<sup>6</sup> PwC 2016, p. 20

<sup>7</sup> SADUN ET AL. 2018, p. 36 et seqq.

<sup>8</sup> SADUN ET AL. 2018, p. 36 et seqq.; MAKRIDAKIS 1990, p. 35 et seqq.

## Approach in the Project

Overcoming the aforementioned hurdles requires a holistic approach that creates workforce acceptance of RPA. For SMEs, this is a particularly challenging task due to limited human and financial resources. For this reason, the RPA acceptance research project is dedicated to the development of a model that encompasses the key influencing factors regarding the acceptance of RPA as well as its Intelligent Technology characteristics. These influencing factors will be empirically tested by a questionnaire study, in a behavior-oriented laboratory experiment and with an online study in order to develop a validated change management concept. The concept will include approaches to consider holistic, organizational and cultural transformation in addition to comprehensive training concepts. Through collaboration between the FIR and IPRI institutes and a large number of industry partners, the results of the research project will be developed with the help of a concrete process model.

In the first step, the general acceptance of the employees with regard to different technological manifestations of RPA will be determined. The interfaces and interactions between the workforce and the software will then be identified in order to define the requirements for the human-software interaction interfaces. Based on the identified requirements, the acceptance model between human and RPA software will be developed as a key deliverable of the project. A reward-based experiment for validation supports the research process by motivating the addressed test subjects with appropriate incentives. Subsequently, training

concepts for increasing the acceptance of RPA in SMEs will be developed and tested with the committee accompanying the project. Throughout the project, the (interim) results will be transferred for direct application in practice.

## Benefits of the Project Results for SMEs

The expected benefit of the presented approach for SMEs can be separated into indirect and direct benefit aspects. The direct benefit results from the reduction of biases towards automation, which improves employee acceptance of the use of RPA. In addition, the training concepts to be developed lead to effective use of RPA by employees. The efficiency potentials associated with RPA can thus be raised in the long term. This is particularly relevant for SMEs in order to optimally allocate existing resources. The indirect benefit consists of raising employees' awareness of digitization tools. General acceptance and openness to further digitization initiatives can thus be strengthened by the results of the research project and socio-technical entry barriers to the use of further technologies lowered.

### Literatur

BLUE PRISM (Hrsg.): Anwendungsbeispiele RPA. <https://www.blueprism.com/de/resources/case-studies/>

GÖTZEN, R.: Robotic Process Automation – Intelligent die Effizienz innerbetrieblicher Geschäftsprozesse steigern. FIR-Flash online, (2019)4. <https://www.fir.rwth-aachen.de/fileadmin/newsroom/newsletter/fir-fir-newsletter-2019-04-leitartikel.pdf> (Link zuletzt geprüft: 14.07.2021)

KPMG (Hrsg.): Trust in AI. A five country study. Zugriff am 14.06.2021, von <https://home.kpmg/au/en/home/insights/2020/10/artificial-intelligence-trust-ai.html>

LADY, M. C.; WILLCOCKS, L. P.: Robotic Process Automation at Telefónica O2. In: MIS Quarterly Executive 15 (2016) 1, S. 21 – 35.

MAKRIDAKIS, S. G.: Forecasting, planning, and strategy for the 21st century. Free Press, New York 1990.

PwC (Hrsg.): PwC's Global Data and Analytics Survey 2016: Big Decisions. <https://www.pwc.de/de/business-analytics/assets/big-decisions-survey-2016.pdf>.

PwC (Hrsg.): Studie Robotic Process Automation im Accounting. PwC-Studie 2020 über den Status quo, die Chancen und die Herausforderungen des RPA-Einsatzes im Accounting in der DACH-Region. <https://www.pwc.de/de/rechnungslegung/studie-robotic-process-automation-im-accounting.html> (Link zuletzt geprüft: 14.07.2021)

SADUN, R.; BLOOM, N.; VAN REENEN, J.: Operative Exzellenz: Die wichtigste Disziplin. In: Harvard Business Manager 40(2018)1, S. 36 – 45.

go VAN DER AALST, W. M. P.; BICHLER, M.; HEINZL, A.: Robotic Process Automation. In: Business & Information Systems Engineering 60 (2018) 4, S. 269 – 272.

The committee accompanying the project can be expanded at any time and allows companies to participate in many ways. If you are interested in the topic, are already using RPA or planning to introduce it, or would like to actively participate, please feel free to contact us. You will benefit from the regular exchange with the other participants, you can participate in the results early on and use them for your own benefit. Participation is free of charge and without obligation.

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## FuturePRO:

# First the Check, then the System

The mechanical and plant engineering industry is facing an ever faster changing business environment. In order to remain competitive in the future, professional project management is needed to respond to this change. However, especially in SMEs, this is still mostly done manually with Excel and Outlook. As part of the 'FuturePro' research project, FIR e. V. at RWTH Aachen University and ICM – Institut Chemnitzer Maschinen- und Anlagenbau e. V. have developed a self-check for SMEs in the mechanical and plant engineering sector, on the basis of which an individual guide for implementing a project management system is generated. >

Being able to respond quickly and efficiently to changes ensures companies' long-term success. However, risks that arise in the process also require active management<sup>1</sup>. Changes are taking place at an increasingly rapid pace and are leading to more difficult framework conditions for companies. Various aspects of these changes are summarized by the acronym VUCA: volatility, uncertainty, complexity and ambiguity. In the context of projects, organizations initiate change processes in order to make the company fit for the future. Projects are characterized by a set goal and an end as soon as these goals have been achieved.

Mechanical and plant engineering is particularly affected by these changes. Innovation cycles are becoming shorter and shorter and product complexity is increasing due to new digital components. It is therefore all the more important that SMEs in this industry also set up their project management professionally in order to be able to respond to these changes.



Figure 1: General conditions of a project management (own presentation according to ALSER and KASPERCZYK 2008)

<sup>1</sup>s. ARASHPOUR ET AL. 2017, S. 652

<sup>2</sup>s. BAHR 2018

<sup>3</sup>s. HASTIE U. WOJEWODA 2015

Classic	Hybrid	Agile	
Waterfall	Water-Scrum-Fall	SCRUM	Feature-driven Development
V-Model	V-SCRUM	KANBAN	Design Thinking
PRINCE2	SCRUMBAN	Extreme Programming	

Figure 2: Project management systems examined

Often, SME project management is still based on *Outlook* and *Excel*. In this respect, they lag well behind the maturity of project management in large companies<sup>3</sup>. But which project management system is best suited for SMEs in mechanical and plant engineering and which tools can be used? The authors of the ‘FuturePro’ project investigated precisely this question and provide SMEs with the appropriate answers in the form of a self-check and an implementation roadmap generated from it.

The self-check<sup>4</sup> enables companies to record their own status quo and project management requirements on the basis of 44 questions. The questions take into account various framework conditions for project management systems (PMS) (Figure 1). A consortium of 23 companies was involved in the development and validation of the questions. The consortium consisted mainly of SMEs from the mechanical and plant engineering sector, but larger companies and SMEs from related industries also participated. This helped to take into account and work out special features of the target group and differences from other companies.

The respective answers of the companies are then compared with different PMSs (Figure 2). An algorithm is used to calculate which PMS best covers the requirements and at the same time requires the least change to the status quo. In this way, SMEs receive the PMS that is best suited to their needs. The project also investigated the extent to which the PMSs considered are suitable for SMEs at all, or whether the PMS needs to be adapted specifically for SME needs. The investigations revealed that the most common PMSs can already meet the requirements of SMEs today. What is needed, therefore, is a low-effort implementation and concrete measures for the successful implementation of established PMS in SMEs.

These measures are provided by a guide (Figure 3, p. 66), which is generated after the self-check and made available for download as a PDF. The core element here is the implementation roadmap. Based on the answers and the selected PMS, this roadmap shows which of the company’s requirements are met by the PMS and which are not. In addition, the roadmap lists concrete measures for successful implementation and also shows which necessary requirements the company already fulfills. The subsequent methodological explanation of the PMS supports the procedure by defining necessary roles and processes and naming the tools



Figure 3: Contents of the downloadable individual guide (own presentation)

<sup>4</sup>You can find the self check at: [futurepro-tool.fir.de](http://futurepro-tool.fir.de)

under consideration. Subsequently, an overview of different project types provides companies with information on the aspects that are important for project management: Portfolio management, resource management, prioritization of tasks, budget planning and risk management. In addition to a brief description of the activities in these areas, concrete methods for carrying out these activities are provided.

The self-check thus offers SMEs in the mechanical and plant engineering sector in particular the opportunity to analyze their project management and select a suitable PMS. The guide provides an individual action plan and far-reaching information about project management.

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**Website:** [futurepro.fir.de](http://futurepro.fir.de)

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**FuturePRO**

iP4MoVE:

# Intelligent Platform for E-Mobility and Networking of Energy Information

As part of the research project 'iP4MoVE', the FIR wants to conceptualize and develop an intelligent platform to optimally connect the two sectors mobility and energy for smart mobility. With the definition of an ideal degree of electrification in load transport, a fundamental acceptance for electromobility in multimodal logistics chains is to be created. The focus is on the conceptual design of an intelligent platform for determining the optimal use of electric vehicles in terms of energy, price and emissions. In this way, the results of the research project will contribute to making electromobility ecologically and economically viable and to ensuring sustainable neighborhood development. At the same time, the integration of renewable energy sources and storage technologies should reduce greenhouse gas emissions. This focus of this article is the question of the extent to which an expansion or restructuring of the current charging infrastructure will dynamize the advance of logistical electrification. In this context, it is important to discuss the hitherto diametrically opposed relationship between supply and demand with regard to renewable energy sources. How the logistical requirements influence the design and placement of charging parks is another important question. >



“The kilowatt hour in itself will have no value in the future. But it will be worth if it is either generated or consumed at the right time and in the right place.”

*Ulrich Schmack, Geschäftsführer von Digital Energy Solutions*



“For the comprehensive transformation process in the energy transition, we continue to need innovative ideas and developments”<sup>1</sup>. For this reason, neighborhood-based approaches are also being used today and the concept of “energy neighborhoods”<sup>2</sup> is being tested in various real laboratories. The aim is the exchange of energy within and between different quarters<sup>3</sup>. The consideration of an energy quarter includes all energy producers and users in a network, such as buildings or infrastructural facilities, in a certain area (=quarter). The energy supply of such quarters allows the intelligent use of potentials for everyone in the energy network, i.e. producers, consumers and third parties. Through the energetic interconnection of buildings in a quarter, there is the possibility to ‘shift’ energies between these facilities.<sup>4</sup> Especially when using renewable energy sources, supply and demand are often not congruent, which is why the temporal shift of energy flows has to be compensated by storing energy. The “Musikerviertel” energy district in Ettlingen, which is supplied with 97 percent renewable energy, serves as an example project. It can therefore already be described as a “self-sufficient neighborhood”. In addition, the quarter emits 1,831 tons less CO<sub>2</sub> per year<sup>5</sup>.

With the ramp-up of electromobility in Germany, the importance of charging infrastructure in the context of energy quarters is growing. Charging facilities are among the energy-related facilities and must be able to be integrated into an energy quarter. To further advance electromobility in Germany, the simultaneous expansion of charging infrastructure is essential<sup>6</sup>. In particular, the fast-charging infrastructure, which currently accounts for around 15 percent of the charging infrastructure in Germany and is a prerequisite for a switch to electromobility in logistics, is currently not yet sufficiently developed. It is mainly sufficient in large urban areas<sup>7</sup>. For this reason, the German government is having 1,000 charging parks built by 2023, which will be equipped with fast charging stations, provide high charging power and thus enable short charging times.

One solution approach to address the problem of insufficient charging infrastructure is to consider charging infrastructure facilities as an integral part of an energy district. In order to establish such an integrated charging

infrastructure, the spatial and energetic availability must be ensured above all. For the long-term establishment of electrically powered trucks, sufficient charging points must be available at strategically selected locations, such as main logistics hubs. A combination with rest area facilities and corresponding service facilities is also conceivable. In addition, energy availability with a correspondingly high charging capacity must be ensured. Taking these two prerequisites into account, it would make sense, for example, to select a location near regenerative power plants (e.g., wind farms) and a highway. In order to be able to make precise statements about opportune main traffic hubs in NRW, the research project is preceded by an analysis of highway utilization (mileage, etc.) and nominal data (average fleet size, etc.) of European logistics service providers. These findings will then serve as the basis for a well-founded evaluation of logistical requirements for the future charging network.

Furthermore, data exchange between the charging point and the user must be ensured in every situation. In addition to real-time information during the charging process, price, fuel and general information about the facility must be accessible to the user. For logistics service providers, it is also fundamental that this data be integrated into the respective navigation systems. In addition, there is currently no way to reserve specific charging points in order to plan a route with an e-truck in advance. In general, logistics service providers have too little or no information about the availability of suitable charging points, which is why route planning with an e-truck is currently too costly to be considered.

This fundamental lack of transparency in terms of both available charging power and e-truck charging demand is being addressed by a platform solution as part of the ‘iP4MoVE’ research project. In addition to the continuous exchange of data from the mobility and energy sectors, the platform also offers a reservation function for charging services - the central prerequisite for sustainable route planning. In the course of sustainable route planning, integrated into a transport management system (TMS), information about available charging services as well as locations is provided. This information is used to carry out sensible and to make binding reservations for available capacities via the platform. This is the only way to make it possible to use e-trucks in multimodal logistics chains and to create fundamental acceptance for the electrification of freight transport. The results described here enable logistics service providers to plan tours for battery-electric vehicles and to calculate and reserve the necessary layovers; billing is then automated. Incidentally, the platform provides further added

<sup>1</sup> BMWi 2019a

<sup>2</sup> INNOGY 2020

<sup>3</sup> BMWi 2019b

<sup>4</sup> STOCKINGER 2019, p. 25

<sup>5</sup> REDAKTION DER INGENIEUR-NACHRICHTEN 2017

<sup>6</sup> BMWi 2021

<sup>7</sup> BUNDESNETZAGENTUR 2021

value in view of the planned supply chain law by providing ecologically relevant key figures.

developing, among other things, an energy simulation model and an algorithm for sustainable route planning.

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The research project 'iP4MoVE' started on 01.10.2019 and has a total duration of three years. The consortium is currently

For further information about the research project or the possibilities of participation, please contact us.

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**Project Partner:** AMSIT – Gesellschaft für angewandte Mikrosystemtechnik und Informationstechnologie mbH, BatterieIngenieure GmbH, Hammer GmbH & Co. KG, PSI Energy Markets GmbH, PSI Logistics GmbH, smartlab Innovationsgesellschaft mbH

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PROmining:

# Establishment of a Platform for the Improvement of the Assets of SMEs in the German Stone and Earth Industry

The 'PROmining' research project, which runs from January 1, 2021 to December 31, 2022, aims to initiate and expand digitization in the German stone and earth industry. Within the project, a data-based decision-making basis is to be created for SMEs through the use of a demonstrator of a platform solution. Across the industry, a lack of data-based decision-making bases has been identified; most decisions are based on empirical values. Furthermore, it is necessary to optimize the capacity utilization of the plants with the help of the demonstrator. This is very volatile due to regional, economic and seasonal fluctuations in demand. The demonstrator is intended to motivate companies to improve their data management and initiate the transformation process toward a digital company. >

Small and medium-sized enterprises (SMEs) are the backbone of German industry. SMEs face a wide range of challenges, particularly with regard to digitization. There is currently no general trend toward digitization in the German stone and earth industry<sup>1</sup>. There is a large technological catch-up potential, mainly due to the structure of the companies<sup>2</sup>. For the mostly very small companies, which can only achieve low sales margins as is customary in the industry, the adaptation of new technologies means a high entrepreneurial risk<sup>3</sup>. The transition phase that occurs when switching to a new software solution inevitably entails a high level of additional work for the companies. This is often not manageable for small companies in parallel with their daily business. The many risk barriers and inhibition thresholds prevent the adaptation of new technologies and thus the expansion of digitization within the industry.

A technological innovation and the associated value creation potential for the industry can be created in the form of a demonstrator of a platform solution. With the help of the demonstrator, SMEs in the German stone and earth industry will be enabled for the first time to generate knowledge about current capacity utilization and forecast demand based on internal and external data. The companies can anticipate rising costs and volatile prices with greater efficiency and thus act more economically. The demonstrator provides participating companies with a data-driven decision-making tool that can be easily integrated into their decision-making and business processes. The demonstrator creates incentives to optimize the internal data management in the companies and to initiate a disruptive digitalization. This induces the first step in the digital transformation process and lays the foundation for the transformation to a data-driven company.

The first project meeting took place on April 16, 2021 with approx. 20 industry partners in digital form and formed a valuable contribution to the design of the first work package through the diverse presentations and discussions. This includes the benefit and potential analysis of a platform for SMEs in the German stone and earth industry. Based on the definition of the business ecosystem and with the help of an analysis of the value chain, a morphology and the formation of types of central players will be developed.

A cross-consistency assessment ensures the unambiguousness of the roles. Furthermore, influencing factors of capacity planning as well as potentials and obstacles to be addressed

for the successful implementation of a data-based platform are recorded in a structured manner in cooperation with the project partners. Expert interviews ensure the transition to subsequent project steps, which focus on the optimization of data generation and processing in the stone and earth industry. In the second research year, the concrete elaboration of the required functions of an operator concept for the PROmining platform as well as the company-neutral implementation, validation and testing of the platform demonstrator are envisaged.

The cooperation of FIR e. V. at RWTH Aachen University with the Institute of Mineral Resources Engineering (MRE) at RWTH Aachen University takes into account the interdisciplinary aspect and claim of the research project. The bundling of FIR's competencies with regard to digitization and business transformation and MRE's comprehensive expertise and industry knowledge form the basis for comprehensive synergy effects that enable the development of a well-founded and validated demonstrator. Already during the project duration, an intensive transfer of results and exchange of experience with the industrial partners is planned through various measures. The committee accompanying the project is always looking for new participants. They benefit from a regular exchange between research and industry and the opportunity to help shape the content of the work, gain early access to the results produced and can use them in a beneficial way in their companies.

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#### Literatur

BAUMS, A.; SCHÖSSLER, M.; SCOTT, B.: *Kompendium Industrie 4.0. Wie digitale Plattformen die Wirtschaft verändern – und wie die Politik gestalten kann. Kompendium Digitale Standortpolitik; Bd. 2.* Berlin, Oktober 2015. <http://plattform-maerkte.de/wp-content/uploads/2015/11/Kompendium-High.pdf> (Link zuletzt geprüft: 23.07.2021)

BÖRNER, A.; BORNHÖFT, E.; HÄFNER, F. ET AL.: *Steine- und Erden-Rohstoffe in der Bundesrepublik Deutschland. Mineralogie, Petrologie, Geochemie, Lagerstättenkunde; Bd. 10.* Schweizerbart, Stuttgart [u. a.] 2012.

DELOITTE (Hrsg.): *Tracking the trends 2018. The top 10 issues shaping mining in the year ahead.* London 2018. <https://www2.deloitte.com/content/dam/Deloitte/us/Documents/energy-resources/us-er-ttt-report-2018.pdf> (Link zuletzt geprüft: 23.07.2021)

<sup>1</sup> DELOITTE 2018, p. 12; O' NEILL 2017, p. 40

<sup>2</sup> BÖRNER ET AL. 2012

<sup>3</sup> BAUMS ET AL. 2015

KOWITZ, S.-F.: *Discover Patterns in Exceptions – Entdecke das Muster im Sonderfall. Bergbau 4.0 und Big Data: Erfahrungen eines Start-ups.* In: *GeoResources* (2016) 3, S. 46–48.

O' NEILL, O.: *Digitalisierung im Bergbau – Industrie 4.0.* In: *Mining Report* 153 (2017) 1, S. 39–46.

RAUTH, H.: *Anlagenmanagement. Reorganisation der Instandhaltung eines Steinbruchs unter technisch-wirtschaftlicher Reflexion.* Mittweida, Hochsch., Dipl-Arb., 2012. [https://monami.hs-mittweida.de/files/2301/DA\\_RAUTH\\_Anlagenmanagement.pdf](https://monami.hs-mittweida.de/files/2301/DA_RAUTH_Anlagenmanagement.pdf) (Link zuletzt geprüft: 23.07.2021)

SKRYPZAK, T.: *Untersuchungen zur Optimierung der Prozessabläufe und der Energieeffizienz bei der Gewinnung von Natursteinen in Festgesteinstagebauen.* Mainz, Aachen 2016. – Zugl.: Aachen, Techn. Hochsch., Diss., 2016.

The project committee is always looking for new participants. They benefit from a regular exchange between research and industry and the opportunity to help shape the content of the work, gain access to the results at an early stage and can use them in a beneficial way in their company. If you are interested, please contact us.

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**Website:** [promining.fir.de](http://promining.fir.de)

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DaFuER:

# Research Project for the Increase the Data Quality

... and what role data fusion plays in this process

With the research project 'DaFuER', methods of data fusion for increasing data quality were to be examined with a view to operational feedback data. Here you can read the most important results, which are illustrated by the use case in the *demonstration factory in Aachen*. >



Current megatrends such as globalization and digitization make great demands on manufacturing companies: Real-time and efficient production planning and control (PPC) as the basis for sound and short-term decision-making is one of them. Necessary conditions for reliable decision-making continue to be high data quality and application-oriented information availability. The central challenge in increasing data quality lies in the investment costs for implementing appropriate measures. Small and medium-sized enterprises (SMEs) are particularly affected by a limited ability to invest.

One way to reduce investment costs is to increase the data quality of a dataset by merging data or combining different data sources. The research project ‘DaFuER’ took up exactly this point. The aim was to ensure data quality, especially for production management and production controlling, by applying data fusion methods. The project developed a guideline for the application of data fusion in the context of operational feedback data, which serves as a decision-making aid for user companies and developers of operational application systems.

The structure of the guide is based on the model developed in the research project for the application of data fusion in the context of operational feedback data. In a first step, the users define the current use case. They first determine the most important information needs; this is done on the basis of an overview showing the information relevant for PPS. The users select the information that they consider unreliable due to poor data quality. They determine the information availability based on the available data. These are derived from the data sources available to the company.

In the second step, the data sources to be merged are determined. For each piece of information identified as relevant, an overview lists potentially related data sources from which this information can be extracted. Users can thus assign concrete, available data sources to their information needs. In addition, they qualitatively determine for each data source to what extent it fulfills the various data quality criteria. Based on these quality characteristics, users are able to select those available data sources for fusion that, complementing each other, fulfill the data quality characteristics.

Finally, the appropriate methods of data fusion are identified. Based on a classification of the considered data sources, the users first developed a morphology to describe a data source generically. By combining all possible types of data sources or their morphological characteristics, process-typical errors during fusion can be derived and error classes can be formed. During the project, it was determined to what extent a method for applying data fusion is resistant to a corresponding type of error. If it is known which data sources are to be fused, it is possible for the users to derive concrete methods of data fusion based on this assignment. Those can thus best address the key challenges in combining the selected data sources. In order to test the model developed in theory in practical application, a use case was carried out at the Demonstration Factory Aachen (DFA), among other things.

The background to this use case was irregularities in the comparison of start and end times of individual operations of a laser cutting machine. The existing data quality is currently inadequate, especially with regard to accuracy, completeness and up-to-dateness.

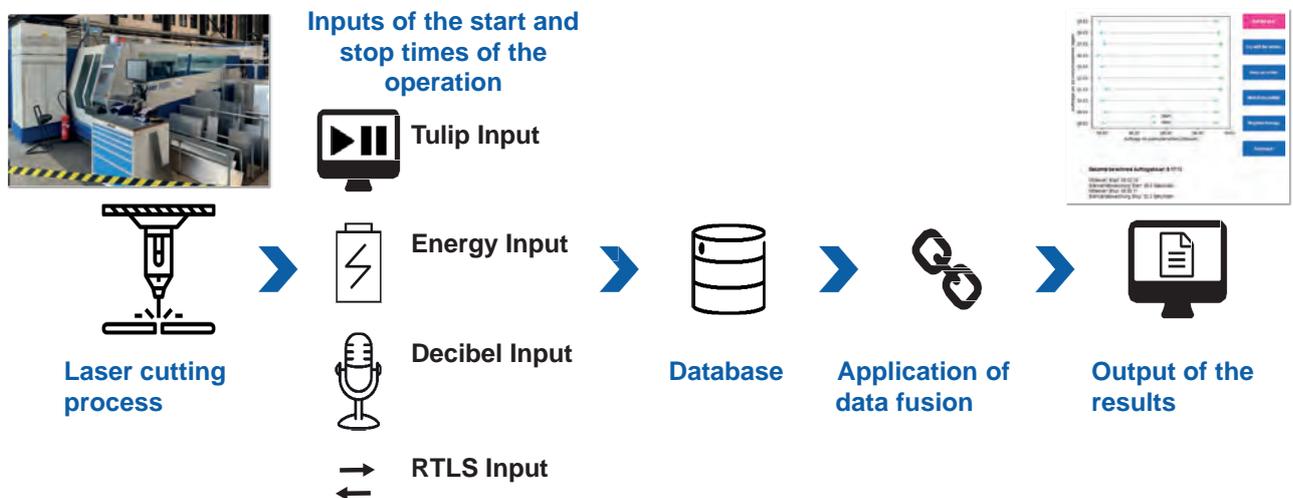


Figure 1 : Use Case DFA

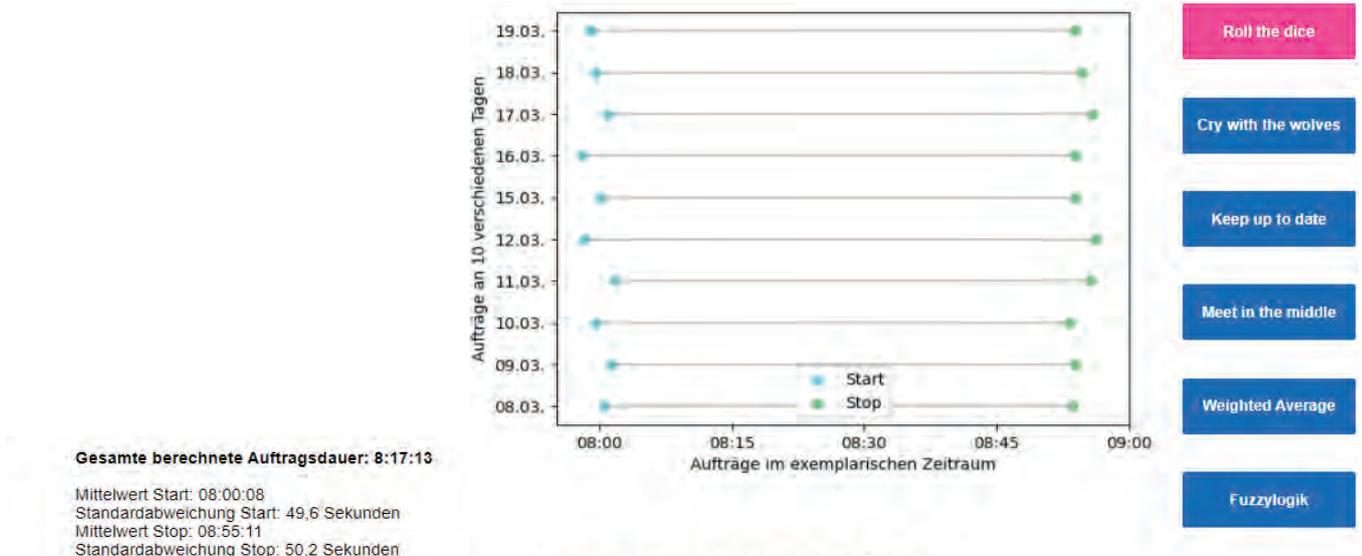


Figure 2: Result of the data fusion (Roll the Dice)

The goal of the practical implementation was to improve the data quality by combining the different information sources using data fusion methods.

The information need to be optimized was related to the laser cutting machine operation time. The information availability consisted of the acquired data from a buzzer, an RTLS sensor, an Intelligent Sensor Technology, and a complementary information system. The Intelligent Sensor System included an energy sensor and a noise sensor. The sensors sent the “start” and “stop” signals, respectively, when the energy consumption or noise level exceeded or fell below a certain threshold. The buzzer sent corresponding signals when the employee performed manual actions. The RTLS sensor was able to measure when employees entered or left a predefined work zone.

In order to select the best possible data fusion method for the application, it was first necessary to identify potentially occurring defect classes. For this purpose, the morphological characteristics of the data sources were combined. Thus, with regard to the use case, potentially large data volumes, the lack of possibility to apply mathematical operators, and different scale levels, among others, could be identified as errors typical for the process. Based on the analyzed resistances of the data fusion methods to the collected error classes, the method categories decision rules, fuzzy logic, and artificial neural networks were particularly suitable for the fusion of the collected data in the context of this use case.

The corresponding methods were then tested with respect to their applicability. Since, based on the manufacturing concept, the operations on the laser cutting system involved a very large number of different jobs, methods requiring a large data base (e.g. artificial neural networks) were excluded. On this basis, a wide variety of decision rules and a fuzzy logic methodology were implemented in the aforementioned use case.

Figure 2 shows an evaluation of the generated data using the data fusion method, more precisely the decision rule, “Roll the Dice”. Shown are the start and stop times generated using the aforementioned method for ten different days in the same time period. In addition, the total order duration over the ten days as well as mean values and standard deviations of the start and stop times are shown for comparison purposes. Thus, for the aforementioned decision rule, the calculated total job duration is approximately 8 hours and 17 minutes. Depending on the data fusion method used, different order durations or mean values and standard deviations result. The results of the application of further data fusion methods for this use case can be found on the website of the research project<sup>1</sup>.

The research project provided users with two options for the actual implementation of data fusion: one option is to step through the process steps of the data fusion application model using the application guide. An alternative is the free, interactive online tool created as part of this research project, which guides and instructs users step-by-step through the topic.

<sup>1</sup> dafuer-tool.fir.de

The project results make it possible for small and medium-sized enterprises to increase information transparency in the operational execution of orders. This was achieved by defining quality requirements in a well-founded and precise manner. In addition, it was possible to significantly increase data quality by applying the developed solutions in practice using selected examples. This simplified the decision-making processes in production management and production controlling, as well as for the collection of key figures.

Literatur

DIENES, C.; PAHNKE, A.; WOLTER, H.-J.: *Investitionsverhalten von kleinen und mittleren Unternehmen. IfM-Materialien; Nr. 268. Institut für Mittelstandsforschung (IfM) Bonn, März 2018. [https://www.ifm-bonn.org/fileadmin/data/redaktion/publikationen/ifm\\_materialien/dokumente/IfM-Materialien-268\\_2018.pdf](https://www.ifm-bonn.org/fileadmin/data/redaktion/publikationen/ifm_materialien/dokumente/IfM-Materialien-268_2018.pdf) (Link zuletzt geprüft: 27.07.2021)*

RUSER, H.; PUENTE LEÓN, F.: *Informationsfusion – Eine Übersicht (Information Fusion – An Overview)*. In: *tm – Technisches Messen* 74 (2007) 3, S. 93 – 102. DOI: 10.1524/teme.2007.74.3.93.

jn SCHUH, G.; REUTER, C.; BRAMBRING, F.; PROTE, J.-P.; HEMPEL, T.; GÜTZLAFF, A.: *Organisation und IT. In: Handbuch Industrie 4.0. Geschäftsmodelle, Prozesse, Technik. Hrsg.: G. Reinhart. Hanser, München [u. a.] 2017, S. 146 – 154.*

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OKReady:

# OKR as an Agile Management System for SMEs

On April 1, 2021, FIR together with the *International Performance Research Institute (IPRI)* started the project 'OKReady – Development of a concept for the introduction of the agile management system *Objectives and Key Results (OKR)* in small and medium-sized enterprises', which is funded by the *German Federation of Industrial Research Associations "Otto von Guericke" e. V.* The aim of the project is to enable SMEs to successfully introduce the agile management system OKR in order to achieve corporate goals more quickly and in a more targeted manner through increased transparency and strengthened employee commitment. In doing so, the two institutes want to tap into potential benefits and find answers to the question of how the introduction of OKR can increase the probability of success of digitization projects. >

Objectives and Key Results (OKR) is an operational management system made famous by Google that improves prioritization capability as well as communication and transparency in the company, measures performance in a tangible way and strengthens the commitment of employees in order to support the achievement of corporate goals<sup>1</sup>. Small and medium-sized enterprises (SMEs) in particular still rely on traditional management systems, often in conjunction with annually conducted target agreements as part of staff appraisals. The speed and volatility of business development, which many companies now face, can quickly render medium- and long-term agreed targets obsolete. The example of economic development during the COVID-19 pandemic reinforces this trend. Target agreements that are designed for an entire year hardly do justice to reality and motivate employees only to a limited extent. With the agile management system OKR it is possible to define goals in a transparent and objectively measurable way. This is a way to overcome the challenges of classic management systems quickly, elegantly and successfully.

### The Management System from Silicon Valley: Economic Opportunities for German Companies

In German SMEs, four out of five digitization projects fail. It is true that SMEs often strive to initiate a large number of pilot projects in the area of digitization. However, these are often carried out in isolation, which is why only twenty percent of projects are successful<sup>2</sup>. Fueled by

the COVID-19 pandemic, companies in Germany have recognized the urgency of identifying opportunities for digitization projects to boost performance within the company. At the same time, the lack of skilled employees with sufficient knowledge to bring digitization to all areas of the company remains the major challenge for small and medium-sized enterprises. Consequently, more and more decision-makers inside want to transform their companies, drive digitalization, make their company more attractive to digital-savvy professionals, and make their management system more agile and responsive<sup>3</sup>.

In order to successfully initiate and implement transformation projects, transparent communication, high motivation of employees and effective use of resources are required. The management system used plays a central role here: OKR has already proven itself as a successful model at Intel, Google and Facebook and has the potential to increase the success rate of digitization projects. At present, however, only a few SMEs in Germany use OKR, even though this method can help align the activities of all employees with a common vision and map corporate goals transparently across all hierarchical levels. In addition, OKR enables management to react faster, more flexibly and yet in a targeted manner to a wide variety of business developments<sup>4</sup>.

<sup>1</sup> ENGELHARDT AND MÖLLER 2017, p. 30 et seq.

<sup>2</sup> RINN ET AL. 2019, p. 5

<sup>3</sup> LINDNER 2019, p. 37 et seqq.

<sup>4</sup> NIVEN AND LAMORTE 2016, p. 25



Figure 1: Operational connection between the entrepreneurial target image and the agile management system OKR

## Consciously Formulating and Implementing Goals with OKR

The first part of the OKR management system describes corporate goals as a completed state in the future, the so-called objectives. The degree of goal achievement is then objectively determined with the help of the corresponding, measurable key results<sup>5</sup>. Using OKR, a company defines the central goals for a specific period, typically for one quarter at a time. The short-cycle horizon of the target formulation enables adaptation to

a dynamic environment. At the same time, the formulation of the objectives establishes a direct link with the higher-level combinations of measures in the strategy. This strategy transfers the purpose, vision and mission of the company to the operational level. The structure of the operational levels is shown in the figure (Figure 1). Such an approach enables employees to consciously focus on prioritizing short-term goals in order to consistently pursue the overall purpose of the company. The specific qualitative goals (objectives) and their quantitatively measurable core results are forced<sup>6</sup>. Key-Results describe the achievement of goals on the basis of measurable characteristic values, they do not represent a task list. The achievement of key results is characterized by a high degree of personal responsibility on the part of the employees, because teams independently derive specific tasks from them.

<sup>5</sup> DOERR 2018, p. 28 et seq.

<sup>6</sup> CREUSEN ET AL. 2017, p. 200

<sup>6</sup> CREUSEN ET AL. 2017, p. 200



## Unfolding the Potential Benefits of OKR through an SME-specific Implementation Concept

In order for German SMEs to benefit from OKR, an accessible and practicable concept for its introduction is necessary. In the research project 'OKReady', OKR is first differentiated from other management systems. This is followed by the identification of concrete use cases for OKR deployment. After a cause-effect analysis of the OKR application on the specific fields of action of the project implementation, the influencing factors that determine the project success are defined. Subsequently, a catalog of measures is developed

in cooperation with the project-supporting committee, which helps to systematically reduce acceptance-specific barriers associated with the introduction of OKR. All the insights gained from the project are finally incorporated into the development of a company-specific introduction concept. This concept also includes concrete support for the selection of a suitable OKR tool. Finally, the qualitative and quantitative effects of the introduction are transparently revealed with the help of a before/after analysis based on a project-accompanying implementation of OKR in companies of the project-accompanying committee.

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If you are interested in the topic of OKR, are currently implementing or already using the OKR method, please feel free to contact us. The project accompanying committee is always looking for new participants. You will benefit from a regular exchange with research and industry, can benefit from the results at an early stage and use them beneficially in your company. Participation is free of charge and without obligation for you.

**Project Title:** OKReady

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"Otto von Guericke" e. V. (AiF)

**Funding no.:** 21740 N

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**Website:** [projekt-okready.de](http://projekt-okready.de)

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PAIRS:

## Pandemic and Toilet Paper?

Especially in times of crisis, sovereign supply chains have proven to be essential in order to be able to guarantee system-relevant processes without disruptions. However, no two crises are alike. Floods or an economic crisis differ significantly from a pandemic, so that different political as well as economic measures are required from the players involved. Nevertheless, crises have one thing in common: early risk assessment and targeted action are necessary to manage a crisis. In the research project 'PAIRS (Privacy-Aware, Intelligent and Resilient Crisis Management)', a cross-domain approach was chosen to identify crisis scenarios and anticipate their development based on a hybrid AI methodology. In addition, the envisioned service-based platform supports stakeholders in crisis early warning, crisis monitoring, and evaluation of response strategies. This will enable them to react quickly to crisis situations and initiate measures to minimize negative effects. At the same time, the platform approach enables access to diverse and distributed data sources as well as interaction and cooperation between different services. >



The past has shown that individual crises such as pandemics, natural disasters or major political changes always burden several social, political and economic areas due to their complexity<sup>1</sup>. The consequences permeate all social structures and thus affect every individual.

Omnipresent is the Corona pandemic, which exemplarily reveals how well-timed and global supply chains are negatively affected. One of the reasons for this lies in the popular principles of lean management. Processes are designed to be efficient and wasteful.<sup>2</sup> As a result, they serve as exemplary drivers for clocked just-in-time production. However, the basis for this is a set of stable processes. The disruption of individual processes is assumed to be fundamentally surmountable. In “normal” everyday business, potential disruptions can be repeatedly handled without major losses. In crises, however, disruptive disturbances occur that can no longer be managed according to the well-known principle of “Actio - Reactio”. The unpredictability of the causes, duration and severity of a crisis make preparation an ambiguous question of complexity. Predictive and data-based measures can be used to manage the resulting obstacles.<sup>3</sup>

Digital transformation is already generating big data for this purpose, including in healthcare. This potential can be processed with increasingly powerful computing machines and used for intelligent detection of crises<sup>4</sup>. Nevertheless, this is sensitive data that is correctly not freely accessible. However, there is a further problem in the concatenation of anonymized data in the practical implementation of crisis management: In particular, the lack of a cross-domain ecosystem for crisis management as well as the lack of data sovereignty and

the corresponding data protection, the few resources in small and medium-sized enterprises as well as the lack of integration of proprietary data and closed systems form the core challenges.<sup>5</sup>

The crisis management platform to be developed in the ‘PAIRS’ project should help to successfully overcome these hurdles in the future. Ensured by a cross-domain and federated approach, it will serve to identify and anticipate crisis scenarios on the basis of a hybrid AI concept (the combination of human and artificial intelligence) in an iterative learning process. The aim is to secure the availability of essential resources and capabilities of companies and their networks and to sustainably strengthen their marketability. In particular, the interactions between economic and political actors will be considered, taking into account data sovereignty and data security. In the realization of this AI lighthouse project, more than 25 partners as well as the FIR are already involved with expertise from production and information management.

The platform reflects the following cycle: the risk of individual crisis scenarios, i.e. concrete manifestations of the crisis event and the general reactions, are specifically assessed in relation to the trigger of the crisis or to the respective trouble spot. From this risk assessment and a self-expanding pool of measures, individual response measures to possible

<sup>1</sup> PETERSEN AND BLUTH 2020, p. 9

<sup>2</sup> GÖRG ET AL. 2020, P. 7

<sup>3</sup> STICH ET AL. 2021, P.

<sup>4</sup> SCHÄFER 2021

<sup>5</sup> STICH ET AL. 2021, p. 35 et seq.

There were indeed serious supply chain problems in the first phase of the pandemic, so we're talking about April, May roughly. And that has to do on the one hand with the loss of suppliers in China and then a few weeks later with the loss of suppliers, especially in northern Italy. But that didn't take long, and already in May and then into the summer, you can talk about a complete normalization of the supplier structures."

*Gabriel Felbermayr, President of the Kiel Institute for the World Economy*

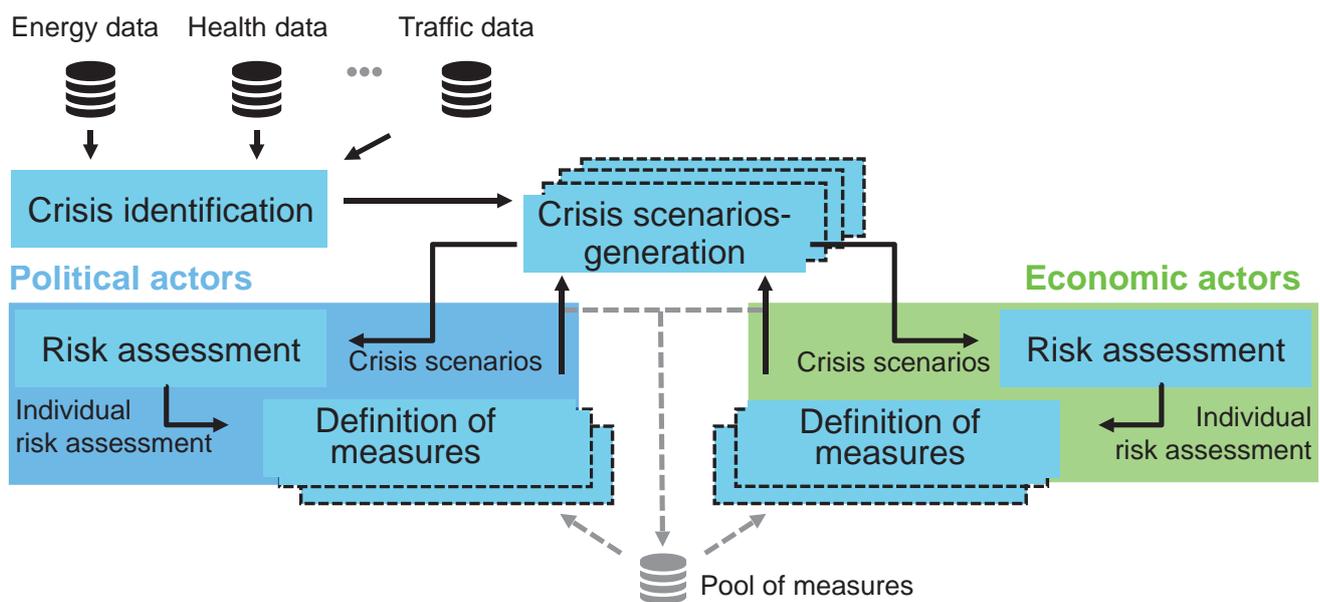


Figure 1: Schematic functioning of the platform

crisis situations can be derived, which are subsequently fed back anonymously into the crisis scenario generator (Figure 1). This results in an iterative precision of the scenarios with simultaneous continuous adaptation of all response measures. The resulting information base serves as the best possible preparation for potential crisis situations and thus increases the resilience of business locations.

From a user perspective, the PAIRS platform enables economic and political stakeholders to anticipate the reciprocal influences of individual measures and incorporate them into their own decisions. The integration of reactions to an initial crisis event into specific crisis scenarios enables dynamic crisis management. By linking associated IT systems, concrete risks for the individual players (e.g. economic in the form of supplier default or political in the form of a sharp rise in insolvencies) are automatically identified and evaluated. Catalogs of measures derived from the platform help the players to select the best possible response strategy. The selected response measures of the individual actors are fed anonymously to the PAIRS platform and serve to detail the current crisis scenarios by identifying the macroeconomic and political responses available to all platform participants. This results in an iterative learning process that takes into account the interactions of all actors involved. Accordingly, e.g. operators of critical infrastructures (e.g. energy, health, etc.) as well as political actors (e.g. government institutions, NGOs, etc.) can derive and deploy their measures in a targeted manner on the basis of the specific image of the current and future

crisis situation (taking into account all reactions). This research project focuses on three use case areas covering a broad spectrum of critical processes.

1. The **use case from the “logistics/production/SCM”** area deals with the challenge that transport requirements and market structures change within a very short time in crisis situations. With the PAIRS platform, companies and logistics service providers can identify changes in market balance early (e.g., increase in demand for hygiene supplies), take action (e.g., build inventory, set up temporary storage locations, assess the impact on their supply network), analyze the impact of their initiatives, and monitor the situation in real time.
2. The **use case “healthcare”** was chosen because pandemics, especially in the healthcare sector, can have fatal consequences for patients (underuse), hospitals (overuse), and medical device providers. With the help of the results of the ‘PAIRS’ project, services are to be developed on the basis of data from hospital information systems that warn of epidemics at an early stage and in a spatially differentiated manner and provide the players involved with concrete input for forward-looking demand planning for crisis management. This could prevent or at least mitigate catastrophic effects for the overall population in the event of a crisis.
3. The **“energy” use case** addresses a central and critical infrastructure. Since energy supply has an impact on

all areas of social and economic life, predicting crisis scenarios in the energy sector (e.g., concerning the failure of the power grid) is essential for holistic crisis control and management.

Overall, the testing of individual use cases in the platform lays the foundation for their subsequent use in practice.

The presented research project has recently started. In the first phase of the project, use cases are defined based on analyses of past crises and corresponding discussions with experts, which enable the derivation of corresponding requirements for the PAIRS platform and its services. On this basis, the foundations of the platform will be developed in the following steps on the basis of topic areas. First, the core components and interfaces as well as the architecture of the platform are designed. In the next topic area, the focus is on developing the data integration strategies in the form of integration solutions as a basis for data availability and access rights in the context of data governance. As a third topic area, the conceptual and technical specification

as well as prototypical implementation of specific and generic PAIRS AI modules for smart crisis management services as well as their evaluation within a performance benchmarking and instantiation on the platforms of the system providers are considered. In parallel to the prototypical implementation of the crisis management approaches and their corresponding functionalities on the basis of the previously named use case categories, elaborations on the topics of security and data protection are being developed. Relevant aspects of data protection and IT security are adequately taken into account by designing and prototyping individual anonymization concepts for dynamic data and conducting legal and technical analyses. In order to ensure a lasting benefit of the PAIRS platform, on the one hand qualitative and quantitative investigations regarding the acceptance and benefit evaluation are continuously carried out in the project. On the other hand, the development of an exploitation strategy and a business model to ensure the economic viability and sustainable economic and social relevance of the PAIRS platform is taking place.

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The PAIRS research consortium currently consists of twelve funded and more than fifteen associated project partners. Due to the size of the research area, further associated partners in the research project are always welcome. As an associated partner, you can basically decide for yourself how and how often you want to get involved. The advantage in any case is that you have direct access to the content of the research project and can directly influence the results with your content and ideas. Are you interested in getting involved? Contact us and talk to us about the research project.

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**Website:** [pairs.fir.de](http://pairs.fir.de)

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Work 4.0, automation, demographic change, the COVID 19 crisis and regional structural change - they present companies and institutions in the healthcare industry in the Aachen region in particular with the complex task of reorganizing and redesigning learning and working. Against this backdrop, they are also confronted with new issues that need to be addressed in greater detail and to which constructive solutions need to be found. Specifically, there are four central guiding themes in which the greatest challenges in the health economics can currently be localized: **Human-Machine Interaction**, **Healthy Working**, **Digital Collaboration**, and **Agility and Innovation**.

For these topics, innovative tools and concepts are being developed, tested and implemented in the two GALA fields of action **Work Design** and **Competence Management** with the help of a toolbox „Work Design" and a toolbox “Competence Management”. With the health sector as the industry of the future, the ‘GALA’ project makes an important contribution to regional development and thus actively shapes structural change in the structurally weak Aachen region. Accordingly, the project is also accompanied and supported by the institutions *MedLife e. V.*, *digitalHUB Aachen* and the *City of Aachen*, which are well networked and anchored in the Aachen region, as associated partners. Figure 1 provides an overview of the project.

## Healthcare Industry as Growth Engine For Structurally Weak Regions

As a cross-sector industry, the health economics is highly relevant, not least against the backdrop of the Corona crisis and an increasingly aging society, and further growth figures can be expected in the future<sup>1</sup>. Nevertheless, an aging population is also leading to increasing cost pressure in the sector. Innovative solutions for the care of older people in particular are one of the key challenges currently facing the health economics. Personalized medicine and telemedicine, with the help of innovative information and communication technologies, open up opportunities to ensure good, comprehensive care. Medical products from the 3D printing process will no longer be a rarity, nor will intelligent implants and surgical robots. The development of nano-based medicines will also continue to advance. In developed societies in particular, the health economics as a driver of value creation and employment will therefore increasingly become an economic growth engine for innovations, both within the industry and beyond it in other industries or clusters<sup>2</sup>. With its high employment potential, the digitized healthcare industry can make a significant contribution to the creation, further development and preservation of high-

<sup>1</sup> BRANDT ET AL. 2017, p. 54 et seq.

<sup>2</sup> BRANDT ET AL. 2017, p. 56 et seq.

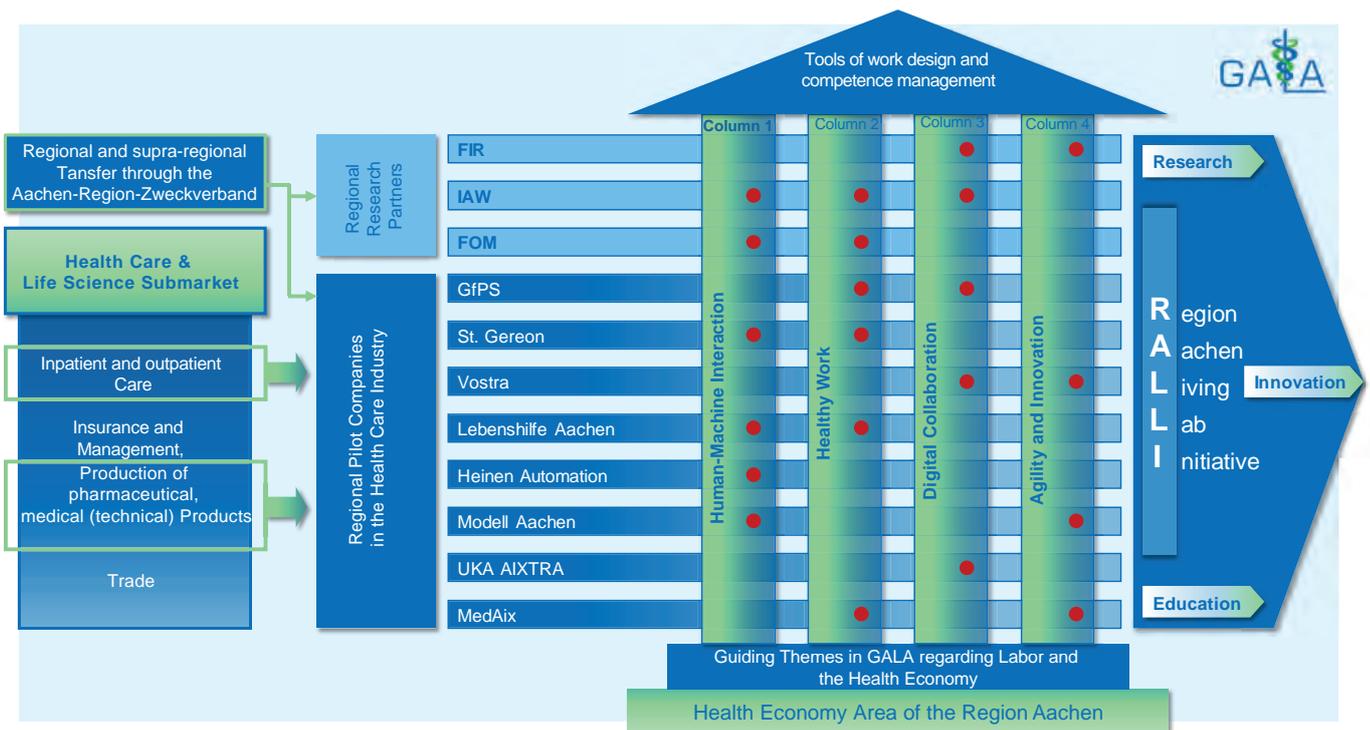


Figure 1: The GALA joint project at a glance

quality jobs in regions. This is also the case in the structurally weak region of Aachen, which is the focus of the GALA project, where around one in six employees currently work in the “inpatient and outpatient care” submarket alone, and which has to cope with a particularly large economic structural change as a result of the decision to phase out lignite in the “Rhenish mining area” at the beginning of 2019. In the Aachen region alone, 23,000 employees in the lignite industry, its supplier industries and other related economic sectors are directly and indirectly affected by this coal phase-out.

## Aachen Health Region at a Glance

With 46 cities and municipalities and a population of more than 1.3 million people, the Aachen region is currently one of six recognized health regions in North Rhine-Westphalia and has an innovative strength that is well above the national and state average. In coping with structural change, the Aachen region is concentrating on its specific strengths and potential in the sense of ‘smart specialization’<sup>3</sup> on the basis of the guiding principles of ‘identifying strengths, bundling activities and exploiting opportunities’. Innovative companies are increasingly integrated into regional structural policy. The health economy was identified in the economic study of the Aachen region from 2020<sup>4</sup> as one of six lead markets in the region, along with the information and communications industry, education and research, production technology and materials, mobility as well as logistics and energy, water and waste management. Specifically, this lead market includes inpatient and outpatient care, insurance and administration, manufacturing of pharmaceutical and medical (technical) products, and trade. With approximately 82,000 employees in 2019, the healthcare and life science sector is the lead market with the highest number of employees in the Aachen region. This means that almost one in five workers is employed in this sector. The lead market accounts for 18.7 percent of the employees in the Aachen region and for 14.0 percent of the number of companies. The share of turnover of the lead market in the economy of the Aachen region, however, is relatively low at 5.3 percent. Due to demographic change and the associated changes, it can be assumed that the healthcare industry in the Aachen region will continue to grow. The extraordinary density of companies and research institutions in the Aachen region are the drivers here. As part of the RWTH Aachen Campus project, for example, research is being conducted in the *Biomedical Engineering Cluster* on clinical and experimental imaging, image-guided therapy, intelligent implants, personal healthcare, biohybrid systems and pharmaceutical product development. Closely associated with the cluster are the *Institute for Applied Medical Technology* at RWTH Aachen University, the *Helmholtz Institute for Biomedical*

*Engineering* and the *Philips GmbH Chair for Medical Information Technology (MedIT)* there. The Institute for Neuroscience and Medicine at the Jülich Research Center completes the lead market-related research landscape. Driving forward networking between clinics, medical and medical technology producers, and the broad-based science and research institutions is the task of the regional industry association *MedLife e. V.*, which supports the joint project ‘GALA’ as an associated partner. Overall, it is therefore clear that the Aachen healthcare region is characterized by a high number of knowledge-intensive companies as well as research institutions and produces particularly high innovation potential.

## 4 GALA Guiding Themes

Specifically, the ‘GALA’ project focuses on the four guiding themes of **human-machine interaction**, **healthy working**, **digital collaboration**, and **agility and innovation**, which are explained in more detail below:

■ **Human-Machine Interaction:** it determines the way in which people and machines communicate, cooperate and/or collaborate directly with each other, but also the interaction and collaboration between people independent of location and time. An interface determines how humans transmit their instructions to the machine and in what form the machine executes these instructions and outputs the results. Depending on the information inputs and outputs, the information transmission in human-machine systems differs and so does the interaction. For example, machines typically output information via visual, auditory, and/or haptic displays that a human picks up via sensory modalities. The recorded information is processed in the next step with the aim of making a decision.

In the wake of digitalization and automation, the development of human-machine interaction is an important component in the healthcare industry. Personal assistance systems that communicate with humans via speech and, for example, help on the Internet in the search for therapy suggestions or the explanation of clinical pictures are already being developed. The recording of human gestures and the subsequent interpretation are also being researched and tested in science.

■ **Healthy working:** Healthy working is of central importance for a growing number of employees in the healthcare industry. Only if they are able to perform their work effectively while learning to reduce

<sup>3</sup> ARNDT ET AL. 2020

<sup>4</sup> ARNDT ET AL. 2020

stress and manage their own limited resources is it possible to maintain employment and performance into old age. *The World Health Organization (WHO)* defines health as “a state(s) of complete physical, mental and social well-being and not merely the absence of disease or infirmity<sup>5</sup>”. In scientific terms, the goal of “healthy work” is primarily to be located in the discipline of occupational science<sup>6</sup>. In the core definition of work science social compatibility, satisfaction and personality development, reasonableness and freedom from impairment, executability as well as harmlessness and tolerability are defined as evaluation criteria of work. With regard to the aspect of personality development, RAU<sup>7</sup> cautions that it is unclear exactly what about personality is to be developed and suggests using the criteria of health-friendliness and learning-friendliness instead. The author also refers to findings on a positive effect of learning opportunities at work on health. For the health of the working humans thus goals result for the avoidance of negative conditions (damage, impairments) and goals for the reaching of positive conditions (satisfaction, health). Such design measures, however, have hardly arrived in the health care industry so far or are not used very broadly. Thus, work in the Aachen region’s healthcare industry needs to be designed to better match employees’ goals, strengths, and passions, while ensuring that they remain healthy. Furthermore, new ways to improve interaction as well as the use of technologies for better working conditions are necessary steps to put the image of the industry as well as the appreciation of these services in a new light.

- **Digital collaboration:** Collaboration in and between work groups from different departments, locations or countries as deliberate activities based on the division of labor, i.e. carried out by several people, with a common goal are essential moments of everyday life in many organizations, often determining their success or failure.<sup>8</sup> Team-based work structures, forms of cooperation and resulting collaborative learning and work processes are associated with positive effects (e.g. innovations<sup>9</sup>) and are already addressed in the scientific approach of collaboration productivity as a form of productivity enhancement in companies. Specifically,

collaboration productivity<sup>10</sup> is about the optimal support of collaboration within and between teams. In technical terms, high-resolution access to data in real time is made possible with simultaneous relief from routine tasks and information searches through a variety of digital work and information tools. In human and organizational terms, communication and collaboration between people will be of key importance. The predicted increases in productivity in the indirect areas are considerable. Nowadays, many problems, especially more complex ones, can only be solved through close and successful knowledge-based collaboration between employees. Behind this is the realization that collaboration creates synergy effects that allow demanding work tasks to be tackled effectively and managed cost-efficiently.

- **Agility and innovation:** Agility is seen as a central lever for overcoming the challenges of digital transformation and implementing innovations<sup>12</sup>. The need for agility is often postulated by characterizing the world as VUCA (volatile, uncertain, complex, ambiguous). Agility generally refers to the ability to move quickly and easily, as well as to think quickly, derive conclusions, as well as translate immediately into immediate action<sup>13</sup>. In this sense, “agile” means the immediate action itself as well as the ability to react at any time and immediately. Accordingly, an agile person is skilled and agile, which can refer to physical, cognitive, and mental abilities alike. With the concept of organizational agility, such basic ideas are transferred to organizations or companies. Organizational agility is then understood as the ability to react both reactively and anticipatively to environmental requirements (e.g., market, customers) by means of innovative and learning-based procedures. In particular, this refers to the ability to identify changes and future opportunities in a highly turbulent corporate environment<sup>14</sup>. Team agility, in turn, is the ability to rapidly change team behavior in response to customer or stakeholder needs, market or technology requirements. It is clear that the agility concept is already by definition associated with positive outcomes related to innovation, among other things. The hype that the concept of agility is currently experiencing is thus based less on an empirical foundation or statements about the extent to which the positive adaptation and innovation

<sup>5</sup> WHO 1946/2020

<sup>6</sup> LUCZAK U. VOLPERT 1987

<sup>7</sup> RAU 2004, P. 182 et seq.

<sup>8</sup> LEIMEISTER 2014

<sup>9</sup> SCHRAGE 1990

<sup>10</sup> SCHUH AND POTENTE 2014

<sup>11</sup> S. SCHUH ET AL. 2013

<sup>12</sup> WORLEY ET AL. 2014

<sup>13</sup> PUCKETT AND NEUBAUER 2018

<sup>14</sup> FELIPE ET AL. 2016

services can actually be implemented with an impact on success.<sup>15</sup>

## GALA Fields of Action

Innovative tools and concepts are being developed, tested and implemented for the four key topics in the two fields of action of work design and competence management, and in this way the regional development of the structurally weak Aachen region is being sustainably promoted. In line with these guiding themes and fields of action, the GALA project is looking into questions such as how the interaction between humans and machines can be optimized for the benefit of employees, how the stresses and strains of work in the healthcare industry can be reduced, for example, through supportive digital assistance and corresponding work organization measures, how digital collaboration can lead to an increase in efficiency and create synergies, and which concrete measures can be used to promote agility and innovation. In this context, the GALA project is taking an innovative approach: Against the background of the shortage of skilled workers, it is intended to develop and test guidelines and qualification modules for international resource management in the healthcare industry in the Aachen region. For example, the Federal Minister of Health, Jens Spahn, already courted Mexican nursing staff in September 2019 and paved the bureaucratic way with a declaration of intent, according to which their entry into Germany will be facilitated, among other things, by accelerating the recognition and visa procedures. Its international recruitment concept calls for Mexican trainees to learn about the German health care system and promote working as nurses in Germany upon their return to Mexico.<sup>16</sup>

## Procedure and Utilization of Results

In addition to document analyses of sector reports, occupational statistics, Literatur and technical innovations on the four GALA guiding themes, an analysis of the strengths and weaknesses of the Aachen health region will be carried out at the beginning of the collaborative project against

the background of current developments surrounding the Corona crisis. From this, conclusions can be drawn for the risk management of the region against future crises. Furthermore, concrete needs analyses will be carried out in the participating companies and design measures will be derived. Based on this, a toolbox “work design” will be developed for the Aachen health region. The experiences will be compiled in prototypical case studies and implemented in pilot projects. In addition, based on the findings, future-oriented differentiated qualification contents with reference to the four GALA guiding themes will be conceptualized, developed and tested in a toolbox qualification. If the project is successfully implemented, proven solutions for the future of work in the health economy of the Aachen region will act as a beacon for work design and competence management on companies and thus trigger a sustainable transformation of learning and work. The “Aachen Region Living Lab Initiative” is intended to support this as an ongoing initiative. National as well as international facets beyond the Aachen region in the form of conferences, the internationalization of educational products, the relief of the health care system or the development and testing of guidelines and qualification modules for an international resource management in the health care industry of the Aachen region are further synergy effects of GALA.

## Kick-off Event and 1st Meeting already Successfully Completed

On April 27, 2021, the digital kick-off meeting of the project took place with all partners via the platform Zoom. In mid-June 2021, the GALA team successfully passed its first milestone. In mid-June 2021, the GALA team successfully passed its first milestone, this time in an innovative environment: In the 3D learning and working environment of *TriCAT spaces*, all partners and the *PTKA Karlsruhe* came together to inform about the work done so far, to deepen the exchange and to gain new ideas for the further project activities.

<sup>15</sup> S. WEIBLER AND ENDRES 2020





## Further Course of the Project

In the further course of the project, the task is to find answers to the outlined challenges in the health care industry as well as to derive suitable work design measures and develop qualification offers. The aim is to further strengthen the regional healthcare industry, to promote regional

development and, closely related to this, to anchor the ideas of New Work, which have been increasingly implemented in companies outside the healthcare industry in the recent past, in the healthcare industry as well. In addition, the exchange with the other support programs of *REGION.innovativ* will be intensified in order to create further synergy effects.

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### Literature

ARNDT, O.; KRINKE-HÄUSLER, F.; CRAEMER, T.: *Wirtschaftsstudie Region Aachen 2020*. Aachen, Dezember 2020. <https://regionaachen.de/wp-content/uploads/2021/05/WirtschaftsstudieRegionAachen2020.pdf> (Link zuletzt geprüft: 23.07.2021)

BRANDT, A.; HEINECKE, N.; JUNG, H.-U.: *Regionalwirtschaftliche Bedeutung der Gesundheitswirtschaft in Deutschland*. In: *Gesundheitswirtschaft als Motor der Regionalentwicklung*. Hrsg.: E. Dahlbeck, J. Hilpert. Springer VS, Wiesbaden [u. a.] 2017, S. 53 – 71.

FELIPE, C. M.; ROLDÁN, J. L.; LEAL RODRÍGUEZ, A. L.: *An explanatory and predictive model for organizational agility*. In: *Journal of Business Research* 69 (2016) 10, S. 4624 – 4631.

LEIMEISTER, J. M.: *Collaboration Engineering – IT-gestützte Zusammenarbeitsprozesse systematisch entwickeln und durchführen*. Springer Gabler, Berlin [u. a.] 2014.

LUCZAK, H.; VOLPERT, W.: *Arbeitswissenschaft. Kerndefinition – Gegenstandskatalog – Forschungsgebiete*. RKW-Verlag, Eschborn 1987.

PUCKETT, S.; NEUBAUER, R. M.: *Agiles Führen – Führungskompetenzen für die agile Transformation*. BusinessVillage, Göttingen 2018.

RAU, R.: *Lern- und gesundheitsförderliche Arbeitsgestaltung: Eine empirische Studie*. In: *Zeitschrift für Arbeits- und Organisationspsychologie A&O* 48 (2004) 4, S. 181 – 192.

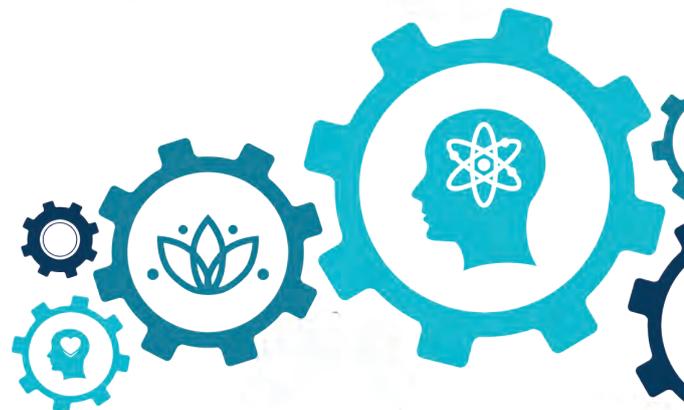
SCHUH, G.; POTENTE, T.: *Industrie 4.0 im Management*. In: *10. Aachener Management Tage. Navigation für Führungskräfte*. Hrsg.: G. Schuh; A. Kampker; V. Stich, 2. Auflage. Apprimus Wissenschaftsverlag, s.l., 2014, S. 29-34

SCHUH, G.; POTENTE, T.; WESCH-POTENTE, C.: *Sustainable increase of*

overhead productivity due to cyber-physical-systems. In: *Innovative solutions*. 11th Global Conference on Sustainable Manufacturing; Berlin, Germany, 23rd - 25th September, 2013. Hrsg.: G. Seliger. Universitätsverl. d. TU, Berlin, 2013, S. 332-335.

WEIBLER, J.; ENDRES, S.: *Der Imperativ zur agilen Organisation – Warum reflektierende Gelassenheit gefragt ist*, 2020. Abrufbar unter: <https://www.leadership-insiders.de/der-imperativ-zur-agilen-organisation-warum-reflektierende-gelassenheit-gefragt-ist/>, 28.07.2021

WORLD HEALTH ORGANIZATION (WHO) (Hrsg.): [Übersetzung] *Verfassung der Weltgesundheitsorganisation*, unterzeichnet in New York am 22. Juli 1946. Ratifikationsurkunde von der Schweiz, hinterlegt am 29. März 1947. (Stand: 6.07.2020) [https://fedlex.data.admin.ch/filestore/fedlex.data.admin.ch/eli/cc/1948/1015\\_1002\\_976/20200706/de/pdf-a/fedlex-data-admin-ch-eli-cc-1948-1015\\_1002\\_976-20200706-de-pdf-a.pdf](https://fedlex.data.admin.ch/filestore/fedlex.data.admin.ch/eli/cc/1948/1015_1002_976/20200706/de/pdf-a/fedlex-data-admin-ch-eli-cc-1948-1015_1002_976-20200706-de-pdf-a.pdf) (Link zuletzt geprüft: 28.07.2021)



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**Website:** [gala-regioninnovativ.de](http://gala-regioninnovativ.de)

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FLEMING:

# The World is Becoming E-Mobile – How Loaded Distribution Grids Nevertheless Remain Stable

Renewable energies and electromobility already have a significant impact on the stability of the electricity distribution grid in Germany. With the continuous expansion of renewable energies and the increasing number of battery-powered electric vehicles, this trend will intensify. This will lead to higher stress on components, especially in the distribution grid. In order to ensure grid stability, distribution grid operators must be able to monitor the condition of the components and remedy impending faults in advance by means of forecasts. An information logistics concept developed as part of the 'FLEMING' project lays the foundation for the realization of predictive maintenance for these components, which can also be easily integrated into the distribution grid operators' existing systems. >

The focus of German climate and energy policy is both on a massive and area-wide integration of renewable energy generation plants<sup>1</sup> and on the integration of charging stations for e-mobility into the existing power grid. The resulting numerous load fluctuations<sup>2</sup>, e.g., due to decentralized solar plants, as well as the temporally and spatially concentrated energy demand due to charging infrastructure (e-mobility) lead to a very large load on electrical equipment and components, up to and including their overload, for example, on switchgear. In order to achieve the goals of the energy and mobility transition while maintaining the same quality of supply, grid operators need an improved understanding of the current status and impending failures of components. At the same time, grid operators, and in particular distribution grid operators, are under increasing efficiency and cost pressure.

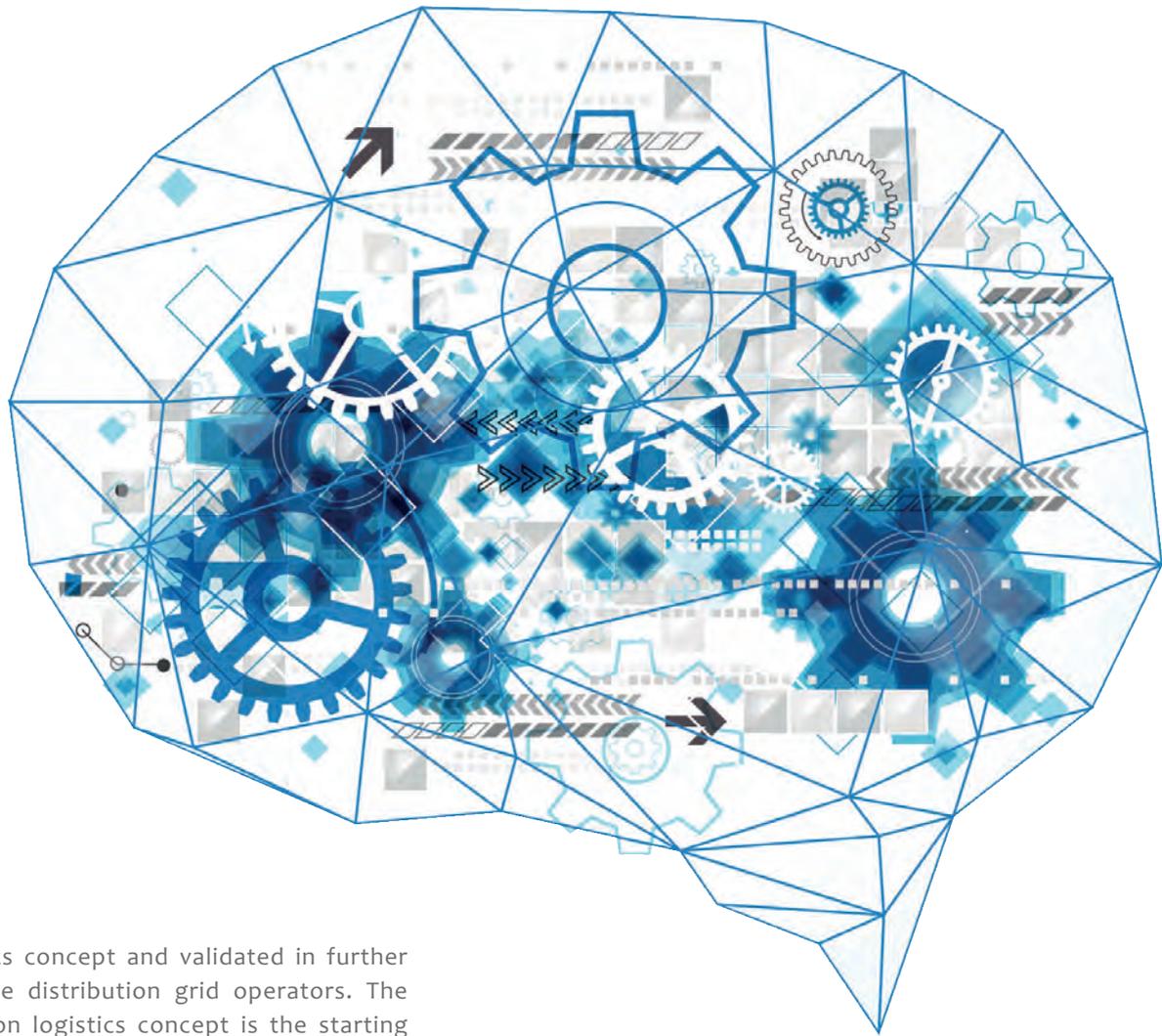
The goal of the FLEMING research project is therefore to enable continuous function monitoring through increased sensor deployment in distribution grid assets coupled with the use of artificial intelligence (AI) methods. Continuous function monitoring enables

grid operators to maintain supply quality despite increasing efficiency and cost pressures. The project thus contributes to a successful energy and mobility transition in Germany.

The majority of distribution grid operators already work with various information systems to digitally capture and process the available data. The differences in the systems and applications used, as well as their range of functions, vary greatly between the various distribution grid operators. In addition, there are legal and regulatory requirements for the supply security with various processes and procedures that must be observed. Continuous function monitoring must therefore be designed to take the different system environment and regulations into account. As part of the project, workshops were held with distribution grid operators and their processes, procedures, applications and information systems were recorded in order to identify the framework conditions and relevant requirements. After recording the status quo, the results of the workshops were presented in use case diagrams and an

<sup>1</sup> RENN AND MARSHALL 2016, p. 224; SCHIFFER 2019, p. 145 – 147

<sup>2</sup> BUNDESNETZAGENTUR 2019, p. 28; GOOP ET AL. 2016, p. 273



information logistics concept and validated in further workshops with the distribution grid operators. The resulting information logistics concept is the starting point for the design of relevant developments for the realization of the continuous function monitoring.

### Switchgear Management in Distribution Grids by Grid Operators

Grid operators take different approaches to grid and equipment maintenance, depending on factors such as the region or size of the grid and the placement of the equipment. Most operators rely on the preventive maintenance strategy and perform maintenance work according to a set schedule. High expenses due to the physical deployment of personnel at the plant locations are the result here. In addition, operators send their staff to inspect the equipment on a fixed route to perform a manual assessment of the condition of all the equipment using infrared cameras. For regular maintenance, the

technicians travel along a fixed route. They then have infrared measuring devices with them for the inspection. This route planning means that the technicians only have standard equipment and a small number of spare parts in their vehicles. As a result, it is possible that not all the parts needed to perform the maintenance are available.

Environmental factors also contribute to unexpected equipment failures. Plants near canola fields, for example, tend to fail more frequently and more quickly than others, making them more maintenance-intensive and costly. To address such issues, some operators are already moving to use a variety of maintenance strategies. For example, they have accumulated enough knowledge within the organization about the robustness of assets and try to operate them until close to the point of failure.

Roles	Information Systems
Urbanist	Geographic Information System (GIS)
Technical planner	Enterprise Resource Planning System (ERP)
Foreman	Data Information System (DIS)
Installation technician	-
Grid control center employee	-

Table 1: Overview of roles and information systems used

None of the surveyed grid operators have permanent condition monitoring in combination with a predictive maintenance application.

### Results of the interviews and development of use case diagrams.

To obtain a holistic view of the interaction of switchgear operators, the processes along the life cycle were recorded: From installation to operation and maintenance to disassembly, the relevant roles, systems, tasks and information were documented (Table 1).

The processes and findings were systematized in use cases and use case diagrams. These were then reviewed and validated within the project consortium and by the grid operators. The foreman received a fault report and a corresponding task in a data information system (DIS for short) to investigate this fault. For example, the “Incident Management” use case was discussed in detail. A foreman usually forms a team with an installer, and both are responsible for investigating the fault. This includes fault classification to report the

origin of the incident if a fault is found. Once the fault is identified, the installer performs the repair. To do this, the installation technician must take material from the company’s warehouse. Material handling is usually documented in an enterprise resource planning (ERP) system to accurately count the material and allocate the costs incurred. Carrying out the repair also involves creating a repair log. Since most switchgears are not yet connected to the Internet, the installer should not only document the repair activities, but also add additional information, such as the apparent condition and cleanliness of the switchgear, as well as the switching numbers. In addition to the use case shown, other use cases such as “operation and monitoring,” “maintenance,” and “plant replacement” were developed as part of the project to provide a holistic view of the relevant use cases for distribution grid operators.

### Derivation of an information logistics concept

Based on the use cases, an information logistics concept was then derived that visualizes the data flows between actors and databases. The information logistics concept illustrates the data flow for the previously described use case “incident management”. Static and some variable data of the plant are usually stored in a geographic information system and a data information system. Grid monitoring (usually voltage and current measurement at specific measuring points) allows the grid control center to isolate certain types of faults to regions. If a disturbance is measured and identified in the grid, the foreman receives notification of the grid disturbance from the grid control center “on demand,” i.e., the grid control center transmits this information to the foreman (“data push”). Necessary information, such as



# ELEKTRO .. MOBILITÄT

geographic data to direct a repair team to the job site, is pulled “on demand” from the geographic information system and forwarded to the industrial technician or, as previously mentioned, the installer, along with a repair order. The captured repair and maintenance data is collected and stored digitally in a data information system. As already described, this information logistics concept will be

used in the further course of the design to develop a concept for the integration of function monitoring and to integrate it into the existing data flows. The visualization supports the identification of the demand-driven information flows. In addition, the required functionalities can be discussed and detailed on this basis in order to ultimately meet the requirements of the users (grid operators).

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#### Literatur

BUNDESNETZAGENTUR FÜR ELEKTRIZITÄT, GAS, TELEKOMMUNIKATION, POST UND EISENBAHNEN (Hrsg.): Bericht zum Zustand und Ausbau der Verteilernetze 2018. Berichte der Verteilnetzbetreiber gem. § 14 Abs. 1a und 1b EnWG. Bonn, Oktober 2019, aktualisiert September 2020. [https://www.bundesnetzagentur.de/SharedDocs/Downloads/DE/Sachgebiete/Energie/Unternehmen\\_Institutionen/NetzentwicklungUndSmartGrid/ZustandAusbauVerteilernetze2018.pdf?\\_\\_blob=publicationFile&v=2](https://www.bundesnetzagentur.de/SharedDocs/Downloads/DE/Sachgebiete/Energie/Unternehmen_Institutionen/NetzentwicklungUndSmartGrid/ZustandAusbauVerteilernetze2018.pdf?__blob=publicationFile&v=2) (Link zuletzt geprüft: 29.07.2021)

GOOP, J.; ODENBERGER, M.; JOHNSON, F.: Distributed solar and wind power – Impact on distribution losses. In: Energy 112 (2016), S. 273 – 284.

RENN, O.; MARSHALL, J. P.: Coal, nuclear and renewable energy policies in Germany: From the 1950s to the “Energiewende”. In: Energy Policy 99 (2016), S. 224 – 232.

Schiffer, H.-W.: Zielvorgaben und staatliche Strategien für eine nachhaltige Energieversorgung. In: Wirtschaftsdienst 99 (2019) 2, S. 141 – 147.

If you are interested in learning more about this project, or if you would like to get involved or discuss the topics, we look forward to your inquiry.

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**Website:** [projekt-fleming.de](http://projekt-fleming.de)

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