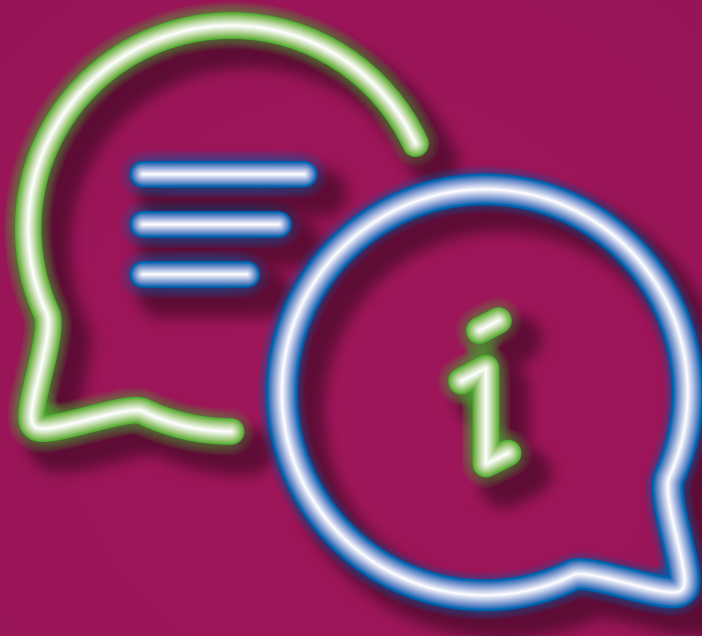


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VISION | INNOVATION | REALIZATION



KNOWLEDGE AND ASSISTANCE

A Smart Helpdesk

Generative AI is revolutionizing the way we deal with knowledge. How can companies take advantage of this development to manage their domain knowledge?

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Jack of All Trades With a Tablet

Can unskilled workers take on even complex manufacturing tasks? Fraunhofer IPK is researching how intelligent assistance systems can help overcome the shortage of skilled professionals.

p. 20

Good to Know

Employee expertise is an important resource for companies – a discussion between experts from Bayer and Fraunhofer IPK.

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Five Millimeters at the Price of
80 Million Euros



**Delicate but powerful:
the butterfly effect
along the process chain**



Production Technology Center (PTZ) Berlin

PROFILE The Production Technology Center (PTZ) Berlin houses two research institutes: the Institute for Machine Tools and Factory Management IWF of the TU Berlin and the Fraunhofer Institute for Production Systems and Design Technology IPK. As production-related research and development partners with a distinctive IT competence, both institutes are in international demand. Their close cooperation in the PTZ puts them in the unique position of being able to completely cover the scientific innovation chain from fundamental research to application-oriented expertise and readiness for use.

We provide comprehensive support to companies along the entire process of value creation: Together with industrial customers and public-sector clients, we develop system solutions, individual technologies and services for the process chain of manufacturing companies – from product development, planning and control of machines and systems, including technologies for parts manufacturing, to comprehensive automation and management of factory operations. We also transfer production engineering solutions to areas of application outside industry, such as traffic and safety.

DEAR READERS

With the release of ChatGPT, AI-based assistance became the focus of worldwide media attention virtually overnight. The potential, but also the fears surrounding the supposedly new technology were quickly and broadly discussed. Even if intuitive AI chatbots were new and exciting to the general public, the questions that accompanied their introduction are well known to us at PTZ Berlin. One concern that is often expressed is whether human beings, especially in the long-term context of the working world, will be supported or rather replaced by developments in the field of artificial intelligence and automation.

At PTZ Berlin, we have been researching such issues in an industrial context for decades, always with a human-centered focus and under the stipulation of developing technologies that support people. This includes, for example, solutions from robotics or (partially) automated production processes and systems. We are also researching and constantly improving assistance systems based on the possibilities of artificial intelligence or virtual reality. Indirect assistance in the form of data-based decision support is offered, for example, by our in-situ monitoring processes for additive manufacturing. Additionally, we develop individual knowledge management solutions tailored precisely to the needs of our partners.

In this issue, we would like to introduce some of these approaches to you: In the future, chatbots should make existing knowledge more accessible within companies, in an intuitive and IP-secure way. This can support the onboarding of new colleagues, for instance. In our



expert discussion between Hans-Christian Kesper from Bayer AG and Dr. Ronald Orth from Fraunhofer IPK, you can read how our partners benefit from such knowledge management solutions, and peak behind the scenes of our research collaboration. Methods aimed at the structured collection, presentation and transfer of knowledge within a company can also help to facilitate coordination between departments. At Fraunhofer IPK, knowledge graphs are being developed for this purpose. Among other things, they ensure cross-departmental transparency in product development.

On the shop floor, workers can receive step-by-step instructions via a context-sensitive assistance system developed at Fraunhofer IPK. This enables them to complete tasks that would otherwise require experience and practice. In times of a shortage of skilled workers, manufacturing companies can thus at least temporarily bridge a lack of expertise.

Finally, I would also like to encourage you to get in touch with us. Let our researchers know whether and how you would use AI in the field of knowledge management, and take part in our automation assessment to get a feel for promising automation potentials within your company.

Wishing you a knowledge-enriching read

Yours

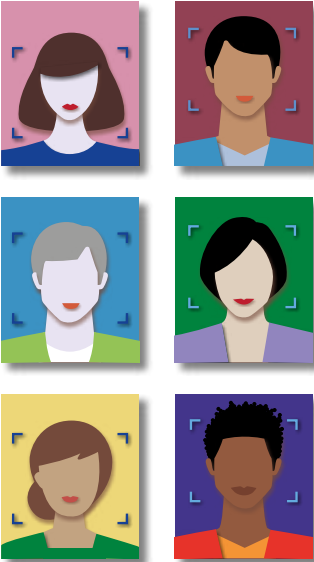
Eckart Uhlmann

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»Personal communication and early involvement of all stakeholders are very important drivers of succes for knowledge transfer processes.«

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Small decisions in product development often have unpredictable consequences. Knowledge graphs help to make complex relationships more transparent.

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IN DETAIL



Read our our article »Jack of All Trades With a Tablet« to find out who is receiving support here

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FDMIX: FAST AND ROBUST MASS PRODUCTION OF NANOPARTICLES

Nucleic acid-based drugs such as mRNA vaccines offer enormous potential for medicine. In order for these active ingredients to be precisely delivered to the body's cells, they must be enclosed in nanoparticles. With FDmiX, short for Fraunhofer Dynamic Mixing Technologies, Fraunhofer IPK, in collaboration with FDX Fluid Dynamix GmbH, has developed a technology platform for the production of nanoparticles that can achieve unprecedented particle quality and stability. The Swiss chemical and pharmaceutical company Lonza Group AG has licensed the technology for its GMP production (good manufacturing practice).



↪ More information on FDmix
www.ipk.fraunhofer.de/fdmix-en

ADDITIVE MANUFACTURING: ASSISTANCE FOR POST-PROCESSING

At Fraunhofer IPK, the post-processing of additively manufactured components is being driven forward with new strategies and processes. By developing an intelligent technology chain, the researchers want to enable end-to-end digitalization of post-processing as well as a reduction in material waste and process time. Their aim is to enable semi-automated post-processing of complex components with a batch size of one. In this context they are developing an assistance system to support workers in post-processing in additive manufacturing.

↪ More information (German only)
www.ipk.fraunhofer.de/hta-2-phase-ii



NUMBER OF THE ISSUE

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is what a single decision in product development can sometimes cost if its consequences are not sufficiently assessed and coordinated with other areas of the company.

↪ Learn how this can be prevented with the help of knowledge graphs on page 36

WELL SAID

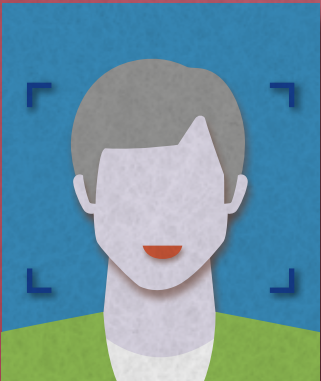
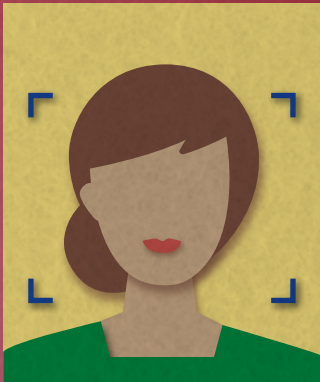
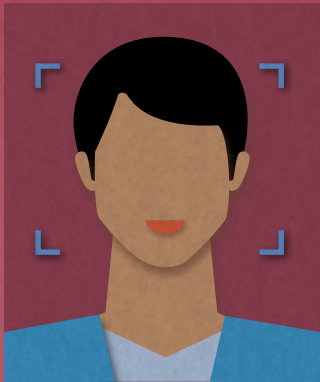
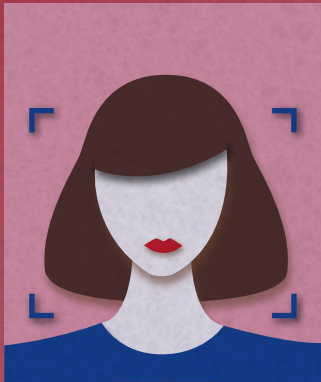


»A business process management system that covers the entire supply chain would be fantastic. It would also help us to respond more effectively to unforeseen events or crises. Figuratively speaking, we would be able to see the iceberg we are heading towards much earlier and steer around it more easily.«

Frank Moos,
Vice President Global Process Management, KSB SE
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Capacity Building Through Research

The dire shortage of skilled workers does not stop short of industry. From onboarding and knowledge retention to assistance systems – production engineering must deliver solutions.



Production technology is a highly application-oriented field. After all, its questions focus on how the products that we interact with every day are made. As a result, the researchers at the Production Technology Center (PTZ) Berlin are always in very close touch with the needs of industry. One of the pain points that is repeatedly being raised is the shortage of skilled workers, which presents manufacturing companies with very specific challenges. They see Germany as a production location under threat if they cannot secure their production capacities with a sufficiently qualified workforce.

When filling vacancies, they are often no longer able to apply the same standards in terms of educational background or prior experience as they did at a time when the shortage of skilled workers was not as pressing and there were hundreds of applications for a single open position. This also increases the requirements for onboarding and continuous support of their employees. Language barriers can make the process even more difficult. On the other hand, the »baby boomer« generation is retiring – and with it many experienced colleagues. A coherent knowledge management strategy as well as user-friendly assistance and management tools are essential in order to retain the wealth of knowledge they have built up over the years and make it accessible to future generations.

Companies will also have to increase their attractiveness to compete for qualified professionals. Young people today have high expectations towards their potential employer. They want them to embrace credible values that are in line with their own, and they expect these values to be reflected in day-to-day business processes. They desire flexibility and agility, expressed in the form of New Work, but also through the intelligent use of technologies such as AI or virtual reality. And they demand career development opportunities, including in the form of sound continuing education concepts.

The shortage of skilled workers increases the requirements for onboarding and continuous support of their employees.

More information
[www.ipk.fraunhofer.de/
knowledge-and-assistance](http://www.ipk.fraunhofer.de/knowledge-and-assistance)



From corporate management to product development and application on the shop floor and beyond, the research scientists at Fraunhofer IPK and IWF at TU Berlin are developing solutions that help their industry partners to meet these demands.

KNOWLEDGE IS KEY

Knowledge management is a task that confronts many companies with major challenges. It is a process that requires us to thoroughly take inventory first in order to design an intelligent strategy in line with the company's goals and given legal requirements. In order to be implemented, it must also be easy for employees to carry out and integrate into their day-to-day working routines. The experts at PTZ Berlin support all these steps

with numerous methods and tools that tackle different levels: from the coordination between individual departments to the corporate level to entire nationwide science and innovation systems.

At the department level, coordination and flow of information between individual company units are particularly difficult challenges in knowledge management. The many different means of gathering knowledge and various types of information, as well as missing interfaces and processes occasionally present management with a Babylonian language labyrinth.

With the help of methods developed at Fraunhofer IPK, management teams can bring order to this chaos: Knowledge graphs help to make decisions and their effects along the process chain easier to trace, preventing unexpected costs and spending additional resources. Immersive extended reality methods can also be used to strengthen cross-unit collaboration by enriching data and translating it into jointly editable virtual models.

At the level of individual organizations, right down to small and medium-sized enterprises, there is great de-

mand for scientifically proven concepts and methods in knowledge management. At Fraunhofer IPK, these are strategically and operationally interlinked, as has recently been required by standards such as ISO 30401 and DIN SPEC 91443. In order to guarantee compliance, researchers are feeding the relevant specifications directly into the functioning of the respective management and assistance systems, together with the requirements and specifications on the output of the respective process. By doing so, the users of these solutions can be sure that all legal regulations and quality requirements are met if applied correctly.

Fraunhofer IPK scientists are also supporting the implementation of knowledge management concepts at a national level: on behalf of the Brazilian industry training service SENAI, they developed guidelines and a toolbox. These enable the now almost 30 innovation institutes, whose establishment the team also planned and supported, to develop individually tailored concepts for knowledge management and implement them along certain milestones.

HUMAN-CENTERED PRODUCTION ASSISTANCE
Focusing on the individual, it becomes clear how



In order to function properly in an industrial business context, virtual assistance technologies require a high degree of data consistency.

well-designed knowledge management and assistance systems can support employees throughout their entire career. Already during onboarding, it can be extremely helpful for everyone involved to not always have to reinvent the wheel. The introduction to the tasks of a new job can be technologically supported with the help of a tool that can draw on the company's accumulated wealth of knowledge, giving new employees a sense of security and reducing the burden of time-consuming handovers for more experienced colleagues. New employees or even temporary workers can quickly find their way around new tasks with the help of these assistance systems. Web-based apps with straightforward, image-based step-by-step instructions, such as those being developed at Fraunhofer IPK, even make it possible to overcome language barriers and integrate employees with different levels of qualification.

Researchers at IWF at TU Berlin are also developing AI-based methods that compile a company's wealth of knowledge into a self-hosted large language model and make it accessible to employees in the form of an intuitive chatbot – a digital helpdesk of sorts! Fraunhofer IPK scientists are working closely with the

IWF team to investigate how this type of knowledge management can be strategically embedded and implemented in companies.

Fraunhofer IPK researchers and their partners are also developing innovative approaches to continuing education and training. For instance, a platform that generates adaptive learning paths for individual employees with the help of AI is being developed, considering the latest learning methods and developments on the continuing education market. The platform takes into account operational requirements specifying certain target profiles, as well as employees' personal preferences, learning goals and skill levels. Fraunhofer IPK experts are supporting the introduction of the learning platform with workshops on holistic operational transformation and skills development strategies. In another project, Fraunhofer IPK scientists developed a training program for the integration of sustainability in manufacturing companies that uses serious games to promote effective learning. It enables individuals to make informed decisions, implement relevant technologies and develop integrated sustainability strategies.

ASSISTANCE ON THE SHOP FLOOR

At the level of manufacturing processes, we can primarily distinguish between direct and indirect assistance. Indirect assistance operates in the background, while direct assistance involves direct human-machine interaction. Direct assistance therefore primarily supports workers on the shop floor directly in performing their tasks. This can for example include the mentioned web-based app with practical guidance, which is equally suitable for numerous applications beyond onboarding. It can also be used for maintenance, repair and overhaul or setting up machine tools, for instance.

Virtual and augmented reality technologies can be helpful tools, providing an interface between humans and machines in direct assistance. In combination with

digital twins, for example, they enable the simple manipulation of data and models, which can then in turn be transferred to a real object. In order to function properly in an industrial business context, these technologies require a high degree of data consistency. Up until now, changes to a production step have generally been made manually. For a new variant, for example, a modified process description is sent to the worker, or a modified program is loaded into the machine control system. This can result in inconsistent situations, for example due to retroactive adjustments. An inter-

disciplinary team at Fraunhofer IPK is striving for consistency from product development to live instruction and machine control in order to ensure that all involved stakeholders are updated at the touch of a button. An ambitious research project with numerous partners aims to make digitally integrated assistance possible this way. Digitalization and data consistency along the process chain are being tested here, exemplified by an intelligent, human-centered assistance system that uses AR and VR methods to support fastening applications in automotive production.



Another example of very direct assistance is the use of physically supportive soft robotics solutions, which are also being researched at Fraunhofer IPK. As such, the exoskeleton PowerGrasp has been developed further to not only provide strength support, but also recognize movement intentions and even states of fatigue.

Indirect forms of assistance, on the other hand, are essentially decision-making aids based on data analysis. These are used, for example, in quality assurance, where sensor-supported technologies relieve employ-

ees of monotonous and strenuous tasks. Evaluation of sensor data can also provide them with a reliable data basis for difficult decision-making situations. For instance, scientists at Fraunhofer IPK can enable their partners to carry out in-situ monitoring of additive processes. They are also finding innovative solutions for working with challenging materials and processes. One such application is a combined welding process for working with aluminum in the production of housings for electric motors and batteries. In this complex process, the aim is to prevent the formation of pores or

adhesion defects. Research scientists at Fraunhofer IPK have thus invented a type of intelligent co-pilot that uses AI and sensor technology to warn of potential errors in the production process. ♦

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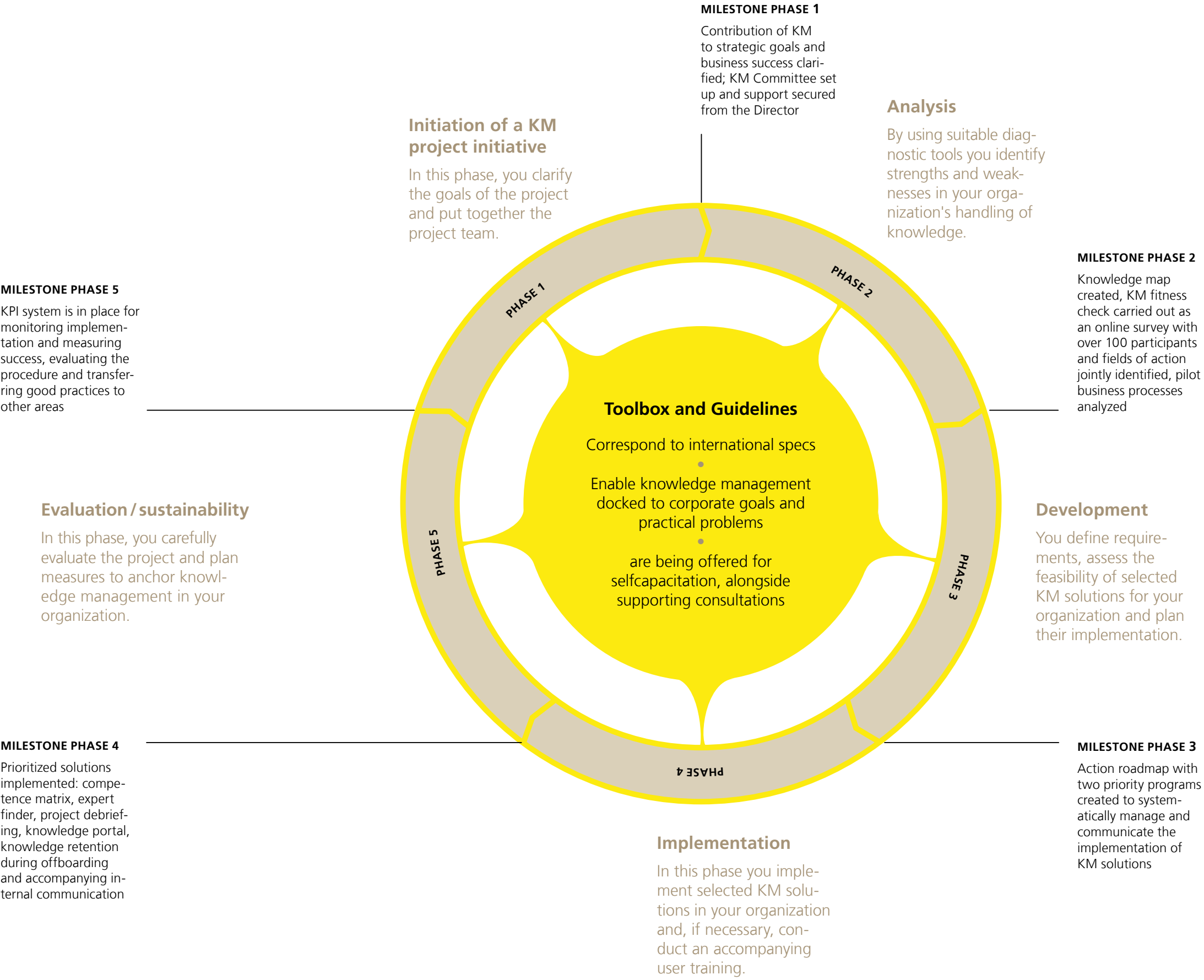


How to Implement Knowledge Management

Coming up with a smart knowledge management strategy for a company or organization is no mean feat, and its implementation comes with its own challenges. Fraunhofer IPK scientists have developed a comprehensive framework to guide their partners in this endeavor.

There are many reasons why establishing a well-thought out knowledge management strategy is in the best interest of companies and other organizations. The flexibilization of the job market leads to a higher fluctuation of employees. In order to not constantly have to rebuild expertise from scratch due to this ongoing staff turnover, companies need to make sure that their knowledge base is maintained in a systematic manner, independently of individual staff. This knowledge base is also the ideal common ground to build understanding between different units within an organization, such as the development, production and logistics units in a manufacturing company. If they all have access to the same sources of information, misunderstandings and mistakes can be avoided.

Scientists from Fraunhofer IPK, on behalf of their partners from the Brazilian Industry Training Service SENAI, have developed a framework to support companies on their way to a comprehensive knowledge management (KM). Their developed solutions, consisting of a toolbox and guidelines, are currently successfully being applied to SENAI innovation institutes across Brazil. This illustration highlights how the approach works and gives some examples for milestones from the pilot application at the SENAI innovation institute in Rio de Janeiro.





2

**Images:
1 and 2**
Whether during set-up
or when starting the NC
program – the smart
assistance system
provides this worker
with step-by-step
guidance for an
unfamiliar machine tool.

Jack of All Trades With a Tablet

Can unskilled workers take on even complex manufacturing tasks? Fraunhofer IPK is researching how intelligent assistance systems can help overcome the shortage of skilled professionals.

Imagine the following scenario: We find ourselves in the not-too-distant future. An automotive supplier is experiencing yet another staffing bottleneck, their fuel cell production is in urgent need of skilled workers. In order to fulfill their orders and not bring production to a standstill, they resort to the workforce of a temporary employment agency. The worker standing in front of the machine tool the following day has never operated it before. He pulls out a tablet, launches the web-based assistance system and gets to work. Whether during set-up, starting the NC program or unloading the finished parts – the assistance system provides step-by-step guidance for all important processes. In the assistance system, extensive expert knowledge is presented so clearly that the worker can

In the assistance system, extensive expert knowledge is presented so clearly that the worker can take on complex tasks.

take on complex tasks that would otherwise only be possible with years of practice and expertise. This applies to the most diverse areas: One month later, the same worker is already operating the injection molding machine of a medical equipment manufacturer, soon thereafter he is carrying out high-precision optical measurements of valve bores on camshaft housings. Sounds too good to be true? Maybe not for much longer!

COPING WITH COMPLEXITY

One of the fundamental challenges in view of the shortage of skilled professionals in production and maintenance is the short-term integration of people with different levels of qualification, especially in increasingly complex production facilities that include

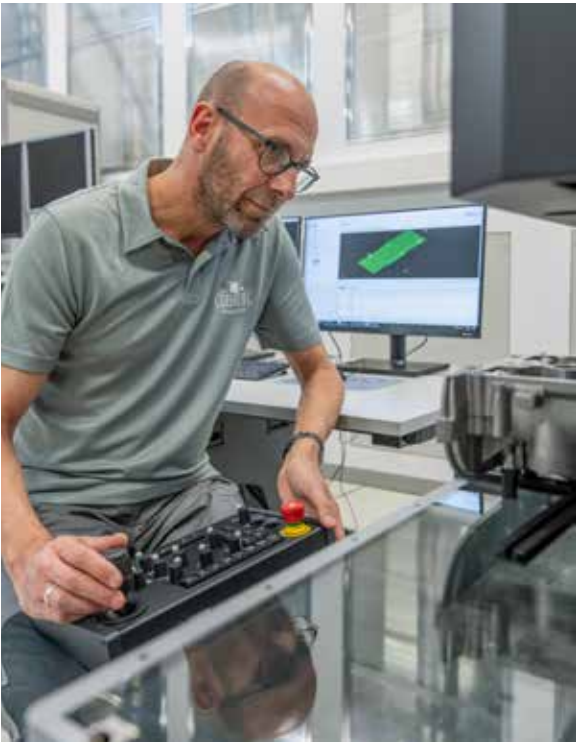


1



2

Images:
Thanks to the guidance of the assistance system, our worker is just as capable of operating the injection molding machine of a medical technology manufacturer **(1 and 2)** as he is of carrying out high-precision optical measurements **(3)**.



3

mechanical as well as electronic and digital elements. Language barriers, which can hinder smooth communication and collaboration, further complicate matters.

Researchers at Fraunhofer IPK are therefore developing assistance systems based on simple mobile devices. The aim is to provide situation-specific information in order to minimize the effort required for finding information or general coordination, including documentation. »Situation-specific« here refers to both the technical context, i.e. which task is to be completed using which tools, and the level of qualification of the employees.

Such an assistance system can help workers who are brought in during temporary staff shortages to reduce errors and minimize stress caused by uncertainty. A validation process continuously running in the background also gives workers the confidence that they are

More information
www.ipk.fraunhofer.de/retranetz-en



The ReTraNetz BB project is funded by the German Federal Ministry for Economic Affairs and Climate Action.

Supported by:



on the basis of a decision by the German Bundestag

not on their own. Finally, this approach enables on-the-job training and the creation of a knowledge database by linking the entered data and instructions to the digital twin of the machine or system in question.

ASSISTANCE IN THE AUTOMOTIVE SECTOR

As part of the ReTraNetz BB project, researchers at Fraunhofer IPK are working on a general solution that is going to be field-tested by original equipment manufacturers (OEMs) in the automotive sector. Their production lines are generally highly automated, but they still involve manual activities such as assembly tasks. The integration of workers often presents a challenge here – be it due to a lack of expertise from career changers or because of language barriers. Assistance systems enable a simpler and, in many cases, even language-independent access to knowledge and guidance and thus a more flexible allocation of workers.

The researchers’ overarching goal is to create an assistance and knowledge management solution specifically for the automotive industry: This should enable workers from different companies to carry out a variety of tasks at different workstations. This is particularly relevant in view of the impending loss of knowledge due to retirement. Of course, no assistance system in the world can replace well-trained specialists, whose expertise and experience will always be indispensable. However, the assistance system’s database can at least make the valuable know-how of previous generations easier to process and pass on to less experienced colleagues. ♦

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Controlled Risks

Fraunhofer IPK is developing model-based process assistance systems for project and risk management with internal control systems.

Whether it’s the General Data Protection Regulation (GDPR), the European Union’s AI Act or supply chain legislation, companies today find themselves in a maze of paragraphs that is difficult to navigate. Matters become even more complex when trying to align the implementation of these regulations with strategic corporate goals and real data from business processes.

BRINGING ORDER TO THE CHAOS

Companies find a certain kind of support in management systems. They provide a structured framework for implementing strategies, optimizing processes and improving organizational performance. With their help, companies can use their resources more effectively, make better decisions and promote coordination between different departments and business processes. The more complex the business environment, and legal regulations, the more important a good management system is for the company’s success.

Internal control systems (ICS) are a subset of management systems. They are intended to ensure reliable financial reporting, prevent fraud and promote compliance with laws and regulations. As such, they play a decisive role in the effective control and monitoring of company processes and are even mandatory for stock corporations.

Typical components of ICS are procedures, guidelines and technologies that are relevant for legal and accounting compliance. They support management in identifying, assessing and mitigating risks that could impair the achievement of corporate objectives. This makes them an integral part of corporate governance and risk management.

One challenge for users of management systems is that they are often quite inflexible. This is because the information and processes fed into them are very diverse and often have complex interdependencies.

In a dynamic environment in which legal requirements and market conditions can change rapidly, companies must be able to integrate new requirements quickly and effectively into their business processes. Rigid management systems with integrated ICS are quickly pushed to their limits here. What Fraunhofer IPK has already demonstrated for project management now also applies to ICS: The process assistant that has been successfully in use for years, was further developed into a system that offers both – control and flexibility.

USING MODELS TO REACH YOUR GOALS

The unique strength of the Fraunhofer IPK process assistant: It is based on company models. A company model depicts the structure, processes, resources, such as roles, documents, IT systems and strategies of a company. The model makes it possible to systematically capture and analyze these diverse aspects and thus take a comprehensive view of risks and control mechanisms. It therefore serves as an ideal framework for the well-informed design of internal control systems.

The model-based process assistant enables companies to embed their necessary control mechanisms coherently within this rich context and implement them in such a way that they are compatible with the company’s specific needs and objectives. This not only makes internal control more efficient and effective, but also supports management in the pursuit of strategic goals. Models also simplify the communication and understanding of control processes within the company and towards external stakeholders, such as investors and regulatory authorities. Last but not least, the clear presentation of all the structures, processes and resources involved not only helps companies to comply with current legal requirements, but also allows them the necessary flexibility to react to future changes.



Image:
Fraunhofer IPK researchers use the model-based process assistant to support their partners’ business processes.

ONE MODEL, MANY USE CASES

A business model unfolds its full value when it is consistently applied, in other words, when it is used in day-to-day operations. Model-based solutions developed by Fraunhofer IPK have been supporting companies in project management for years, ensuring that day-to-day processes are consistently followed and all necessary information is available at all times. The new, easy-to-use ICS functions of the process assistant not only minimize risks through control mechanisms. As a central source of information, the company model makes it

possible to integrate risk management, internal controls and project management. The common information basis enables efficient risk management during project execution, as new or newly assessed risks are always taken into account. ♦

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Even though the enhanced process assistant is still relatively new, it has already proven its worth – in use at the family-run KSB SE & Co KG. Read our interview with Vice President Global Process Management Frank Moos on the following pages!



The Holy Grail of Complexity Management

KSB is one of the leading manufacturers of industrial pumps and valves. With more than 16,000 employees worldwide and its own sales divisions, production facilities and service operations, KSB develops and manufactures customized pumps for a wide range of applications. We spoke to Frank Moos, Vice President Global Process Management, about the role that robust business process management plays in the company’s success and how assistance systems support this.

| futur | **Mr. Moos, KSB has the reputation that no two pumps are the same. How do you manage the wide range of variants for different applications, e.g. in the building, industrial, water or energy industries?**

/ **MOOS** / KSB’s holy grail is configuration and complexity management. Our product catalog contains around 360,000 variants that can be ordered via our web store. We can currently generate 2.5 times 10⁴⁷ variants in our configurators. Even in the case of the most standardized of our pumps, we have a repetition rate of 1.8, which is immense. The fact that we can offer so many variants presents us with a variety of challenges, ranging from procurement of parts to documentation. And it only works if the business processes behind it are set up properly. That’s where our central global process management comes in.

| futur | **So how have you set up your business processes?**

/ **MOOS** / We provide the methods and tools in my team. We use MO²GO, a model-based process assistant developed by Fraunhofer IPK, as well as a process mining software from Celonis. We also have so-called global process owners who define the framework for all processes and the process architecture. For standard products in our web store, the sales process is always the same: there is a customer inquiry, a quote is created, the order is produced, delivered and paid for.

For large industrial pumps, things become much more complex, because here we have an additional stakeholder management. We have to coordinate technical and commercial requirements, and consider geopolitical conditions as well. To do this, we have global process owners who keep an eye on different markets, products and business types and set up a

framework that takes country-specific regulations and market conditions into account. Below this level, local process owners manage or shape the requirements at a local level, for example where there are different local laws and regulations. In addition, we have established our lean management team. These levels must all interact operationally. The idea we implement at KSB is this: We provide a central process tool as an architecture, in our case MO²GO, and use it to create uniformly harmonized processes and standard tools from top to bottom as far as is necessary. If more details are needed, we use procedures and guidelines to further specify them internally.

| futur | **What advantages does MO²GO offer your company compared to other process assistants?**

/ **MOOS** / With its object-oriented modeling approach, the Fraunhofer IPK process assistant makes it possible for us to structure processes in a transparent way – both horizontally and vertically. For example, I might say: I create an offer, followed by ten or twenty steps in different sequences and I’ll know exactly what happens at the end. But I can enrich this with every resource I need to carry out this process. So I don’t just look from left to right, I also see what happens in each process from

Frank Moos
has been active in the commercial and technical field for 20 years. After various positions, most recently at airberlin technik and TUI, he joined KSB SE in 2019 as Vice President Global Process Management. With Fraunhofer IPK, he has been working on several R&D projects in the field of process management since 2011.

»The contextual view of processes and resources that MO²GO provides is an immense advantage over any other process documentation.«

bottom to top. Which roles, which documents are involved? Which guidelines affect a process, which machines? I can connect any number of different variables to a process and check: What happens if I adjust a particular variable and how does that affect my process model? This contextual view of processes and resources that MO²GO provides is an immense advantage over any other process documentation.

This also benefits our large international pump projects, which often run for several years. Based on the MO²GO process architecture, we use a project process assistant that is generically structured and supports us in quality assurance with milestones for process-based projects. This really gives us an up to date picture of a project situation and allows us to identify: Okay, in 9 out of 100 projects, we have

pending issues that pose a risk, and at the same time we can see what actions can be taken to address them. Our project managers now use this project process assistant regularly and perform weekly checks: Where do individual projects stand? Which steps in the processes have we completed? Which quality gates have we achieved? Are there lessons learned? We discuss this each week, then fill the project process assistant with the relevant feedback and work with it continuously. The highlight: If we realize at the end of a long project that we should adjust a process step, for example to improve quality, we can see the impact of this change across all ongoing projects. We see where else we can implement this improvement, where we can apply it retroactively or – when in doubt – where a risk could arise and how we can resolve it.

| futur | **Speaking of risk management – you also use a risk web app to manage complex regulations, for example. How exactly does that work?**

/ MOOS / Here too, we rely on the process architecture and consider every process step that we model: What could go wrong, i.e., what are the potential risks? How significant could their impact be? The risk management web app that we are developing together with Fraunhofer IPK visualizes these risks. Similar to a fever thermometer, I can see how serious a risk is and how it changes over time. The app is based on the criteria of the PS 982 auditing standard of the Institut der Wirtschaftsprüfer in Deutschland e. V. (Institute of Public Auditors in Germany, IDW) and other applicable regulations that define principles for auditing and optimizing internal control systems for internal and external reporting. Both tools, the project process assistant and the risk management app, are continuously analyzed and optimized with the help of process mining, in our case with Celonis. This is practically an

automated process-based control which helps us to verify that our integrated risk and control systems are working. Today, this can no longer be done manually, especially when it comes to regulations, if your company operates globally across multiple locations. Take, for example, the different anti-corruption laws that apply nationally and internationally – it is almost impossible to keep track of them without the support of assistance systems.

| futur | **In your opinion, what direction should the development of business process assistance systems take?**

/ MOOS / At the moment, we are actually discussing how to further optimize the mechanisms of our business partner risk analysis on a process basis. But I would also like to continue what we have started with Fraunhofer IPK and be able to carry



Image:
Pumps, valves and services – KSB's portfolio is extremely diverse. © KSB SE

out business impact analyses preventively. To do this we need a system similar to a neural network, with which we can connect individual process stages even more closely in order to generate not only a picture of the current situation, but also a kind of preview: what if ...? What happens, for example, if a machine breaks down in a German foundry? What impact would this have on the assembly in India, if the corresponding component is not delivered? What happens if IT systems fail? What critical fallback systems do I have? How far do I get in a worst-case scenario? A business process management system that covers the entire supply chain would be fantastic. It would also help us to respond more effectively to unforeseen events or crises. Figuratively speaking, we would be able to see the iceberg we are heading towards much earlier and steer around it more easily. ♦

A Smart Helpdesk

Generative AI is revolutionizing the way we interact with knowledge. How can companies take advantage of this development to manage their domain knowledge?

Generative artificial intelligence (genAI) has found its way into the working world – whether it is among software developers who get ChatGPT to help them write code, specialists in production for whom AI-supported search engines provide solutions to their daily problems, or designers who find inspiration in the form of AI-generated images.

These real-world developments inevitably confront companies with questions of how to position themselves in relation to genAI technologies and how to utilize them. Most are still at the very beginning, some have launched initial pilot projects – but concrete objectives and potential application scenarios are often still unclear. In addition,

many companies have ethical and legal concerns and legitimate questions about data protection, copyright and the protection of intellectual property (IP).

Researchers at IWF at TU Berlin and Fraunhofer IPK are therefore jointly working on solutions for deploying genAI models that are tailored for use in companies. Their research and development is specifically aimed at actual questions and problems in company-internal knowledge management: How can genAI support companies in making specific domain knowledge more easily accessible to their employees? How can this be done securely and protecting IP? How can the use of genAI be embedded in the company strategy?

And finally, how can employees be motivated to accept and use an AI-based knowledge management system?

The focus of the R&D activities is a chat prototype that is based on self-hosted large language models (LLMs) and can act as the company's own chatbot, autonomously generating written replies and content to answer questions or suggestions from employees. In the future, this chatbot should make it easy to access knowledge that is available within a given company. In addition to technical issues, the team at TU Berlin and Fraunhofer IPK is also researching aspects of organizational development, such as the cultural acceptance and necessary skills of employees, in order

to use the chat prototype effectively. The goal is a holistic solution that integrates both technological and organizational development. This way, genAI technologies are strategically combined with human expertise so that they serve as tools to complement human intelligence.

FOCUS ON IP PROTECTION

As part of the »ProKI« project, researchers at IWF at TU Berlin are investigating how LLMs can be used in conjunction with so-called retrieval algorithms to map companies' domain knowledge and make it accessible to the company within a structured, self-contained and therefore secure framework. What ChatGPT and others can achieve on a large scale in the form of so-called foundational models, i.e. very large knowledge models, can also be developed in a smaller context specifically for individual companies.

Self-hosted LLMs allow for structured and protected access to a knowledge base,

even when the amounts of available written knowledge are relatively small, for example from technical documentation such as operating instructions, maintenance logs, checklists or other company sources. It is precisely this company-specific knowledge, or domain knowledge, that is the companies' intellectual capital and therefore mission-critical. The main advantage of the prototype developed at IWF is that this domain knowledge in its various forms can now be accessed through simple communication in everyday language, both spoken and written, and even in the form of images. Through the self-hosted in-house structure, organization-specific requirements concerning proprietary information and intellectual property can be met.

FRIENDSHIPS IN THE VECTOR SPACE

The researchers are developing different LLM-based chat prototypes that allow employees to interact securely with domain-specific knowledge. The aim is for this interaction to take place entirely within the

ABOUT THE PROJECT

ProKI is a network of leading research institutions that deals with the systematic industrial application of the latest AI methods in manufacturing technology.

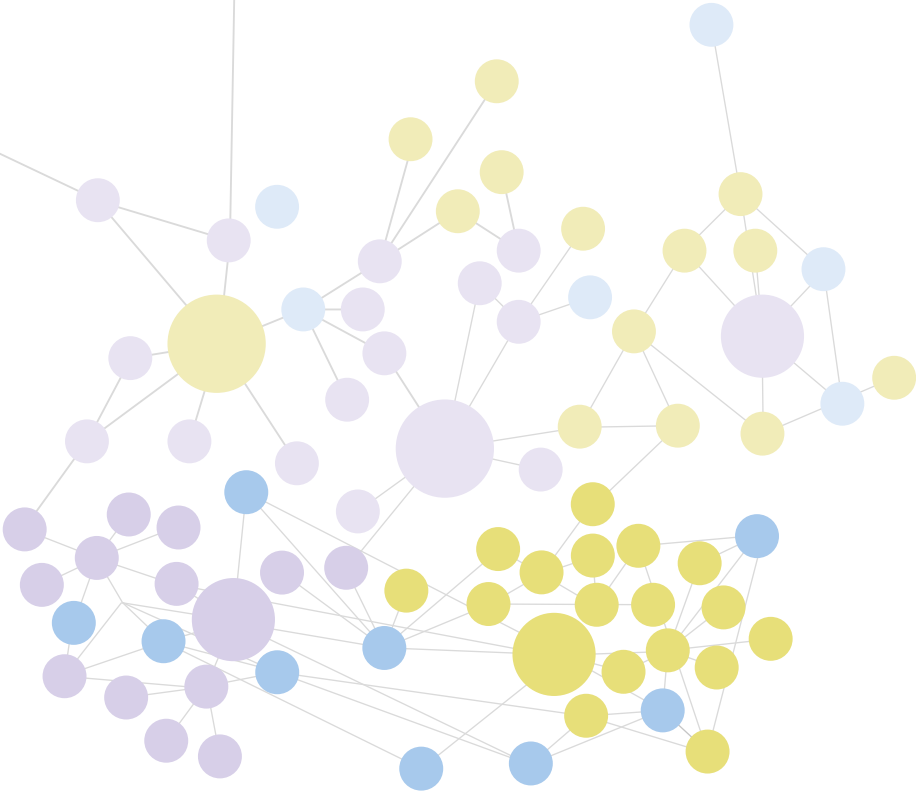
More information
(German only)
www.proki-netz.de

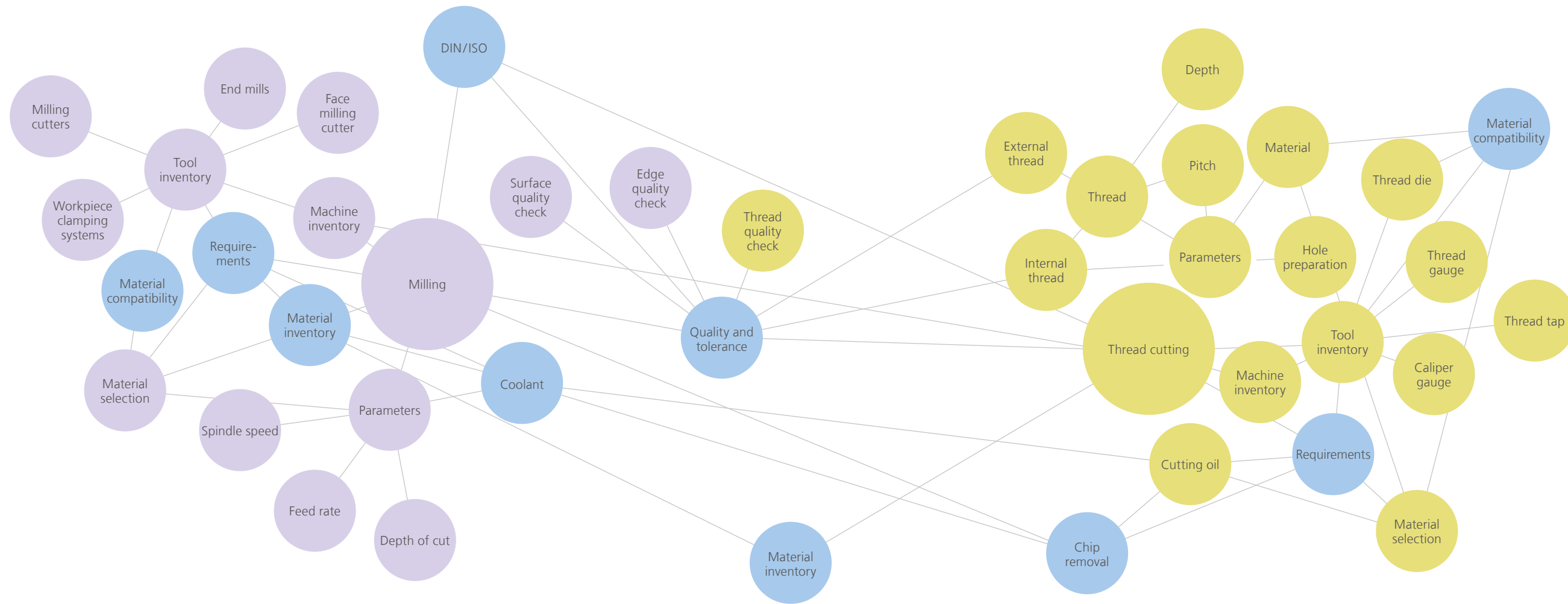


This colorful cloud represents the condensed database of an embedding model – in this case for the specific context of operating instructions for milling machines.

The labeled close-ups on the next page illustrate how the semantic relationships between individual terms are represented by their respective spatial proximity.

- Terms in thread cutting
- Terms in milling
- Terms in both areas





Are you interested in using generative AI in your company? Tell us what matters most to you! Take part in our short survey on the current use and needs analysis of AI in knowledge management:



other words if they frequently interact with each other. Words and phrases with similar meanings or usages are close friends, such as »milling« and »machining«. By recognizing these stochastic-syntactic patterns, embedding models help to use words and phrases in a context-related way, based on the domain knowledge fed into the system. So, if someone asks the chat prototype a question, it is first placed in the domain-specific context, for example the vector space for operating milling machines, using the pre-trained embedding model. Finally, a self-hosted LLM is integrated into the pipeline, which uses the context gained from the query algorithm to provide information-rich answers in everyday language.

genAI to make sure they are able to use the technology effectively. In addition to knowledge about the fundamentals of AI, ethical and legal aspects, media competence and technical skills such as prompting, must also be taken into account.

the company's expansive data base, the chat prototype will also be able to identify the right contact persons with expertise on specific issues, thus also promoting the offline knowledge transfer between employees. ♦

The Demonstration and Transfer Network AI in Production (ProKI-Network) is funded by the German Federal Ministry of Education and Research in the program »Future of Value Creation – Research on Production, Services and Work« (FKZ 02P22A000 to 02P22A070) and supervised by the Project Management Agency Karlsruhe (PTKA).

Federal Ministry
of Education
and Research

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Should I Be Using Robots in My Production?

An automation assessment developed at Fraunhofer IPK helps companies answer this question and explore their automation potential.

The number of industrial robots in use worldwide increases every year. Almost 600,000 robots were sold in 2023, and according to forecasts by Statista, this trend is set to continue. In addition to handling and assembly, robots are increasingly being used in manufacturing, namely wherever production lines need to be adapted at short notice. Robots unfold their potential especially in interaction with humans. Whether in machine loading, manufacturing of components or quality control – human-robot collaboration (HRC) combines the advantages of manual and automated work and enables companies to make their production more flexible.

Nevertheless, small and medium-sized industrial companies still find it difficult to effectively integrate collaborative robots, also known as cobots, into their production processes. Existing collaborative assembly stations are fairly rigid and the interaction between



Image:
Good cooperation:
Gantry robot and
worker assembling
car parts

humans and robots is limited to a predefined area and a small number of tasks. Common reasons for this are a lack of expertise or experience in planning and implementing HRC applications, fear of a risky investment, but also possible challenges in terms of worker safety as well as the robustness and reliability of the robots. Flexible HRC applications that would be required for dynamic production environments are not yet common in industry.

FLEXIBLE COLLABORATION

Flexibility in human-robot collaboration usually refers to how quickly cobots can be reprogrammed or used for new processes. This ignores an aspect that is crucial to the design of manufacturing systems: the number of tasks a cobot can complete in a given time. Flexible collaboration means that the interaction between humans and robots while executing manufac-

turing tasks can take place in different forms and under different time constraints. It requires the cobot to keep a constant eye on the human and react to changes or disturbances in its environment in real time. To achieve this, cobots are equipped with external sensors and special control functions such as image processing and force control. AI algorithms can also help to enhance these capabilities. The use of these advanced autonomous robot technologies is an important factor for successfully implementing flexible HRC applications.

SYSTEMATICALLY ANALYZING AUTOMATION POTENTIALS

Researchers at Fraunhofer IPK are now providing support in analyzing the individual automation potential of a company by means of an automation assessment. »Many companies already have initial ideas for HRC scenarios or individual processes they would like to automate. But they often don't know where to start«, says robotics expert Arturo Bastidas-Cruz.

A first step in the automation assessment is therefore to work with the company in consultation meetings and workshops to identify those manufacturing processes that have a high potential for automation. To this end, the Fraunhofer researcher and his team have defined a series of characteristics to assess the current situation in customers' production environments. »We are consolidating our expert knowledge of state of the art robotics into certain criteria in order to systematically evaluate the potential for human-robot collaboration«, explains Bastidas-Cruz. »Based on these criteria, we can then make a reliable assessment.«

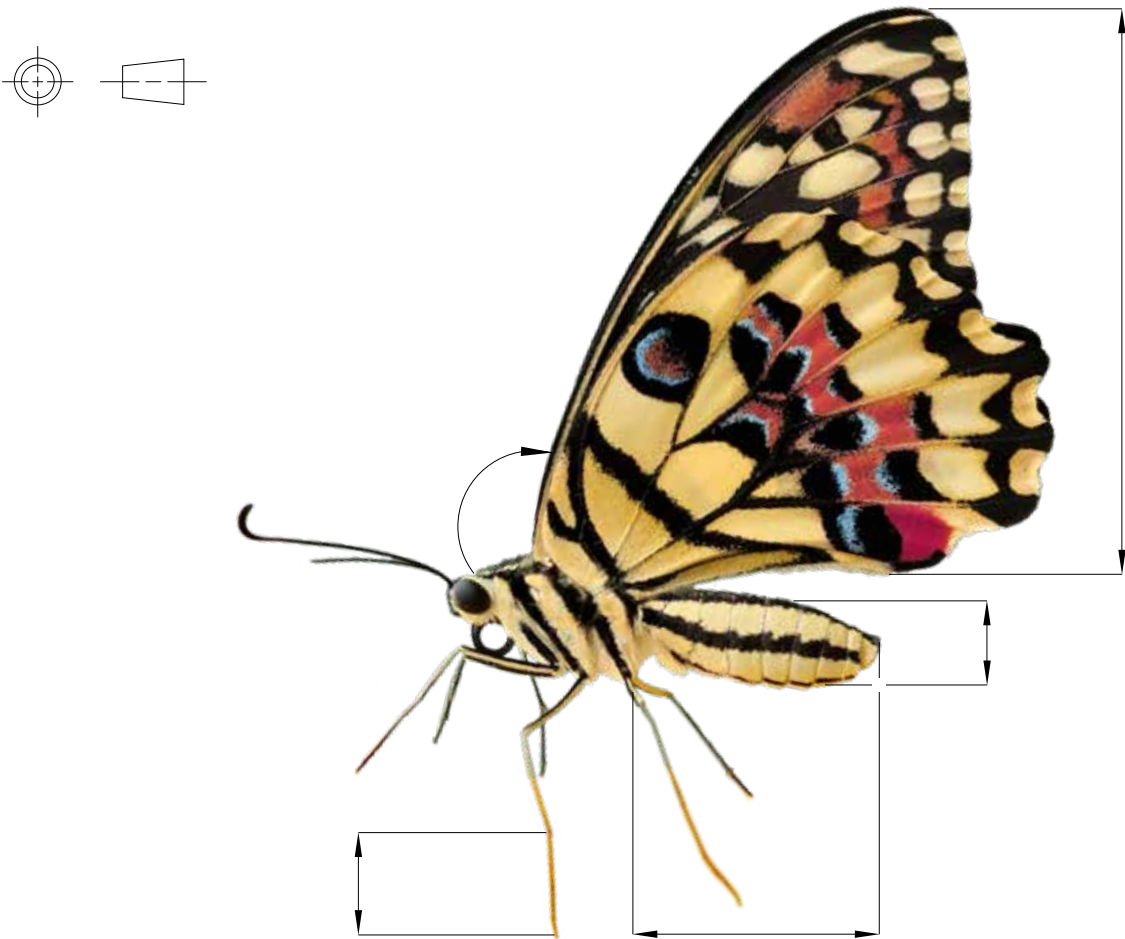
»Many companies already have initial ideas for HRC scenarios or individual processes that they would like to automate. But they often don't know where to start.«

Arturo Bastidas-Cruz

This process is supported by software that enables a quick and easy evaluation of production processes using the defined catalog of criteria. The software calculates an index for each process, which represents the automation potential on a scale. The higher the score for each process, the greater its automation potential. Which specific HRC scenario is actually feasible is then verified in a performance analysis that considers the design of the workspace and the tasks of the collaborative scenario. Finally, the scenario is evaluated based on relevant performance criteria such as safety, economic viability, flexibility, productivity, ergonomics and quality. The researchers work with the customer to determine which tasks are to be shared between robot and worker and in what form – always with the goal of exploiting the full automation potential of each production process. ♦

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Five Millimeters at the Price of 80 Million Euros



Small decisions in product development often have unpredictable consequences. Knowledge graphs help to make complex relationships more transparent.

An automotive supplier commissions the development of a new camshaft for a newly optimized engine type. The camshaft is five millimeters longer than the previous generation, meets all product requirements and fits into the engine after testing. Material costs – a few euros. In an ideal world, this is how development could work. Unfortunately, however, our world is much more complex than this idealized scenario. The developers did not realize what the five millimeters difference in length would mean for other areas of the company. In logistics, fewer shafts can now be transported on each trip, and the existing workpiece carriers no longer fit, either. A new logistics concept is needed. The production department also runs into problems with the new generation. The previously used machine can no longer produce the shaft – the search for a replacement is launched. But will an expensive new machine fit into the budget for production planning?

THE BUTTERFLY EFFECT

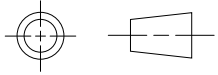
You might have heard of the metaphor of the butterfly that can cause a tornado on the other side of the world by flapping its wings. The consequences of a small change in a complex system are often vastly underestimated. Our example company's product development team could not foresee the many challenges associated with their decisions, as these dependencies can often only be assessed by technical experts for the individual process steps. Although individual relationships can be modeled in IT systems, there is generally no link whatsoever between these information models. There are many reasons for this: There are no interfaces to

the IT system, each system uses its own language for modeling and data storage. Process-related and organizational responsibilities between the departments are not very transparent, and knowledge holders are difficult to identify. As a result, approvals are often issued at the level of individual components or assemblies, whereas broader relationships between these levels can be overlooked. A holistic review often takes place only after months of development work, when the first prototypes are evaluated.

THE ROUNDTABLE

As soon as problems are identified in these prototype tests, the departments involved would traditionally sit around a table and try to find a solution. It may turn out that the shaft can be made shorter by three millimeters if another component is adapted accordingly. That is one way to solve problems – not efficiently, but effectively. Above all, however, this process is reactive and therefore time-consuming, and time is money in product development.

All the information needed to anticipate the problems that would arise later was essentially already available in the company. It was just not adequately prepared and available in the right place at the right time. Our company therefore has an essential interest in improving the collaboration of its employees in terms of creative problem solving and ultimately innovative value creation. The question now becomes: How can we facilitate the exchange of information and knowledge between the individual departments?



ALL DIMENSIONS IN MM

FIRST ISSUED	Product Development	TITEL	
DRAWN BY	Design	future gust of wind	
CHECKED BY	Production and Logistics		
APPROVED BY	Knowledge Graph	DRG NO.	SHEET REV
	SCALE 1:1	butterfly_dwg	1 of 2

Inter-departmental coordination with the help of a knowledge graph

Legend

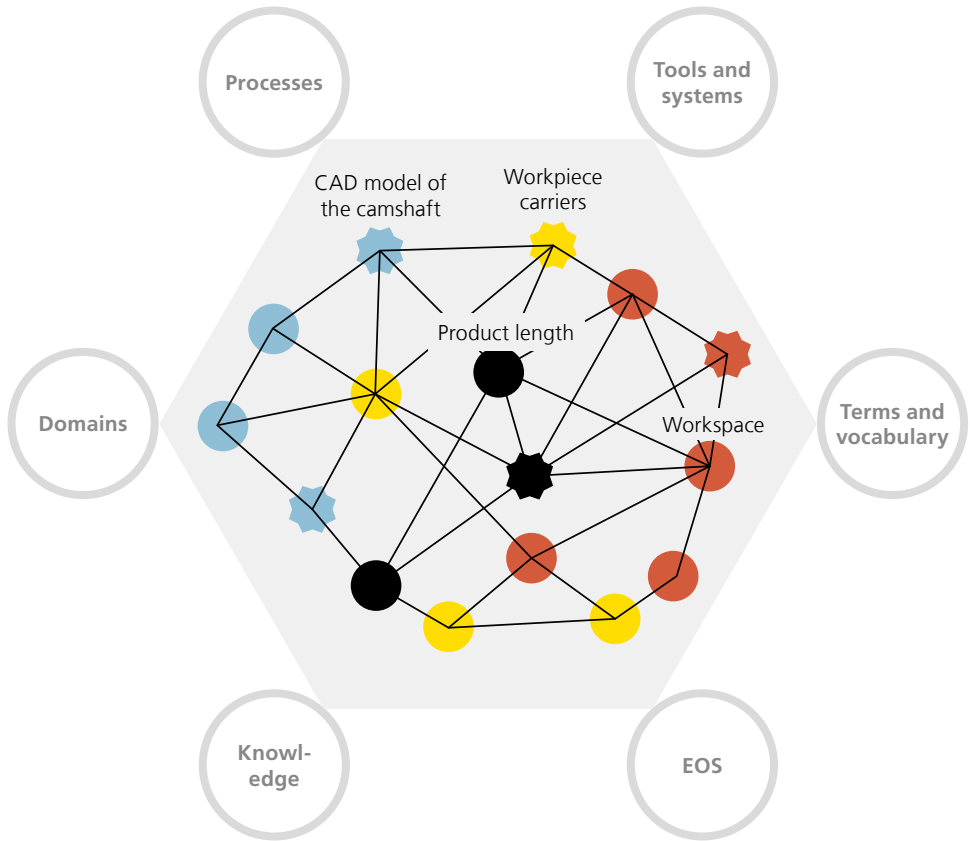
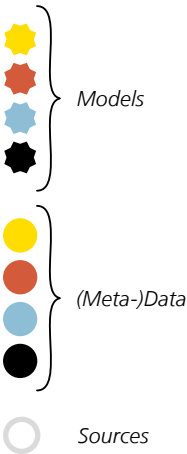
Source of information:

Product Development

Logistics

Production Planning

Department-independent or inter-departmental requirements



The key lies in processing the information in such a way that it provides clues to the dependencies, in this case the logistics problems resulting from the longer camshaft. Knowledge graphs offer one way of doing this. With their help, the contexts of the systems involved can be linked and complex questions answered. Implicit knowledge, such as logistical, technical or organizational and process-related relationships, can also be mapped and thus explicitly formalized. Knowledge graphs hence offer a structured and networked perspective on existing knowledge and make it possible to

provide information in a context-sensitive manner. They support product development teams by allowing efficient and flexible integration of data from different sources and making it interpretable for queries.

FROM DATA TO KNOWLEDGE

To model specific contexts in knowledge graphs, different classes of information (nodes) are created and connected to each other with relations (edges). Nodes and edges can be enriched with additional information. This creates formal descriptions and information links that

can be machine-read and interpreted. In our example, a node for the camshaft could be created and enriched with corresponding information, such as its overall length. Important relations to other nodes and the information describing them in more detail are then modelled, for example the workpiece carriers in logistics with their maximum transport width or the machine in production with its workspace. The involved experts determine and formalize which nodes, relations and information are critical, so that the information and links contained in the knowledge graph can be converted into corresponding assistance functionalities. This could include guidance on changes to the design or the identification of a solution space.

As the example shows, individual pieces of information can come from different sources. A graph can initially be created as an empty reference model and the actual information can be provided by the systems integrated into the graph; the graph thus forms a common language for information from all systems. There are different approaches to integrating information according to the respective requirements and strategy. Depending on the context, integrated data can be enriched with additional information and relations. Knowledge graphs, therefore, not only enable the creation of cross-system contexts; these contexts can also be extended individually beyond the system data.

TOWARDS IMPLEMENTATION

The modeling of knowledge graphs is very application-specific and therefore requires a great deal of contextual knowledge. First, relevant information from the individ-

ual systems must be identified and modeled. The individual data points must then be linked to describe their relations to each other. In addition, an individual context expansion is carried out based on the questions at hand and the requirements for the assistance.

This sounds time-consuming, but offers various advantages: Information can remain in its source systems despite the use of knowledge graphs while existing infrastructure and systems can continue to be used productively. In addition, the individual expansion of information and the associated gain in knowledge for specific questions facilitates the targeted use of existing data. Knowledge graphs can grow and continue to integrate additional sources for new questions. They are machine-readable, which means that they can also be used for the automated integration of systems with each other.

Knowledge graphs thus support the exchange of information and communication between our company's employees and systems – so that when the next product is developed, they can make well-informed, forward-looking decisions. And the butterfly flutters on. ♦

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FIRST ISSUED	Product Development	TITEL future gust of wind	
DRAWN BY	Design		
CHECKED BY	Production and Logistics	DRG NO. butterfly_dwg	SHEET REV 2 of 2
APPROVED BY	Knowledge Graph		
	SCALE 1:1		

ALL DIMENSIONS IN MM

TAILOR-MADE SKILLS

Ready for digitalization in production? With the help of an AI-based learning platform, SMEs can prepare their employees for their individual roles in a digitally integrated production.

The shortage of skilled labor in Germany is not only a consequence of familiar demographic changes as well as the challenges that companies are facing in integrating qualified immigrants. It is also a question of skill development: The Industry 4.0 automation wave is changing the requirements for employees’ skills and abilities, altering entire job profiles. For example, operating machines nowadays often requires programming skills rather than expertise in mechatronics. In order to remain competitive, companies must strategically train their employees for these new challenges in digital, networked production. While large corporations systematically train their staff, small and medium-sized enterprises (SMEs) often lack the capacity to do so.

This is where the KIRA Pro project comes in, helping medium-sized industrial companies to purposefully evaluate the areas in which skills need to be developed and expanded in the medium term. The objective is to link the strategic level of the company – i.e.

asking where development should go – directly with the operational level, i.e. the training of individual employees. To achieve this, the KIRA Pro project team developed a learning path generator. The AI-supported learning platform assists SMEs in their strategic HR development by comparing the employees’ actual skills with the required ones and creating a learning path with a tailored selection of learning content. Four parameters are matched by the AI-based system: the company’s requirements (target profiles), the employees’ personal development goals (preferences), their individual skill levels (actual profiles) and the available range of training options (offer).

STATE OF THE ART

The learning platform developed by technology partner Peers Solutions GmbH uses an AI-based assistance system to generate adaptive learning paths that take into account current developments and various trends in the continuing education market – the keyword being New Learning:

- The developed platform offers learners a high degree of **flexibility**, which enables faster learning processes in the face of changing technologies and increasing environmental dynamics.
- The resulting flexibilization facilitates **individual and self-guided learning**, which is also made possible by the learning platform. The focus is on the learners and their needs. They take an active role in the learning process, which encourages both a high degree of personal responsibility and the ability to reflect.
- In addition, the learning platform divides knowledge into small units. This form of **microlearning** is considered to be one of the most relevant digital forms of learning in the coming years, as it enables modular and therefore flexible learning.
- Finally, learners have access to **new digital learning formats** on the platform, such as podcasts, e-learning and virtual reality.

STRUCTURE OF THE LEARNING PLATFORM

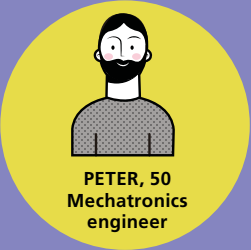
Focus on digitalization

Likes reading

Can invest half an hour per week



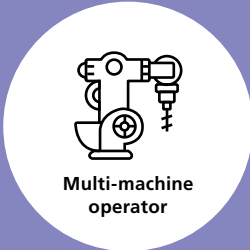
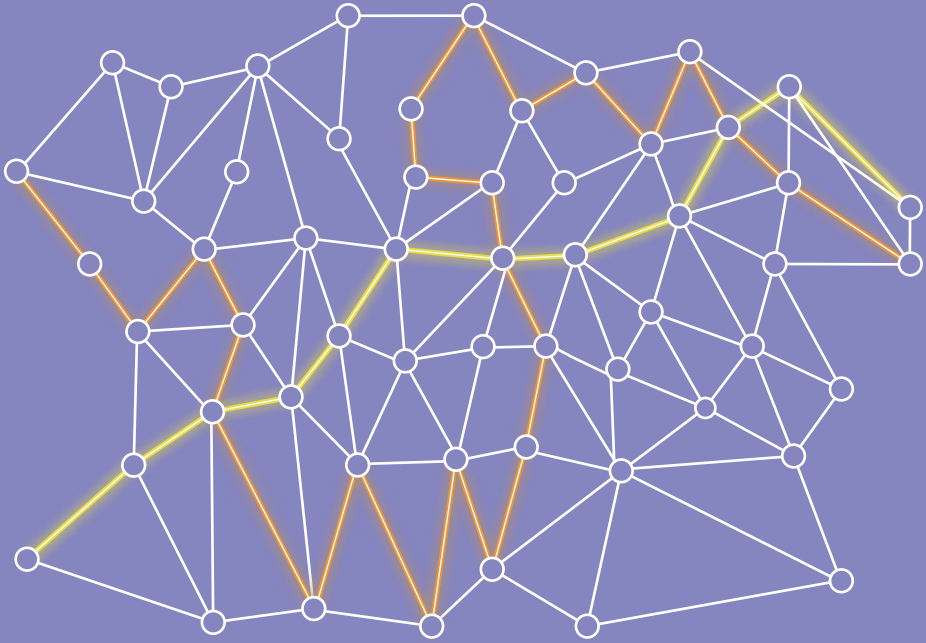
INDIVIDUAL ACTUAL PROFILE



Interested in sustainable production

Likes listening to podcasts

Can invest two hours per week



TARGET PROFILE

- New status
- Learning options in various formats
- Sabine’s personalized learning path
- Peter’s personalized learning path

Illustration: pikisuperstar / Freepik
Pictogram: Flaticon.com

To generate the adaptive learning paths, gaps between the currently available skills and those required in the future are first identified using an evaluation system known as the skills gap assessment. This involves combining the employee’s self-assessment (ACTUAL 1) with the external assessment by the respective manager (ACTUAL 2) and comparing it with the target

values (TARGET) specified by the management team. The AI algorithm analyzes the largest knowledge gaps (i.e. the differences between ACTUAL and TARGET) in combination with the greatest learning potential (on a scale from 0 for beginners to 100 for experts) and links these with the selected learning preferences – such as desired skills and learning formats – as well as the indi-

vidual learning capacity. On this basis, the system suggests suitable learning content and exercises for the user. These tailored learning paths, which automatically adapt to individual needs, skills and learning progress, provide an optimal learning experience by allowing users to progress at their own pace.

STRAIGHT INTO APPLICATION

In order to accurately implement the platform in companies, researchers from Fraunhofer IPK organized workshops to accompany the project at the companies Harms & Wende and FBT Feinblechtechnik. The workshops' target was to support the companies in developing and implementing a comprehensive corporate transformation and skill development strategy.



STRATEGIC HR DEVELOPMENT WITH A CAREER FRAMEWORK

Together with Harms & Wende, a company specializing in welding technology, the Fraunhofer IPK team designed and implemented a so-called »career framework« as part of the accompanying organizational development. It enabled the SME to systematically generate internal career paths and thus promote its employees' long-term career development. The highlight: Comparable competence-oriented role profiles, which were divided into basic and add-on roles, allow career paths to be put together as modules. With the basic roles, classic career paths such as the evolution from junior hardware developer to senior hardware developer can be mapped. On the other hand, the add-on roles, such as project manager, represent extra qualifications that can be combined with the basic roles. These additional, smaller target profiles help to counteract any existing bottlenecks in the team in the short term and enable employees to be trained precisely in line with the company's strategic transformation objectives.

KIRA PRO AT A GLANCE

Reference to the company's strategy and objectives and to established QM standards

Personalization through individual learning paths that are tailored to the role and the existing competence level

Matching between the company's requirements, personal development goals and preferences, and available training options

Holistic AI-based tool to support talent and performance management

FROM PROCESS-EMPLOYEE MATRIX TO SKILL PROFILE

Together with FBT Feinblechtechnik, Fraunhofer IPK researchers have advanced systematic skills development from a quality management (QM) perspective. Like many companies in Germany, the SME is certified according to the ISO 9001:2015 quality management standard, which is why very detailed quality management documentation was already available. This allowed the researchers to refer to a process map, a process-employee matrix and 50 sub-process descriptions in order to develop skill profiles at the main and sub-process level and roles in a multi-stage process. This QM-driven derivation of skill profiles down to the individual level helps to avoid losing sight of the connection between the targeted job and the qualifications provided by the individual training approach. In this way, the learning platform can be used to specifically prioritize those skills that are central to company processes or particularly common. The chosen approach also meets the requirements of various QM frameworks such as ISO or EFQM regarding employee skills development: Relevant skills are derived from the company's objectives, available skills are assessed and skills gaps are identified. On this basis, suitable qualification measures can be derived and implemented at the individual level and documented accordingly in order to ensure verification and evaluation of the effectiveness of the measures – including towards third parties such as auditors. ♦

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Images:
Katrin Singer-Coudoux **(1)**
and Maria Kretschmer **(2)**
implement KIRA Pro in
companies.

More information
[www.ipk.fraunhofer.de/
kira-pro-en](http://www.ipk.fraunhofer.de/kira-pro-en)



The research and development project KIRA Pro is funded by the German Federal Ministry of Education and Research (BMBF) in the INVITE (Digital Platform for Continuing Vocational Education and Training) innovation competition and supervised by the Federal Institute for Vocational Education and Training (BIBB).



Good to Know

Employee expertise is an important resource for companies. How can it be made available across globally distributed locations? A discussion with Hans-Christian Kesper, Senior Expert Operational Excellence at Bayer AG and Dr. Ronald Orth, Head of the Business Excellence Methods department at Fraunhofer IPK.



HANS-CHRISTIAN KESPER
Senior Expert Operational Excellence at Bayer AG

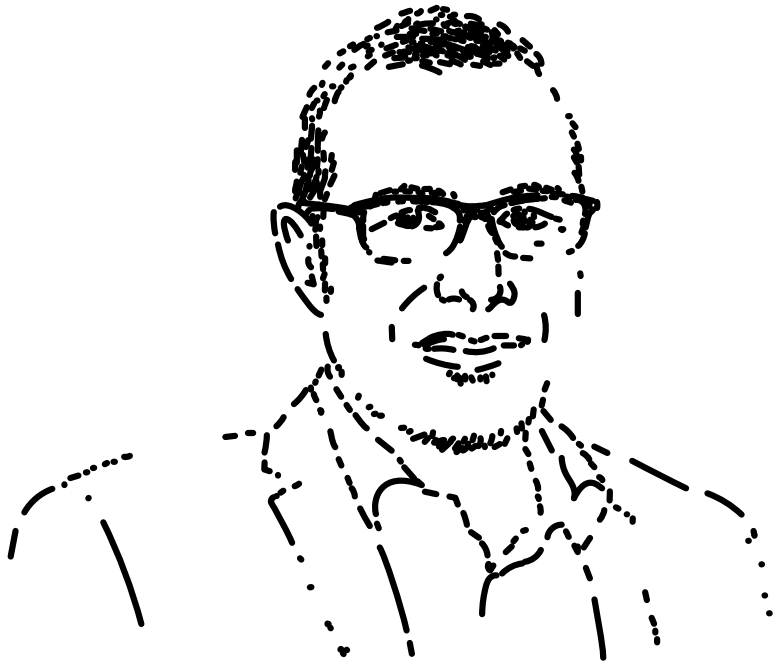
| futur | **Mr. Kesper, »sharing is caring« is the motto of Bayer’s global knowledge strategy. What role does knowledge management play in your company?**
/ KESPER / In many companies, knowledge management is only given a subordinate role. Yet it has been scientifically proven that around 18 percent of daily work is wasted on inefficient processes and around 25 percent on duplication of effort. Large companies such as Toyota, Apple, Google and Amazon have recognized that sharing knowledge benefits the entire company and has been proven to increase efficiency by up to 25 percent and innovation performance by up to 50 percent. Communication and availability of knowledge are immense drivers of success when restructuring processes in companies and also lead to greater employee

satisfaction and company pride. In the context of flat hierarchies, this is therefore a basic prerequisite for functioning cooperation. Furthermore, graduates today no longer judge companies solely based on monetary factors, but primarily on their immaterial substance, which shows how open, innovative and sustainable a company is.

| futur | **What challenges do you face at Bayer in the CropScience division?**
/ KESPER / Bayer CropScience develops seed and crop protection solutions that are used globally and regionally. The division is strongly customer-oriented, with the aim of guaranteeing the best possible process for users. Speed is therefore our business. To achieve this, we need a high level of availability of the necessary information in an agile network of colleagues. As in any company, this ensures customer satisfaction and follow-up orders, which will hopefully lead to the company’s success and expansion and, last but not least, secure jobs.

| futur | **Mr. Orth, what information, what knowledge do companies need in order to know what they are doing?**
/ ORTH / First of all, it is important to have a basic understanding that knowledge is a relevant success factor. This insight is often already established in companies in the technology sector that are very knowledge-intensive and dynamic. The valuation of intangible resources, however, remains difficult. When we launch and invest in measures, how can we as a company say that we have really made a difference at the end of the day? Compared to production, where you have hard key figures, this is a challenging question for us. If we decide that knowledge is relevant, even though we can only measure it to a limited extent – this basic understanding and a willingness to change are fundamental prerequisites for companies to tackle this issue and raise it from the shop

floor to the management level. This is also how we and Bayer came together: There was a willingness to initiate changes, to introduce specific knowledge management measures. Together we then looked at where the company stood and where it wanted to go. This self-reflection is an important aspect – only when we know the status quo as well as our goals can we derive and implement concrete measures.
/ KESPER / I am at home in the field of operational excellence, so »first time right« is the guiding principle: to do something right the first time by following a structured procedure. The actual and target states must be clearly defined. It is my task to find solutions for the deviations in between. What I find much more important, however, is that the problem description must always be clearly identified and described before looking at the actual and



DR. RONALD ORTH
Head of the Business Excellence Methods department at Fraunhofer IPK

target states. In other words, is there a problem at all? This principle is often forgotten. In our case, the problem description for when it came to »knowledge management« was simple: employee dissatisfaction.
| futur | **How did you tackle this problem?**
/ KESPER / We first conducted a status survey among the approximately 350 employees in the engineering department at CropScience. How satisfied were they with the current knowledge management and information retrieval system at CropScience? Together with Ronald Orth’s team, we generated a questionnaire. This initial online survey was good, but did not satisfy us. We therefore verified the results again in 25 individual interviews. Overall, this gave us a conclusive and com-

prehensible result, which we have assumed as being representative – even beyond engineering.

/ ORTH / The individual discussions were important in order to gain a better understanding of the burden of psychological strain. You often see the concern that knowledge management is associated with enormous effort – even more documentation, for example. This was a significant insight in the survey: Many employees stated that they have many diverse tasks but less and less time. We were able to address this and make it clear that our aim is to relieve and support them, by making it easier for them to find and use certain information that is already available in the company. Planning changes in small steps in the beginning can also help to see which solutions have already proven successful at other locations. Are there regular project reviews or checklists that can be used in other projects?

»Sharing knowledge benefits the entire company and has been proven to increase efficiency and innovation performance.«

Hans-Christian Kesper

| futur | **What specific solutions found in the joint project are you now introducing at Bayer?**

/ KESPER / Through the surveys we discovered that employees are very dissatisfied with the way they find information. We improved our intranet search, which we will supplement with a generative AI tool. It should enable employees to find well-founded answers to specific questions, or even recommended instructions. We no longer want to generate lists of results based on search queries that colleagues have to laboriously scroll through. Instead, the system generates answers to questions in a similar way to ChatGPT or Google Gemini and provides the source of information so that you can verify it yourself. We hope to implement this by the middle of the year.

Secondly, we established a multilingual Q&A platform with automatic translation,

in which a GPT tool is already integrated, providing quick answers to questions from colleagues and thus supporting various communities in archiving best practices and lessons learned. It also enables experts to connect with each other quickly. Bringing colleagues together with this forum was an important aspect for us. The third measure is being planned: short video formats similar to those on YouTube or TikTok or podcasts, for example on common repair tasks. If we want to work globally with knowledge management, multilingualism must be guaranteed as a standard.

| futur | **What challenges in the implementation of your knowledge management solutions do you still face? Do cultural differences play a role in your global company?**

/ KESPER / Not in the technical area. But we experience striking cultural differences in the way we communicate with each other. I believe we have a lot of catching up to do in that regard and should learn from each other. An example from everyday life: I send an invitation with a brief description and my colleague declines without comment. What does that show me? Are they not interested? Are they unavailable, is the topic wrong? We need to work much more with feedback in relationships and when it comes to our behavior – we can learn a lot from each other if we are open to it. That is simply crucial, communication that does not consider the relationship level doesn’t work sustainably. And successful knowledge management without communication is simply inconceivable to me. And success is just sexy.

/ ORTH / Building these personal relationships was very important in the initial phase of our project. After all, the people we got to know at the beginning were also the ones who supported the process in the end. I can only emphasize that personal communication and early involve-

ment of all stakeholders are very important drivers of success.

/ KESPER / I would just like to add: As with any change, it is important that a) the urgent need is felt strongly enough by the employees and that b) the »story« of the change is right. The entire process hinges on the question of communication and the tangible will of the management to see it through to the end. It is therefore important to communicate clearly and promptly. The speed of the change process also plays a major role. As already mentioned, we should give employees enough time to understand and change their behavior according to their personal learning plateaus. We should encourage them to share their knowledge. After a certain start-up time, they will feel that they also benefit personally.

| futur | **One final question: How is it possible to retain knowledge when experts leave the company – the keyword here being offboarding?**

/ ORTH / That was actually a major topic in our project as well. How can we retain and pass on the experience of someone who has been with the company for 30 or 40 years? A GPT platform would certainly be an exciting option here. Instead of traditional documentation, you could conduct interviews and then feed them into GPT tools via voice-to-text. Employees could then chat with their company’s knowledge base and see what experience is available on a particular topic. We are still at the very beginning, but this is an exciting research approach to capture and make available experiential knowledge in and for companies in a different way. In principle, however, I am convinced that a good structure and personal communication are still important drivers of success in offboarding and in knowledge transfer processes in general.

/ KESPER / In my opinion, knowledge management will no longer be possible without a generative AI tool connected to

approved data sources. But I am thinking even further ahead: Offboarding could be completely eliminated by continuously recording our employees’ empirical knowledge and making it available for use through our Q&A platform. This will make onboarding new colleagues much quicker. We should always capture knowledge, experience and feedback promptly, otherwise we will not be able to improve ourselves and our company performance. And as already mentioned: There is nothing wrong with being successful. ♦

»Personal communication and early involvement of all stakeholders are very important drivers of success for knowledge transfer processes.«

Ronald Orth

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Learning Sustainability? Yes, Please!

Without a plan and strategy, sustainability can cause considerable costs. A new in-house training program teaches concepts, methods and technical solutions alike.



Business success is no longer measured solely by revenue and profit figures, but also in terms of how ecologically and socially responsible a company acts. Reconciling these three aspects poses major challenges for many companies. This is where Fraunhofer IPK's in-house training program »Competitive Sustainable Manufacturing (CoSuMa)« comes in. It is aimed at specialists and management in manufacturing companies and teaches fundamental concepts such as circular economy and life cycle assessment as well as specific technical and methodical solutions. The aim of the training is to enable participants to make better decisions, introduce matching technologies and develop a comprehensive sustainability strategy for their company.

The in-house training program has a modular structure. The first stage is a basic module, which covers fundamentals, principles and interconnections of sustainable production. It is designed in a blended learning format that combines flexible e-learning with in-person training. In the e-learning units, participants deal with the question of what sustainability means and how it will influence the way companies operate in the future. Concepts and terms are introduced, categorized and explained using specific examples. The e-learning is followed by a two-day in-person training in which the theoretical knowledge is applied practically and playfully in a serious game. Here, the participants help a fictional company that manufactures drills from building blocks to become more sustainable. Exchanging ideas between all participants helps to deepen their knowledge and explore complex interrelations.

After completing the basic module, participants also have the opportunity to expand their knowledge in more specific transfer modules. These modules focus on technologies and methods such as additive manufacturing, integrated reporting and practical tools for identifying waste in the context of sustainability. »Our in-house training is designed to help companies anchor the topic of sustainability in their thinking and thus also shape the actions of non-experts,« says Natalie Petrusch, a research scientist at Fraunhofer IPK who designed the training together with partners in industry and science. »Our aim is for participants to complete the program as sustainability ambassadors who take the rest of the workforce with them on their journey.« ♦

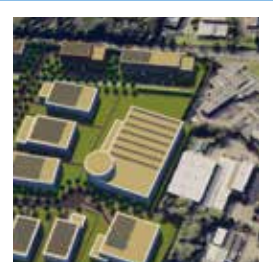
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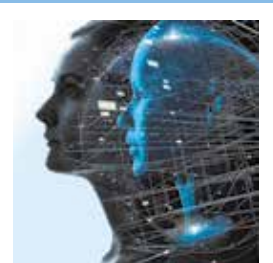
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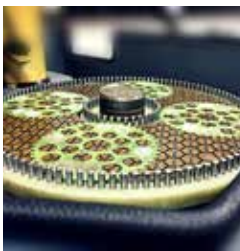
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