TRANSFER

OPERATION 4.0 –
DATA-ENABLING
IN HEALTHCARE

Steinbeis

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DEAR READERS,

More than a century ago, Willem Einthoven transmitted simple heartbeats remotely through a telegraph wire, laying the foundation for the development of a pioneering new discipline: tele-medicine.

Sensors are not just getting smaller and smaller, they now come with intelligent and reliable analytical and transmission algorithms – paving the way for the fully automated monitoring of a raft of biosignals such as heart rates, cardiac arrhythmia, blood pressure, blood sugar levels, and body temperature, all in real time. This is making it much easier for physicians to provide their patients with extensive care, in ways that make sense in clinical terms. Used systematically, these technologies reduce the length of hospital stays and the overall mortality rates of patients with chronic cardiovascular disease by up to one third. From an economic standpoint, this reduces inpatient stays and treatment costs.

To allow a large number of patients to benefit from these positive effects in the future, independent of the regional care situation, it will be necessary to introduce powerful data management systems, complete with transmission technology, analytical methods, clear rules defining responsibility for processes, multi-dimensional data exchange, and world-class data protection measures. It will also be important to expand the payment system for digital medical logistics processes, based on financial models.

Organized professionally, telemonitoring/telemedicine has every potential to develop into a sustainable care concept for the future. But to work, it will require the political will when it comes to healthcare and discussion that is open to different outcomes when it comes to technologies, responsibilities, opportunities, but also risks – not to mention suitable technological, legal, and structural conditions.

We strongly believe that telemonitoring, big data, and artificial intelligence can be an enrichment to medical thinking and action. The foundation for this will be provided by data enabling. In this edition of the Steinbeis TRANSFER magazine, a variety of Steinbeis experts report on their experiences and personal perspectives on the topic of Operation 4.0 – Data-Enabling in Healthcare.
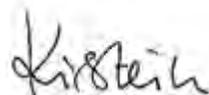
We wish you a fascinating read!

DR. MED. JUDITH PIORKOWSKI
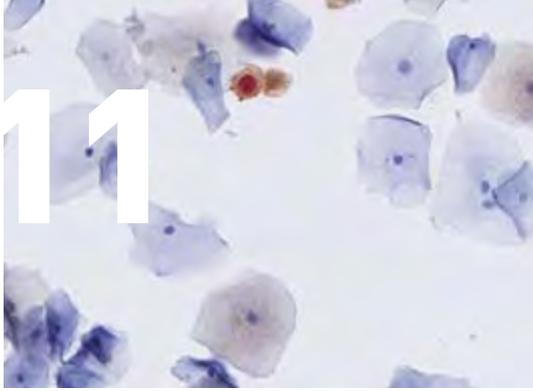judith.piorkowski@steinbeis.de (author)

Dr. med. Judith Piorkowski is director of Rhythm and Heart, the Dresden-based Steinbeis Research Center. The main focus of the experts at the center lies in data management in tele-monitoring and data logistics in telemonitoring studies.

www.steinbeis.de/su/1822

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Dr. med. Bettina Kirstein is a doctor undergoing further training as a cardiologist. She also inputs with her expertise on Steinbeis projects in collaboration with Judith Piorkowski.

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OPERATION 4.0 – DATA-ENABLING IN HEALTHCARE

When **KONRAD ZUSE** unveiled the **Z3** in 1941, the world's first **PROGRAMMABLE COMPUTER**, nobody could have imagined that not even a century later, computers and the **DIGITAL SOLUTIONS** they have spawned would permeate almost every area of modern life. And as a result, **PUBLIC HEALTH SERVICES** and **MEDICINE** are also undergoing long-term change.

Whereas Zuse's **Z3** was only capable of basic arithmetic and could only store **64 WORDS,** modern **AI** is able to analyze complex correlations, and for example in **MEDICAL PRACTICE** it can provide valuable help with diagnosis. One thing all computer-based hardware has in common is a data foundation. Information can be highly sensitive, especially in healthcare, so it has to be handled with discretion. On the following pages, a variety of Steinbeis experts discuss the **OPPORTUNITIES AND THREATS** of data enabling in the healthcare sector, highlighting how Steinbeis projects are already making use of the **DIGITAL ADVANTAGE** available to health-care services.

"THE OPPORTUNITIES CLEARLY LIE IN THE POSSIBILITIES TO OPTIMIZE DIAGNOSTICS AND THERAPY"

AN INTERVIEW WITH PROFESSOR DR. MED. DANIEL KÖNIG, STEINBEIS ENTREPRENEUR AT THE STEINBEIS TRANSFER CENTER FOR HEALTH PROMOTION AND METABOLISM RESEARCH

Digital technology plays an important role in medicine. It's particularly important to manage data properly so that people's fears that they might become "transparent patients" do not become reality. Professor Dr. med. Daniel König, Steinbeis expert in health promotion and metabolic research, spoke to TRANSFER magazine about the most important milestones in the introduction of digital technology in medicine, as well as opportunities and threats. He also discussed how despite the multitude of possibilities opened up by digital solutions, face-to-face contact between doctors and patients is still crucial.

Hello Professor König. The introduction of digital technology to medicine has resulted in sweeping changes. What do you consider the most important milestones? And what changes should we prepare for in the near future?

In the area I specialize in, I would draw a line around diagnostics, therapy, and the development or implementation of digital intervention concepts.

When it comes to diagnostics, I would particularly highlight monitoring of the cardiovascular functions and metabolism. I'm referring here to things like new tools for capturing and documenting laboratory measurements. But here too, emerging technology and telematic infrastructures are leading to an increasing number of improvements in the diagnosis of cardiac arrhythmia.

In terms of therapy, the main area of development is telemedicine; in other words at least some parts of the consultation process of physicians and the interaction between patients and doctors can now take place through digital technology. Some of this communication is accompanied by the aforementioned diagnostic tools. The current coronavirus pandemic has opened up a number of new possibilities and opportunities, but it's also highlighted limitations, especially if you think about actual testing.

In terms of intervention, online education and intervention programs are increasingly exploring new avenues and allowing healthy people – but also patients on secondary prevention programs – to improve their health by making use of online healthcare options.

What opportunities, but also what challenges will these developments present us with? And how does this affect your day-to-day work?

The opportunities clearly lie in the possibilities to optimize diagnostics and

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DIGITAL TECHNOLOGY SHOULD ONLY BE SEEN AS A SUPPORT FOR MEDICAL TREATMENT OR THE DOCTOR-PATIENT RELATIONSHIP.

therapy. Despite this, digital technology should only be seen as a support for medical treatment or the doctor-patient relationship. If you place too much emphasis on trying to digitalize things, important aspects of a condition or staying healthy could get sidelined. So you must never forget that visiting doctors in person, talking to people, and being examined by a physician will always be an important aspect of diagnosis and therapy.

Although a lot of progress has been made when it comes to data privacy, protecting personal information is still an area of risk. Even though a great deal is being undertaken to stop the often quoted "transparent patient" becoming reality, people still have concerns, especially when it comes to cloud-based, decentralized data processing, or sharing information via social media.

Your Steinbeis Enterprise has worked a lot in the area of healthcare promotion. What influence will digital solutions have on your work in this area?

One of the areas we work on is the impact of lifestyles on health risks for people with cardiovascular conditions or Type 2 diabetes. Using activity monitors provides you with lots of options for carrying out assessments, but also for making interventions. But this doesn't only apply to making diagnostic assessments.

Making evaluations directly available to users in the form of digital training or online coaching sessions is an excellent opportunity to improve their behavior.

Turning to big data – it's becoming possible to gather and connect up more and more medical data, to the benefit of both patients and medical research. But managing this kind of highly sensitive patient records also raises many ethical issues. In your opinion, is there a good way to solve this issue to the satisfaction of all parties?

When you're handling highly sensitive patient records, you must have clear rules in place for certain aspects in advance and these have to be communicated. How will data be gathered? It must be completely clear where information will be stored, who will have access to it, and who can and may be permitted to analyze data. It must and should not be allowable to ask patients for permission until they have been fully informed. If you're conducting a study or gathering large volumes of data, for example to track personal activity, so-called pseudonymization must be used to make it impossible to work out the identity of individuals.

Many of these aspects are already covered in detail by the General Data Pro-

tection Regulations. If you look after patients properly or conduct clinical studies responsibly, many of these data protection issues will already be dealt with in sufficient detail. But as we saw with all the recent discussion on data privacy for the coronavirus app, time and again new issues come up and these have to be discussed and taken into account.

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CYTOREADER: AI AND FIGHTING CANCER

STEINBEIS EXPERTS TAP INTO ARTIFICIAL INTELLIGENCE FOR THE EARLY RECOGNITION OF CERVICAL CANCER

Cervical carcinoma – more commonly known as cervical cancer – does not normally start with any obvious symptoms, or discomfort that makes it easier to make an early diagnosis. It can, however, be spotted relatively easily by conducting early tests. The Steinbeis Transfer Center for Medical Systems Biology (MSB) has developed a cloud-based artificial intelligence platform called CYTOREA-DER, that helps labs introduce and run improved cervical cancer screening using a method called dual-stain cytology (CINtec® Plus). As well as improving the accuracy of diagnostic testing, it also enhances the efficiency of screening.

The aim of cervical carcinoma screening is to detect precancerous lesions so that the condition can be treated, thus preventing the development of invasive carcinomas. There have been important advances in the prevention of cervical carcinoma in recent decades, also made possible by Harald zur Hausen's discovery that the cause of the disease is the human papilloma virus (HPV). Cervical cancer can therefore by prevented by a combination of vaccination and regular screening tests.
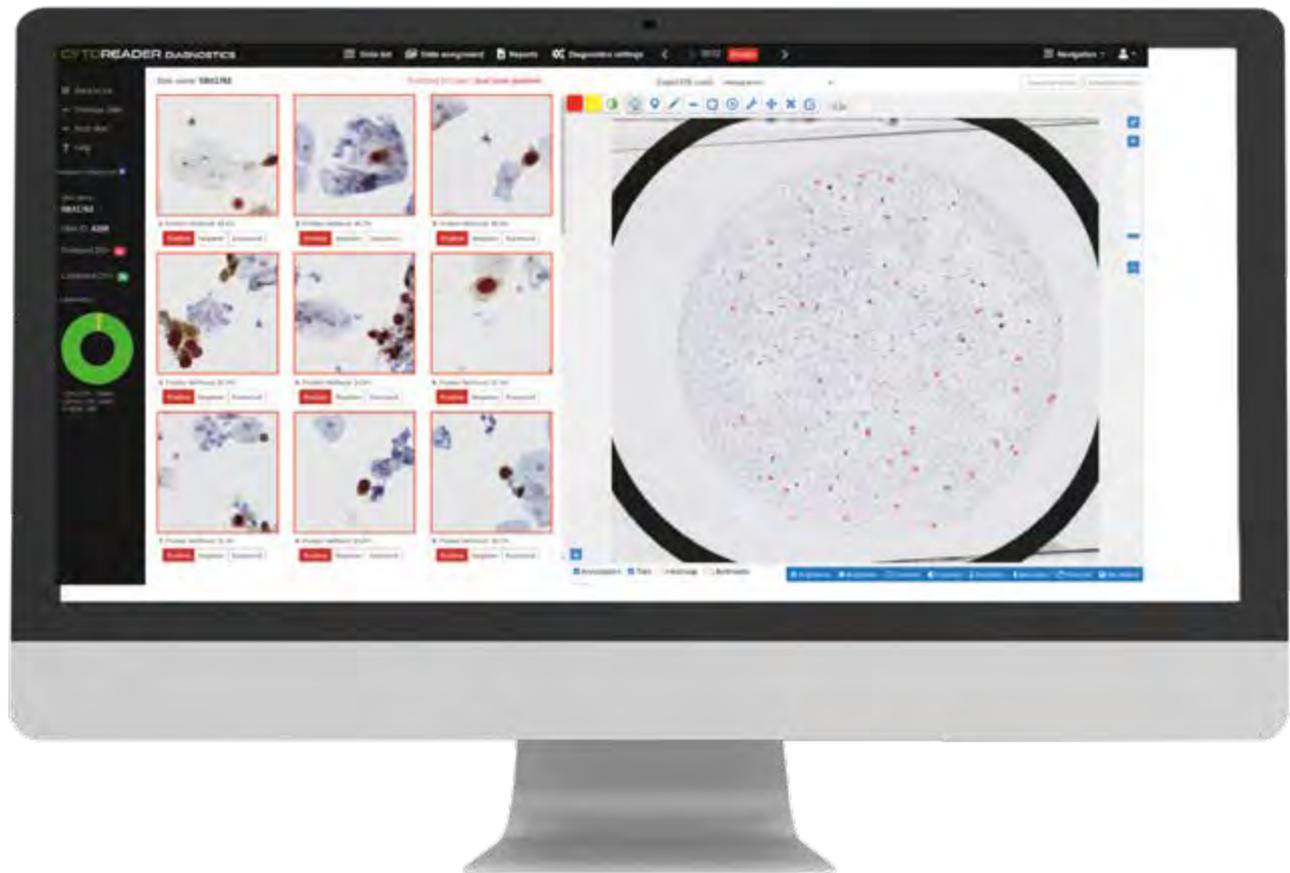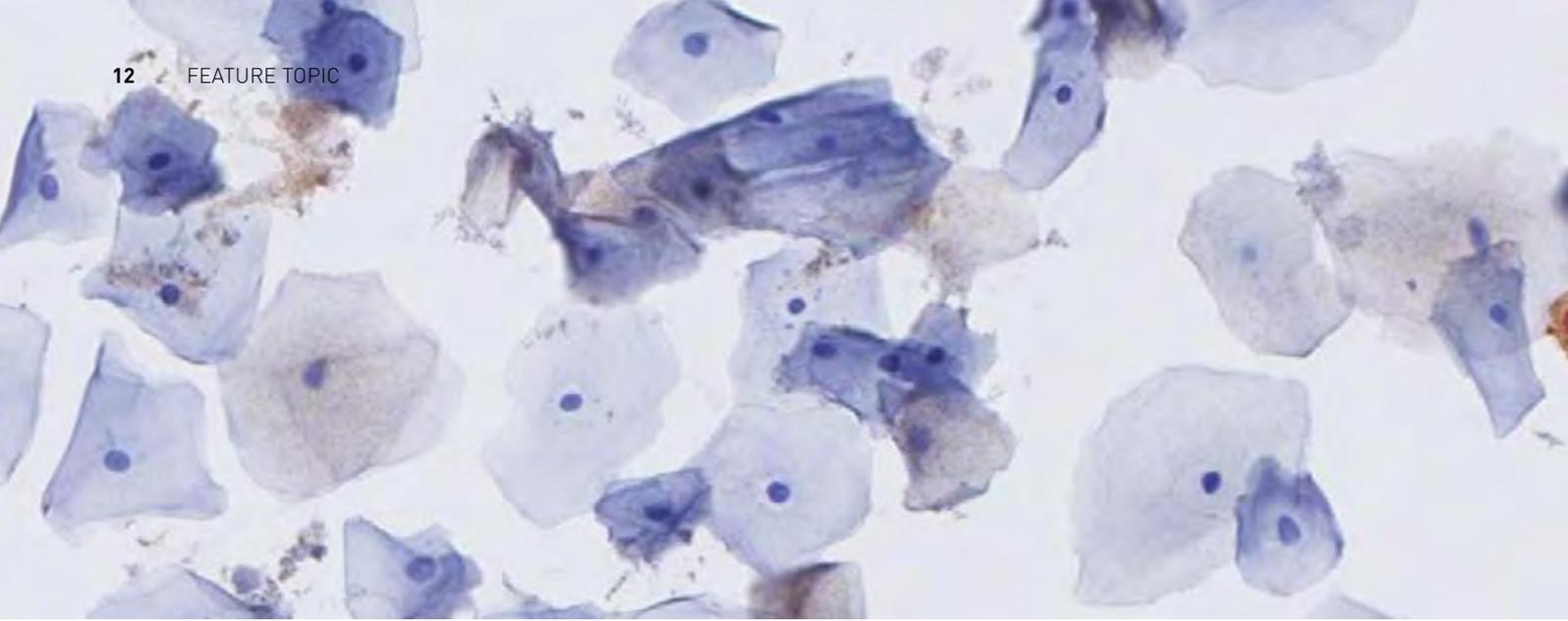
EARLY DETECTION TESTS USING THE DUAL-STAIN TEST

Cytological detection of altered cells from cervical smears is central to the use of screening programs to drastically reduce cervical cancer mortality in developed countries. The basis for this came as early as 1943, when experts starting using so-called Pap tests. Evaluating Pap tests was difficult, however, time-consuming, not particularly accurate, and had a tendency to produce false positives. In recent years, attention has therefore turned to dual-stain testing, which was developed for the use of biomarkers in cytological testing. Testing can detect the simultaneous expression of two proteins in cells: p16 and Ki-67. These indicate raised levels of cell division (Ki-67) coinciding with a malfunction of cell division (p16). In March of this year, the testing method was approved by the United States Federal Food and Drug Administration (FDA), resulting in improved early detection testing. Although manual assessment of dual-stain tests is more consistent, specific, and sensitive than with Pap tests, to a certain degree it is still susceptible to subjective opinion. Glass slides containing cellular material of the cervix are examined cytologically under the microscope for the presence of the two proteins.

AUTOMATING SCREENING USING CYTOREADER

Experts at the Heidelberg-based Steinbeis Transfer Center for Medical Systems Biology have therefore developed the CYTOREADER platform, which automates this final subjective stage of cervical screening by using artificial intelligence. Their new platform has been comprehensively assessed in initial epidemiological studies in partnership with the American National Cancer Institute and the health company Kaiser Permanente in northern California. The studies involved 4,253 patients (Journal of the National Cancer Institute, June 25, 2020). Compared to standard procedures (Pap cytology), the studies were able to reduce colposcopies (biopsies) by 30%, without compromising the detection of precancerous lesions. CYTOREADER operates fully automatically in the background and can assess the quality of microscopic samples and support diagnostic decision-making. The AI system makes it possible to improve the quality of diagnosis by enhancing sensitivity and specificity, also making the screening program more efficient. Using the fully automated slide scanner allows cytological slides to be digitalized fully automatically with microscopic definition.

To do this, complex image processing techniques are used, such as deep learning networks, which can be trained by sharing examples of good and bad quality. The digital images of patient samples are then uploaded to the cloud where they are processed, assessed, and archived. The cloud system can be accessed via standard browsers, making it possible for experts anywhere in the world to analyze samples via the internet.

These fully automated deep learning networks for analyzing cellular cytological samples are the backbone of the CYTOREADER system. They were trained by using samples of two types of thin-layer cytological slide preparations (ThinPrep® and SurePath™). To conduct its analysis, CYTOREADER breaks down images of digitalized slides into thousands of tiles, which are sorted according to the level of cancer risk. Physicians or cytologists making a diagnosis are then shown a gallery of the 30 most pronounced examples of cancer precursors. In the studies, it took less than a minute and only a few clicks of the mouse or keyboard to make a diagnosis.

IMPROVED DIAGNOSIS AND GREATER CAPACITY

Direct comparisons with Pap cytology showed that CYTOREADER can signifi-

cantly improve the already enhanced diagnostic quality of dual-stain testing. The number of inaccurate positive diagnoses dropped significantly (due to the higher specificity) and the detection of actual cases improved (due to higher sensitivity). The number of positive patients recommended for colposcopy (invasive tissue biopsy) could be reduced by 60% to only 42% of HPV-positive cases. CYTOREADER thus significantly outperforms the current performance standard of Pap cytology in diagnostic terms.
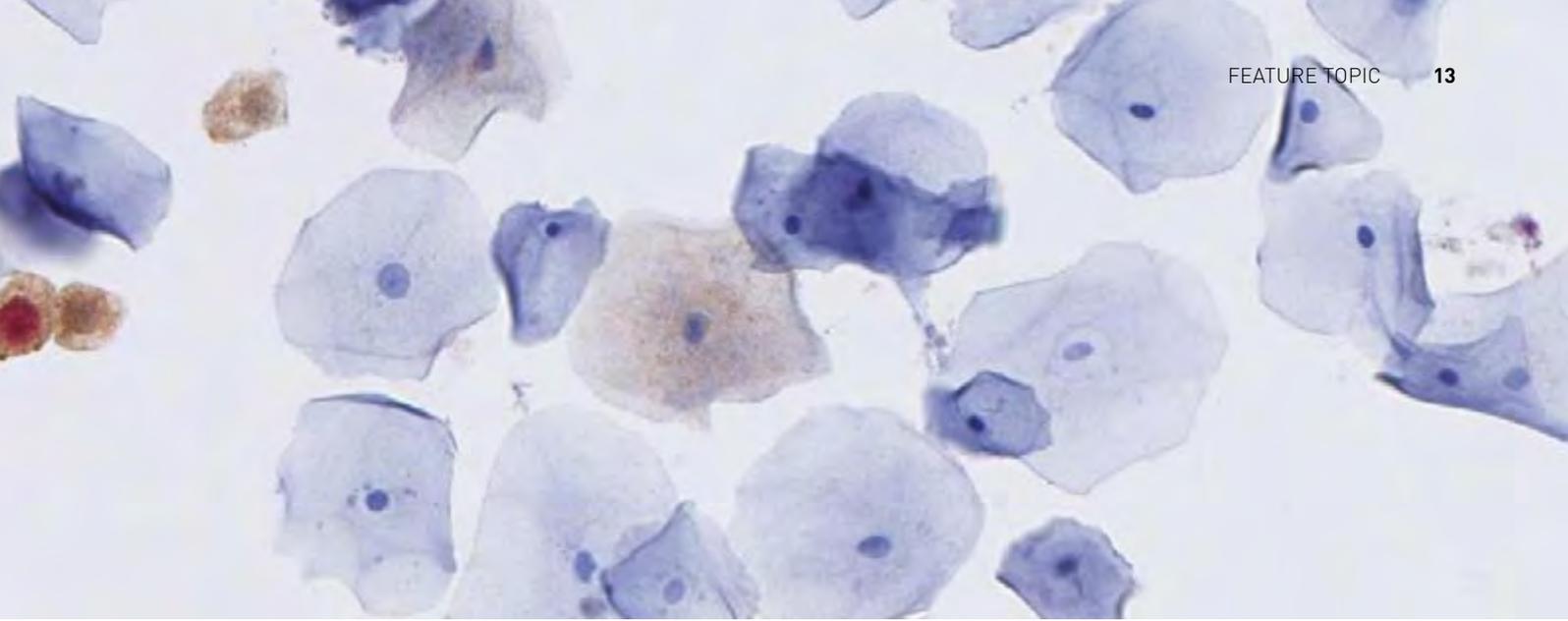
To use CYTOREADER, a slide scanner is needed. This can also be set up as a service in a local laboratory. Sample logistics also have to be adapted, but on the other hand, using the cloud offers clear advantages in the course of projects. Laboratories no longer require complex, maintenance-intensive, in-house IT systems. In addition, patient samples can be made accessible anywhere in the world 24/7. The evaluation capacity provided by the computer system for deep-learning networks is almost infinitely scalable, simply by bringing in extra cloud computing resources. Digitalizing labs thus makes it possible to reorganize certain stages of the value chain. This will play an essential role in driving change in the business landscape of laboratories in the coming years, and it is entirely possible that additional market concentration will take place. Overall, the cloud has the ability to sweep local technological hurdles aside, allowing lab services and experts to focus on their core competences.

Breaking down value chains in this way, even beyond regional and national boundaries, will also have a significant impact on global practices. Since 80% of cervical cancer cases occur in developing countries and emerging economies, the cloud has the ability to catapult such countries into state-of-the-art medical technology. Subsequent to the positive study findings, the plan now is to submit CYTOREADER for FDA or IVD approval.

MORE INFORMATION

ON CYTOREADER

WWW.CYTOREADER.COM

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WHO NEEDS THIS STRESS?

STEINBEIS EXPERTS PROVIDE HELP WITH UNDERSTANDING STRESSFUL SITUATIONS AT WORK AND DEALING WITH THEM EARLY

Absenteeism caused by mental problems is on the rise, resulting in significant damage to the economy. What can companies do to recognize stressful situations early and react quickly? This was the question looked at as part of a joint project undertaken by Steinbeis experts Elke Kirchner and Dr. Holger Gast, who have now developed an online tool for assessing stressful situations at work – especially ongoing situations that impair performance. Their tool gives companies a simple-to-understand, user-friendly instrument that makes it possible to reduce absenteeism and succeed as a business.

The market needs a straightforward solution that enables business leaders to identify potentially stressful situations early, prevents time being wasted, protects people, and still meets legal requirements under Section 5 of the German Occupational Health and Safety Act. Two Steinbeis experts, Elke Kirchner of Healthy Organizations (the Steinbeis Consulting Center) and Dr. Holger Gast of Agile Development of Information Systems (also a Steinbeis Consulting Center), have now developed a web-based tool that uses online questionnaires to assess and plan working conditions with the aim of minimizing risks posed by mental stress at the workplace. Four key factors are looked at:

- The work environment/work station
- Work planning
- Tasks and topics
- Social interactions/contacts when working with others

FINANCIAL FACTORS IN ASSESSING MENTAL HAZARDS

The aim of evaluating mental hazards is to understand whether or which stressful situations at a company can be identified by employees.

Such assessments provide a basis for introducing measures with a focus on working conditions (such as noise) or be-

havior (communication, leadership). The aim is to improve the performance of individuals and bolster teamwork. The result can be improved staff retention and reductions in sickness-related absenteeism. Money spent on identifying and reducing stress is amortized in the long term: "Happy, enthusiastic, and healthy workers stay longer at the company and improve the image of a business as a potential employer," emphasizes Elke Kirchner. Aside from reducing the cost of recruiting and training new employees, this raises productivity due to lower rates of absenteeism. However, understanding the risk posed by mental stress requires detailed expertise, primarily because risk assessments go far beyond the typical questions asked when conducting employee surveys.

THE STEINBEIS ONLINE TOOL – ANONYMOUS, SAFE, AND EFFECTIVE

As soon as Holger Gast started analyzing the requirements for the new questionnaire, it became clear that the first priority had to be that answers could be submitted anonymously.

The subject area is so sensitive for staff that they need to be allowed to describe the situation at their companies without fear of consequences. This was also important to gain the sign-on of union representatives and HR management.

The first step was to ensure the system only uses online encryption technology (https), so that responses could not be intercepted. The system resides on a dedicated server which is not used for any other purposes. "We also made sure that the database was designed to only save the actual responses, and not store information relating to browsers or submission times – like with lots of other questionnaires – because knowing such things might make it possible to work out who filled in the answers," explains Gast.

Even knowing the order different employees completed the questionnaire in could be used to work out certain things. For example, a company might keep connection logs showing when external servers are accessed, and perhaps survey answers in the report are logged in exactly the same order.

For technical reasons, instead of using numbers in sequence, the tool developed by the two Steinbeis experts picks a random ID whenever it stores records. It also reproduces information based on random IDs. As a result, even if someone did access the database, they would still be unable to see the sequence in which answers were submitted.
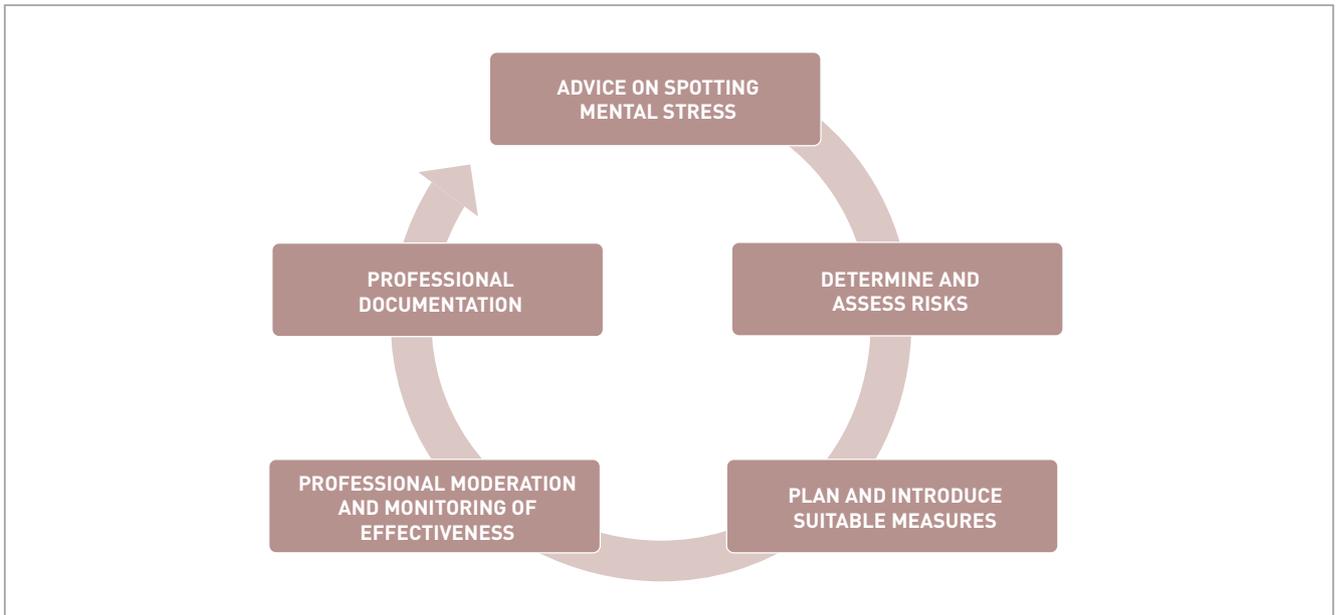
The process for evaluating the risk of mental stress in keeping with Section 5, Subsection 3, Part 6 of the Occupational Health and Safety Act

SUCCESS – THE PRODUCT OF PARTNERSHIP

By joining forces for the project, both Steinbeis Enterprises have provided an example of successful partnership in the Steinbeis Network.

The expertise of the Healthy Organizations Steinbeis Consulting Center made it possible to design a questionnaire with a strong focus on key issues, and the technical expertise and the special "software that writes software" method used by the other Steinbeis Consulting Center, Agile Development of Information Systems, were an important factor in implementing the project, which was both lean and adaptable.

Together, the two centers succeeded in delivering the mental risk assessment project without making things complicated for the customer. They also ensured that not too many resources were required. At the same time, pooling expertise strengthens the sense of community in the Steinbeis Network.

To view a demo version of the questionnaire (German only), go to
www.gesunde-organisationen.com/demo-fragebogen

The demo does not link to any other systems and only runs on the browser of the user. No information submitted for the questionnaire is actually shared.

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"ONE DECISIVE FACTOR FOR DATA ANALYTICS PROJECTS TO SUCCEED IS COMBINING ARTIFICIAL AND HUMAN INTELLIGENCE"

AN INTERVIEW WITH DR. PHILIPP LIEDL, MANAGING DIRECTOR OF STASA STEINBEIS ANGEWANDTE SYSTEMANALYSE GMBH

We are surrounded by data, at work and at home. Filtering out information that is actually relevant and using it properly is one of the biggest challenges of modern times. Naturally, the quality of data is crucial. One person who knows a lot about this issue is Steinbeis expert Dr. Philipp Liedl, who talked to TRANSFER magazine recently about using AI for data analysis, big data, and applied systems analysis in the field of medicine.

Hello Dr. Liedl. Your Steinbeis Enterprise converts data into knowledge. What do you see as the biggest challenges at the moment given the increasing flood of data and information?

One of the greatest challenges is to extract the information that is actually relevant from all the data that's available. One way to do this is to use AI methods to analyze data. But it's important to pick

the right input variables – or features – when you do this to go into the AI models. If you don't, analyzing the data ends up raising questions rather than answering them. To do this, you need to draw on expert knowledge in each field of application. This makes the process of spotting mutual relationships between different influences more reliable and the results can be interpreted more quickly. We've found that one decisive factor for data analytics projects to succeed is combining AI algorithms with expert knowledge provided by humans, so you have to combine artificial and human intelligence.

The increasing volumes of data now also make it more difficult to check data quality. Not only does this apply to information on technological processes, things are even harder with data in the field of social sciences. This increasingly means you have to use automated

testing methods to safeguard the required data quality – for example, to identify data blips or data errors.

How important is it to think laterally across different disciplines in managing the flood of information?

It does help to use methods across different methods to process and analyze the flood of data, and it can also help if you filter out the information that is actually relevant with an eye to reducing data complexity. For example, at STASA we've succeeded in adopting algorithms – which we originally developed for analyzing mass data from manufacturing processes, including the variables they produce – and transferring these to other application areas so they can be used to extract mass data characteristics.
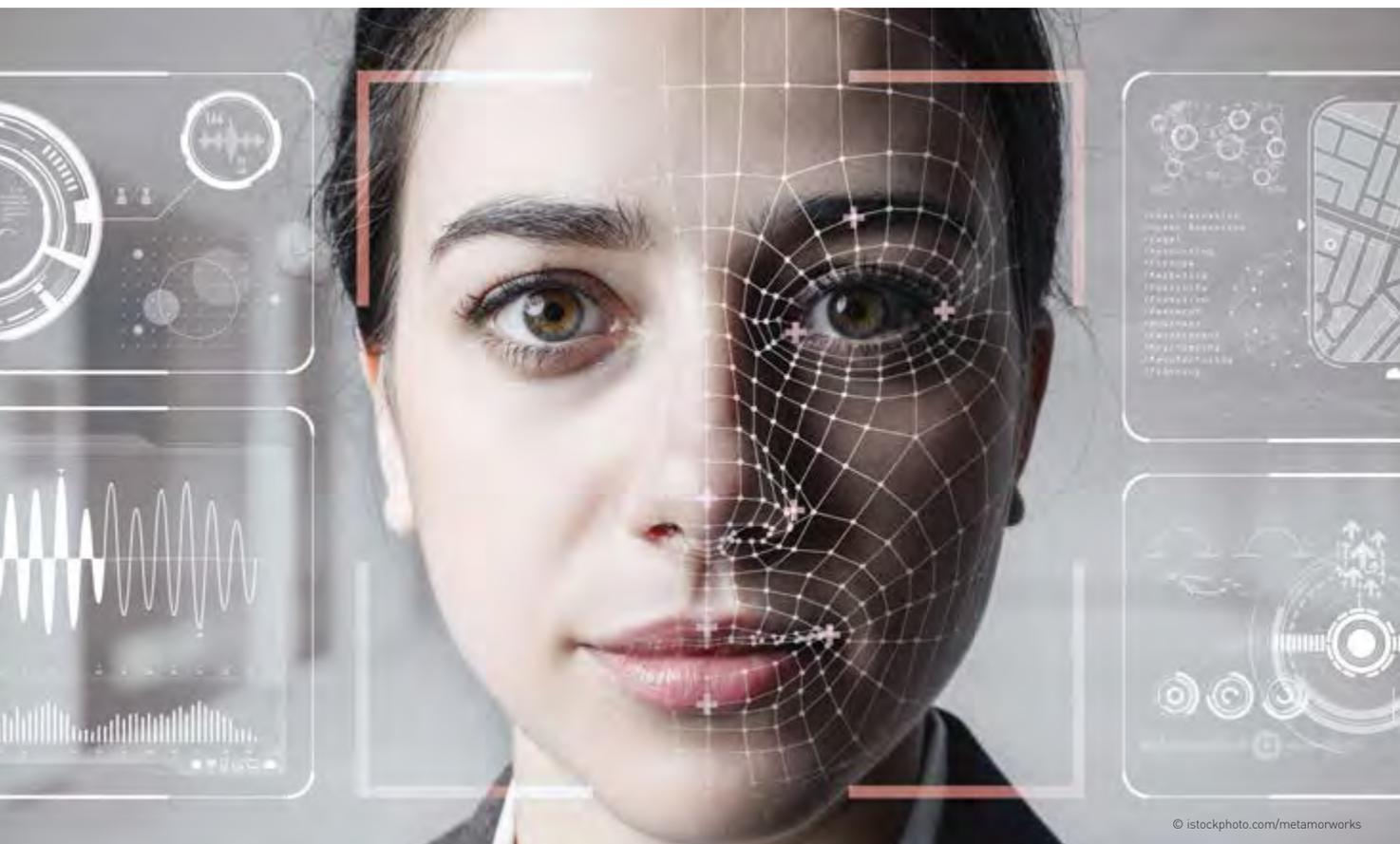
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We've used our interdisciplinary approach to develop a number of best practice methods in recent years, and these have enabled us to deliver a variety of successful projects relating to data analysis, modeling, and forecasting – for customers in industry, trade, and the public sector. Our aim is to work closely with customers so we always understand the specific nature of each particular application within our solutions. We also want to forge links between different disciplines by talking to our customers within a broad variety of specialist fields. This helps ensure that implementing data analytics projects with the customer results in a win-win-situation.

What potential do you see in using big data methods in the field of medicine – but also what risks does it present? And what impact do these have on your work?

Our work in the healthcare market involves analyzing regional data and developing software tools. From that perspective, there's significant potential in strengthening networks between different healthcare services. This can be done by providing a platform for health-related topics, such as telehealth solutions and home care.

In the future, demographic change will result in increasing demand for healthcare services because society is going to get older and older. The demands will be different depending on the region, and there'll be a particularly strong rise in older people in rural areas, who'll be overrepresented because lots of younger people will wander off to the urban areas. It's also more difficult to provide healthcare services in rural areas because you have to travel longer distances to get to a doctor. Also, in sparsely populated areas, providing nursing services

in the home involves long driving distances, so overall, care workers have a greater time investment than in urban areas. Telemedicine services or platforms for improving the organization of healthcare services and nursing can help in this regard by meeting the growing demand.

At the same time, working with digital media becomes difficult for older people and they're less proficient in it. As a result, the solutions provided in this area have to be even more user-friendly than in other areas and offer intuitive controls. In terms of risk, one of the main factors in this area is data protection. You have to gain the trust of users. So it's extremely important to adhere to prevailing data protection guidelines. Also, such platforms should only ask users for information that is really needed to provide the online services. The responsibility lies with us as developers in this

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ONE OF THE GREATEST CHALLENGES IS TO EXTRACT THE INFORMATION THAT IS ACTUALLY RELEVANT FROM ALL OF THE DATA THAT'S AVAILABLE

respect, although the operators of such platforms also bear a responsibility.

You often use methods of applied systems analysis for your work. Can these also be applied to public health services?

It's easy to transfer the methods of systems analysis to the healthcare system and it's already being used there now. We also apply our methods to the public healthcare system, for example by merging our models of local-area demographic development with the issues faced in healthcare.

This is where the increasing use of digital solutions in the healthcare system helps. For example, we're currently working on a project called DiCaSA, which stands for Digital Care Supply Advisor. It's backed by NBank with funding through the European Social Fund and involves developing a web-based platform, which among other things should improve care provision at home in rural areas. The platform will allow people requiring care and their families to link up with care providers in such a way that it will not only be possible for them to find the best possible kind of care options, but also care workers will be able to improve their services by planning the coordination of appointments. This

should improve care worker capacity and ensure it's put to optimal use for people requiring care.

There are also a number of other interesting ideas. For the providers of healthcare services, such as hospitals, physicians, and pharmacies, having graphical displays of patient characteristics in geographical terms, so on maps, and anonymously of course, can be really useful for supply and demand planning. For example, they can be shown interactive maps that indicate postal areas at a glance where there are particularly high or low numbers of certain patients.

Enriching your own data with other data – of a socio-economic nature, such as population numbers by age group or gender – allows you to gain quick insights, and these can be used for demand planning. For patients, it would be interesting to provide platforms that map the availability of services in the healthcare system, so for example they could find out where the nearest doctor or pharmacy is and work out the best way to get there on foot, by car or by public transport.

Lots of us are currently following the number of COVID-19 cases on interactive maps in the internet provided by different research institutes and the media.

In geographical epidemiology, it's been common practice to conduct such analyses on the transmission patterns of epidemics for years now.

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THE KEY IMPORTANCE OF DATA

STEINBEIS EXPERTS DEVELOP A DIGITAL DATA ECOSYSTEM FOR CLINICAL STUDIES

Somehow it sounds like a paradox: Advancements in medicine over the last decade are one of the reasons why in the future, caring for people will still be a major challenge. Why? Because life expectancy is rising and with this, so is the number of people who require medical support. At the same time, however, there are increasing shortages of skilled staff in the public health sector. Digital solutions may be one way to solve this problem by uncovering new approaches to diagnosing patients, providing treatment, and managing documentation. To pave the way for this, a coherent data ecosystem will be required. This is where the experts at TZM – a member of the Steinbeis Network – come in as part of a research project. KIKS – an acronym in German for artificial intelligence in clinical studies – offers software solutions in conjunction with the UMG platform to address the lack of standardization and networks between different medical devices.
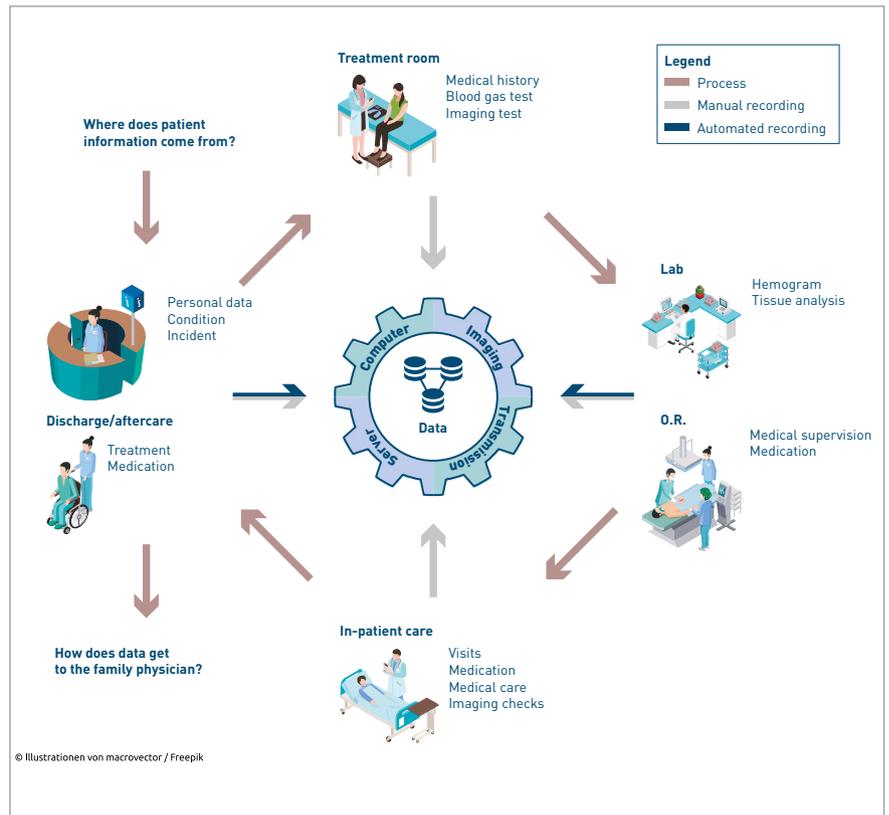
Data in a clinical setting – diverse and often unstructured

Prosperity has resulted in fundamental improvements in living standards and working conditions in developed countries around the world. As a result, infant mortality has decreased and there have been steady rises in life expectancy. Progress in medicine is just one of the factors that have led to people living longer. On one side of the equation, there are a growing number of people who require medical care into old age, while on the other, there are major – and worsening – shortages in medical specialists and nursing staff. For example, there is already a shortage of at least 50,000 nursing specialists in German hospitals [1]. According to a study conducted several years ago by auditing company PricewaterhouseCoopers, there will be a shortfall of 800,000 personnel in the German healthcare system in 2030. At the same time, there will still be a large number of open doctors' positions [2].

DIGITALIZATION: OPPORTUNITIES AND CHALLENGES

There appears to be little choice for medicine in the future. New ways must be found to keep up the high standards of care and achieve appropriate levels of efficiency. One way forward lies in new digital technology. By using artificial intelligence, introducing systems based on the internet of things, setting up telemonitoring networks and telehealth solutions, and making use of robot technology, many of the aforementioned challenges could be mastered. Such technologies improve and accelerate diagnosis, enhance treatment by making it more individual, and make it easier to manage documentation and schedules.

There still remains one major challenge, however: New digital technology will only be introduced on such a wide scale if a sufficiently broad foundation of usable data can be made available. One only needs to look at the day-to-day pro-

cesses of hospitals to understand that data is generated in many areas of the patient care process. One thing is particularly noticeable: The approaches and methods used to gather, store, and process data are highly heterogeneous. For physicians, nursing staff, and hospital IT departments, this is totally frustrating. It also creates a significant and unnecessary amount of extra work.

Aside from this factor, and the (quite rightly) often debated need to manage people's medical records with discretion, there is another aspect to this situation – an issue that is currently one of the biggest hindrances in using new technology in medicine: the lack of standardization in communication protocols. The "diversity" that results from this lack of standardization acts like a straitjacket because every time somebody tries to connect medical solutions, they run into a dead end, especially if data from a transmission unit (the data source) can't be understood by the re-

ceiver (the data sink). It's not enough to simply connect devices if the data sink is unclear about the type of information it is supposed to extract from individual data streams or certain data sources – or where or how it is expected to do this. There is an extremely realistic danger that false numbers are extracted for subsequent processing and analysis. Genuine connectivity enables interoperability – or in other words: It enables data to be exchanged based on fundamentally standardized and reliable information.

A KEY PREREQUISITE FOR SUCCESS: A DATA ECOSYSTEM

It will be important to set up and develop a suitable data ecosystem in the future, especially if artificial intelligence should be used to improve the diagnosis and treatment of medical conditions. One key priority will be clinical studies, because they are an important stage in validating and approving drugs and

treatment methods. Against this background, the Federal Ministry for Economic Affairs and Energy announced a pitch. One of the winners that emerged from the initiative was a research project called KIKS, a German acronym standing for artificial intelligence in clinical studies. The overall project is valued at more than €15 million, involving no less than 16 consortium partners, five of whom are university hospitals. The aim of the project is to develop a digital ecosystem which will equally benefit patients, hospitals, and the producers of medical technology. On the one hand, KIKS should identify the requirements that hospitals and the producers of medical products will have to meet to make effective use of clinical data. On the other, the idea is to develop a cloud-based digital ecosystem based on these key requirements. This ecosystem should be capable of delivering state-of-the-art architecture and security technology in line with legal and ethical considerations.

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THERE APPEARS TO BE LITTLE CHOICE FOR MEDICINE IN THE FUTURE; NEW WAYS MUST BE FOUND TO KEEP UP THE HIGH STANDARDS OF CARE AND ACHIEVE SUITABLE LEVELS OF EFFICIENCY.

UMG - Universal Medical Gateway

One system – many connections
Patient monitors
Hospital systems (PDMS/HIS/RIS/LIS/etc.)
Cloud/web

Transferal of vital statistics and system data
Vital statistics go to monitoring and PDM systems
Alarm information goes to notification systems
System data such as running time and temperature

Multiple interfaces
4x serial RS232
2x LAN/ethernet
Usable in parallel

More: https://tzm.de/umg

The UMG system combines clinical instruments using plug-and-play technology

THE UMG MAKES DATA EXCHANGE MORE SECURE

TZM was invited to join the consortium due to its long track record and experience in developing medical software. The UMG (universal medical gateway) platform developed by TZM makes it possible to acquire data from medical devices and transfer this information to clinical systems. The UMG integration platform is adaptable and manufacturer-independent. It also ensures data is exchanged securely between equipment. As well as safeguarding connectivity, it lays an important foundation for interoperability. Aside from offering functional advantages, such as expanded patient monitoring options and ways to enhance patient care, it also improves administration, simplifies invoicing, and provides accurate patient documentation etc. The UMG basically acts as a "bridging element" that acquires reliable data from previously unconnected sources and processes information by drawing on new technology. To do this, the platform uses powerful plug-and-play technology and is wonderfully easy to operate. For example, it does not require complex configuration or settings, and hospitals can use the system without requiring special infrastructure beforehand. The UMG solution can be bought outright or used as part of a service agreement.

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BIG DATA? SURE, BIG DATA!

DATA IN THE HEALTHCARE INDUSTRY – AN ESSAY ON POTENTIAL AND CHALLENGES

Data are the raw materials of the 21st (our!) century – one of the most frequent things people say about big data. But what actually are big data? And what do big data mean for healthcare services? Steinbeis experts Dr. Martin Vogel and Jürgen Blume of the Steinbeis Research Center for Medical Technology and Bio-technology talked to TRANSFER magazine.

If there's one thing the two Steinbeisers agree on, it's that the term big data is not just a reference to size. Huge volumes of data have been a common phenomenon (and challenge) in imaging science and medicine for decades. The term big data is more likely to be used to describe the phenomenon of continually gathering big volumes of data and the associated requirements this places on system design, storage systems, analysis, and displaying information. One well-known example of this is Google Maps. Maps uses positioning data supplied by countless cell phones to provide information on current and forecast traffic flows on certain days of the week or times of day.

There's now a term for the experts who deal with all the technical issues relating to big data: data scientists. Data scientists work on a number of challenges:

- Selecting appropriate system topologies for certain issues (such as which system components should take on which tasks – a central computer, a peripheral computer, a cell phone etc.)
- Proposing storage models that also take future system developments into account (e.g., normalized storage in SQL databases or document-centered storage in NoSQL databases)
- Developing suitable evaluations (e.g., traditional analysis models, self-adapting, self-learning algorithms, or artificial intelligence)

ARTIFICIAL INTELLIGENCE: OPPORTUNITIES AND THREATS

Dr. Martin Vogel and Jürgen Blume believe that AI algorithms offer the biggest application opportunities for big data. A computer system can access huge volumes of data – expertise based on experience – and use this to make predictions. How successful every new decision made by the system was is then used to optimize decision-making. This results in a permanently improving system, which becomes much more accurate at making predictions than classic models. In individual cases, systems used in specialized fields are already even "better" (in other words: more accurate and quicker) than human experts.

At this point, however, one needs to consider the risks: The decision-making chains or "trees" used by AI algorithms are sometimes huge (millions of mutually dependent individual decisions) and become impossible to be understood by humans. In other words: In most cases, we don't know what computer systems base their forecasts or decisions on. This can be particularly worrying if a system has to make a decision about an "unusual" marginal case (in terms of stored experiences).

As a result, the two Steinbeis experts believe that it only makes sense to use AI

systems in healthcare if they play more of a supportive role – by which they mean the final decision should always be made by an expert (although mechanisms need to be found to stop people getting into the habit of continually "clicking through" options), or risk assessments should be used to ascertain if an autonomous system could cause irreversible harm to life and limb.

RAW MATERIALS AND DATA PROTECTION

If such factors are taken into account, AI algorithms can be extremely helpful in revealing unknown connections within data. There is a hitch, however: Some struggle with the concept that data are a raw material. Unlike traditional raw materials, data are not something that is simply gathered and sold, especially in healthcare services, where they actually belong to people – usually patients – and there's every possibility that they are also owned by other key stakeholders, such as medical insurance companies, medical staff, or other service providers. Legislators may even have an important influence, albeit unintended, if new laws are badly formulated.

In any case, it's not analyzing data that becomes interestingly challenging, but clarifying with certainty to whom which

data belongs – and whose permission is required to use data.

This is a direct consequence of data privacy rules, especially EU general data protection regulations introduced in May 2018. Ultimately, this takes us back to the previous situation under German data protection law, seen by many as the strictest in the world.

From a general standpoint, the Steinbeis experts believe the goal when using big data for any kind of purpose must always be that people are understood, as well as their intentions, and how data affect (or will affect) them. In addition, especially in healthcare services, it must be ensured that corresponding measures introduced for legal reasons – or to give reassurance – are not merely given consideration as an afterthought. Instead, they should be put in place as soon as possible.

Thinking about dig data projects from this angle – in terms of the technology, but also legal and social aspects – and adopting an overarching approach from the beginning, is certainly a challenge, but in the end it's worthwhile!

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CALLIOPE – DIGITAL SUPPORT FOR CARE SERVICES IN RURAL AREAS

STEINBEIS EXPERTS TURN TO DIGITAL TECHNOLOGY AND COLLABORATION

Caring for others – as a relative at home or as a professional care worker at a care facility – is strenuous, physically and mentally. It is also becoming increasingly challenging, not only due to current demographic trends and structural changes in society, but also because of growing cost pressures. To manage this complex situation, in 2018 the Ferdinand Steinbeis Institute (FSTI) launched a micro testbed called Nursing and Care in Rural Areas. The aim was to come up with tangible solutions by working together with key stakeholders and experts in the field of nursing and care services.

Caring for others poses a number of challenges for family members and those around them. It is often an additional burden to everyday life and is stressful, not only mentally but also because of time pressures [1]. This situation is being made worse by the current upheaval in care services fueled by a nursing crisis, the feeling that staff are not generally appreciated, and structural changes. This is happening against a backdrop of demographic developments, which will result in a nationwide rise in people requiring long-term care of 47.4% by 2030 [2], underscoring current and future demand for long-term care and the "care gap." Nursing staff will also be expected to perform more complex duties in the future, including routine medical tasks [3]. The stakeholders that are affected by these trends in the care sector are senior citizens them-

selves, their families, caregivers, business and financial policymakers, and ultimately those who contribute to the finances of the social security system [4].

The current pandemic highlights how important it is to improve nursing. The aforementioned challenges will require new solutions, however, especially if we want to avoid overloading the medical infrastructure. This becomes all the more important if one considers the squeeze on costs in the nursing industry and care homes, which often results in providers competing on cost rather than quality [4].

PUTTING MICRO TESTBEDS TO THE TEST

Digital solutions provide us with a number of new opportunities to solve this problem in the form of technologies and

methods being developed and tested at the Ferdinand Steinbeis Institute. Some forms of technology, such as the internet of things, can be used to help people caring for others at home by building a bridge between inpatient hospital care and follow-on care at home. Other solutions also make it easier to access care services through digital technology, support family members providing care, and improve the standards of outpatient care. For this to work, however, a variety of specialist disciplines and different types of stakeholders need to be dovetailed. This is where the methods used by the FSTI with its micro testbeds (MiTb) come in, creating business networks that make it possible to develop digital platforms that deliver benefit on a number of fronts. With an MiTb, the business capabilities of participating companies are pooled with the complementary capabilities of other firms in order to facilitate collaboration based on trust in a space in which all stakeholders feel protected. The aim is to leverage digital solutions in order to develop use cases that deliver benefit. During the execution of the project, use cases are identified for implementation as proof of concepts. These are then used to assess the concept underpinning the business model and work with the other MiTb partners in making it more concrete [5].

The Nursing and Care in Rural Areas MiTb, launched in September 2018, involves five stakeholders working in the field of care and nursing as well as four experts in implementing the identified application scenario. The project kicked off with two workshops to allow the participants and experts to present their goals, discuss challenges, and formulate the specific problems they face, especially given current capabilities. There was then a third workshop in which the team started defining the use case. The participants came up with the following vision of the processes of nursing and care services, which is also being used to derive use cases.

SAVING LIVES THANKS TO A VOICE-ACTIVATED ASSISTANT

One of the use cases describes Selma M., an 85-year-old who still lives in a small apartment and is capable of looking after herself without outside help. One day, she slips in the bathroom and injures herself. She can't move one of her legs and is lying helpless on the floor. What a relief that she has her voice-activated assistant – Calliope. Selma instructs Calliope to call for help. Aside from describing the nature of the emergency, it also sends information about her medical background stored in a health app on Selma's smartphone. This includes medical authorizations (a patient decree) and information on her blood group, her medical history, details of any previous treatment, and any medicines she is currently taking. It also highlights that Selma is taking an anticoagulant.

The rescue service realizes that her case is urgent and arrives only a short time after the emergency call made by Calliope. A paramedic makes a quick diagnosis – he suspects that Selma has fractured her hip and administers first aid. In parallel to this, he is helped by Calliope to identify if there is a nearby hospital with a free bed and capacity in surgery or intensive care to treat the hip fracture. Within minutes, Calliope has received the required information and recommends that Selma be transported to St. Barbara's Hospital. When Selma arrives at the hospital, she is already expected because Calliope has forwarded her vital information. There is a surgeon at the hospital and a process has been initiated for a traumatic hip joint replacement. The incident is very difficult for Selma at first, but she makes a good recovery and is soon transferred into post-operational convalescence. Calliope is also kept fully informed by the hospital.

When Selma is discharged from convalescent care, Calliope already knows what happens next and initiates a program: "discharge from the convalescent care home after a hip joint replacement." The care services already know about the situation when Selma gets home and have the key to the apartment ready for her. By now, Calliope has also informed her doctor and set up the first home visit. A nearby pharmacy ensures she is supplied with the medicine stored on her medication schedule. Naturally, Calliope will also remind Selma to take her medication and do her exercises. Physiotherapy appointments are lined up and orders are sent to a local supermarket to deliver food and drinks. And of course, Calliope will still be there for Selma in case there's another emergency.

A BRAVE NEW WORLD?

The information stored by Calliope, data in the health app, plus any information on the hospital, the convalescence home, the family doctor, and the overall healthcare system, is all gathered by the MiTb platform and evaluated alongside data on comparable medical incidents in the area. This allows the Steinbeis experts to acquire information on a macro level, which can not only be shared with patients, but can also be made available to service providers. This information helps optimize processes, ensures quick care can be provided – ideally without error – and helps safeguard the comparative quality of services.

The question that users often have is how Calliope knows what to do. It was programmed by experts at the MiTb and it will always keep users up to date with the latest developments. The system is also underpinned by human "pilots" in the area, who have a detailed understanding of the healthcare system and initially monitor semi-automated processes used by Calliope. Later they allow Calliope to work automatically, meaning they have less and less involvement in routine processes.

This vision of the potential process, which was drafted with the support of the stakeholders involved in the test-bed, has been combined with research into typical geriatric processes to come up with a list of requirements for developing a proof of concept. This spans the following use cases:

I. Information on the condition of the patient (medication box, patient movements, etc.)
II. Medicine deliveries
III. Optimized routes for nursing staf

One thing that the use case highlights is that the goal of the MiTb implementation phase is to develop a system platform. This platform will store required data on the patient gathered by sensors in the home. Data is then fed into a patient database and made available for the platform to conduct evaluations. Patients are also provided with a medication box fitted with sensors to determine whether they take the right medicine and whether it needs replenishing. This information is analyzed by algorithms so that it can be decided whether caregivers need notifying or whether more medicines need ordering. Orders can be signed digitally by a doctor.

Medicines can be delivered from a near-by pharmacy by a specialist delivery service. The routes used by delivery drivers can also be optimized by algorithms to ensure they are kept efficient and thus environmentally friendly. This can also help avoid potential emergency deliveries, and improving care in the home even helps minimize supply gaps.

HOW DID IT GO FOR THE MEDICAL EXPERTS?

For the two experts with a medical background, Dr. Thomas Heinz (hospital specialist) and Dr. Ralf Hardenberg (expert in internal medicine), the whole idea of micro testbeds took them into completely uncharted territory – it was an adventure, but also an enriching and exciting experience. The entire approach to providing medical care in rural areas needs to be reinvented. "In Lower Saxony, the main issue is that there are insufficient human resources and long distances between different stakeholders. If you don't dovetail outpatient or pre-admission care structures properly with inpatient and post-release structures, it's not possible to provide care that is not just patient-centric and individualized, but also cost-efficient," says Ralf Hardenberg, with conviction.

Calliope should help all stakeholders involved in the process to make it easier for people who require help to "come on board" – patients, their families and friends, and the experts. Information should be gathered and shared without data redundancies so that it "fits like a glove" for those who are looking after others, despite data protection guidelines. But this will not be possible if case management and AI are not used meaningfully.

HOW DID IT GO FOR NURSING STAFF?

Three nursing specialists were involved in the testbed project – two gerontologists, Melanie Philip and Philipp Zell, and Michael Wilhelm, who has worked for many years in care homes. "The things we experienced on the MiTb were new for all of us, but they were exciting. We were able to shed light on the support required by the target group – from a variety of angles – and this made it possible to formulate goals accordingly," says Michael Wilhelm. The Calliope system that emerged from the process will make everyday work safer and easier for everyone involved in the ecosystem. It will be safer because support needs will be recognized by careworkers (more rapidly), and it will become easier because

The architecture and process sequence for notifications issued by patients on medical conditions
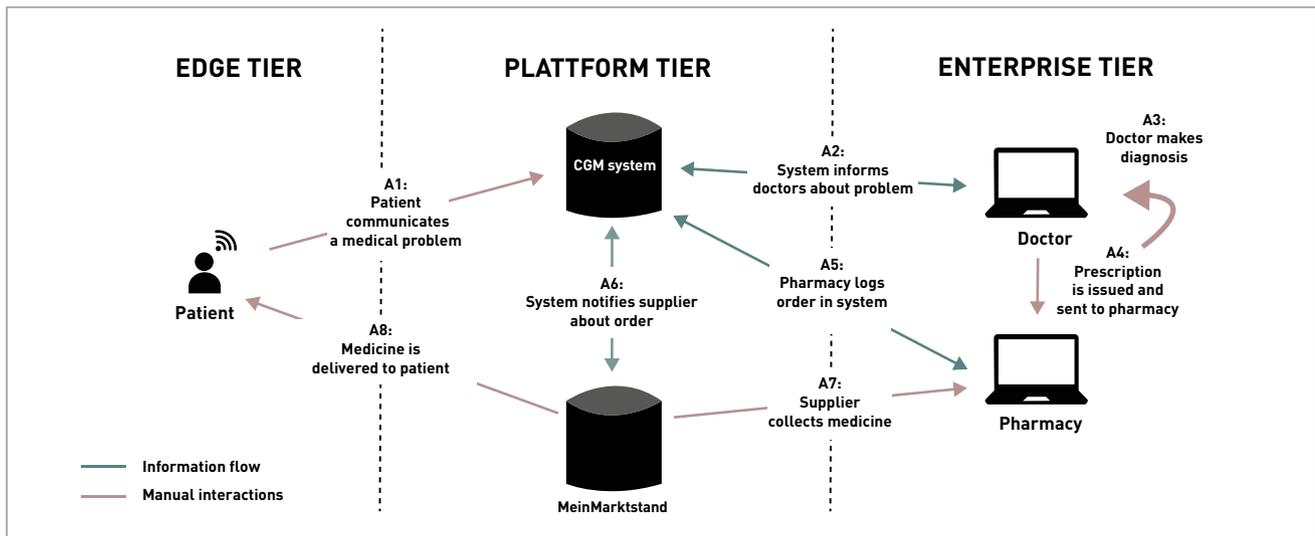
the limited resources available in the healthcare system will be used more efficiently.

Data will be gathered once, made jointly accessible, and fixed processes can be implemented. Until now, a great deal of time had to be invested in getting in touch with all stakeholders, such as after discharge from hospital, and agreeing care plans. Artificial intelligence also offers clear advantages, because it pools experiences made in patient care, logs risks, and makes adaptations for future care services.

NEXT STEP: IMPLEMENTATION

The MiTb will now move on to implementing the outlined use cases. In doing so, it will be important to merge capabilities and realize value creation scenarios in order to ensure benefit is gained by all parties. To execute the project, a provider of care services and a pharmacy have been chosen to translate the described process in practice. After implementation, it will be important to share experiences again and identify any impact the process has on existing business models – plus any new opportunities that may arise. Because the new system will be introduced to nursing and care homes, it will also be necessary to consider regulatory implications to ensure the system is feasible in practice. Some major challenges are anticipated in this respect. Nonetheless, without the MiTb it would not be possible to capture these issues in detail and highlight the potential offered by such "network solutions." The MiTb shows that partnerships in networks are key to making the

value added by digital solutions more tangible. Also, particularly when it comes to care services, networks are important for tackling public policy factors, demographic issues, and structural challenges. Such projects add transparency to

the journey undertaken when identifying solutions. They also make it possible to define detailed methods for the future – and for example they allow you to gauge the impact a solution like Calliope has in plugging the healthcare gap.

MiTb: Nursing and Care in Rural Areas

Participants:
- Dr. Thomas Heinz (specialist clinic)
- Melanie Philip and Philipp Zell (care pioneers) and Michael Wilhelm (care homes)
- Dr. Ralf Hardenberg (specialist in internal medicine)
- Bernd Roder (pharmacy)

Experts:
- Hase & Igel, Jan Schoenmakers (data analysis): Hase & Igel is a consulting firm specialized in big data, processing large volumes of information on human behavior and using AI to spot patterns, assess situations, and make forecasts. The integrated analysis of patient information, prescriptions, and sensors makes it possible for Calliope to understand in detail the condition of people requiring care and identify courses of action that will work for individuals, thus allowing them to be looked after for longer periods at home. It also makes it possible to paint a broader picture of the impact and knock-on effects of different treatment options.
- J4S, Ingo Janssen and Lothar Martens: J4S is providing the edge devices for the project.
- MeinMarktstand, Garvin Hinrichs (delivery): MeinMarktstand is an e-commerce provider of regional, premium-value foods and drinks sourced from sustainable companies. It has kindly agreed to make its logistics concept available for the Calliope project, and this will make it possible to have fresh and long-life food and drinks delivered to the front door, without personal contact. It is currently able to deliver products to any area in the north-west of Germany within 24 hours. Customers can also request specific delivery times to ensure products are received regularly.
- compuGroup (platform): compuGroup is providing a data and service platform for the project.

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SENSOR-DRIVEN DIAGNOSTICS: IMMEDIATE, RELIABLE, AND QUICK

BIOELECTRONIC SENSORS PLAY AN INCREASINGLY CENTRAL ROLE IN PATIENT TREATMENT

Each person's metabolism is different, and thus the effect of a medicine on patients depends on the individual. In the future, it will be possible to identify the ideal combination of active ingredients to include in a medicine – and quickly and easily adapt it to individual patients. In fact, bioelectronic sensors are already capable of providing the information we require to predict the success of therapy. They can be used to monitor how a broken bone is healing or to spot if a tumor has suddenly started to grow. They also offer us the opportunity to avoid animal testing when trying out new medicines. Experts at Medical Electronic and Lab on Chip Systems, the Munich-based Steinbeis Transfer Center, have specialized in bioelectronic sensors and are now using them to develop intelligent systems for use in medical applications.

↑   A selection of different multi-parameter sensor chips and sensor systems

At the heart of these systems lies a special electronic sensor chip that was developed and perfected through years of research carried out by Professor Dr. Bernhard Wolf and his colleagues. They have called their technology the multi-parameter sensor chip. This chip is capable of detecting several parameters at the same time – such as pH values, absolute temperature, oxygen concentration, impedance, and ion concentrations – by lining up several sensors within a single chip. The sensor chip has been continuously miniaturized and now measures no more than a couple of millimeters. This is a decisive factor for many medical applications, such as electronic implants.

The information provided by the multi-parameter sensor chip can be evaluated by a computer and cross-correlated. For example, the chip can quickly observe the condition of living cells and tissue, offering crucial benefits in a whole host of medical areas.

QUICK MEDICINE TESTING, FEWER SIDE EFFECTS, LOWER COSTS

The Steinbeis experts are using a microtiter plate with 24 reaction chambers to carry out drug tests. The chambers can be filled by a pipetting robot. In each chamber there is a multi-parameter sensor array, turning each reaction chamber into a kind of tiny bioelectronic

laboratory. Animal or human cells are cultivated directly on top of the sensors on an intelligent multi-well plate. The result is a biohybrid system of living cells combined with an electronic sensor. Whenever a substance (in liquid form) is added to the reaction chambers, the sensors measure metabolism responses in the cells, such as changes in pH values or the concentration of oxygen around the cells. This information is forwarded to a computer by the electronic system.

The scientists' process makes it possible to carry out large batches of tests – crucial when testing medicines. For example, the system can ascertain which com-

A close-up of the intelligent multi-well plate showing the reaction chambers with sensors
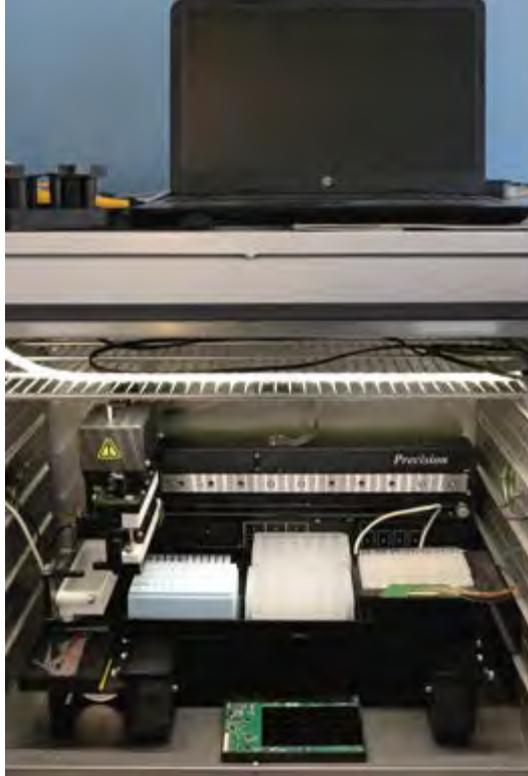
An intelligent microplate reader (IMR) with a pipetting robot (underneath in the incubator) and a laptop for evaluation purposes (on top of unit)

bination of active ingredients would be best for treating a patient's tumor. To do this, a doctor conducts a biopsy on a patient and removes tumor cells, which are then cultivated in the lab on the sensors of the intelligent multi-well plate. Next, an ultra-precise robot pipettes 24 different combinations and concentrations of active ingredients into the reaction chambers so that the sensors can measure the responses of the tumor cells. The computer then uses these measurements to come up with the ideal active ingredients and dosage levels. This allows physicians treating the patient to gain important information on the drug most likely to offer successful therapy options – or to highlight drugs that do not come into question. This kind of information can be crucial when treating patients, especially in cancer treatment. In this way, from the very beginning patients can be treated with the right mixture of drugs and the ideal dose, also making it possible to reduce side effects and save money.

The intelligent microplate reader (IMR) developed by the team of Steinbeis experts from Munich can be adapted to a variety of testing requirements. It is particularly well suited to testing drugs for efficacy and tolerability prior to approv-

als. In the future, this could make it possible to avoid a large number of experiments currently carried out on animals. The Steinbeis experts have also been working with Domatec, a medium-sized specialist in water hygiene and environmental analysis. Together, they intend to modify the IMR system to allow quick and reliable measurements to be taken of bacteria in air conditioning systems and drinking water.

REACTING QUICKLY BY TAKING MEASUREMENTS DIRECTLY IN THE BODY USING ELECTRONIC IMPLANTS

Personalized medicine is currently one of the most important trends in medicine. Electronic implants can be used in this area for capturing physiological information directly inside the human body for individual medical diagnostic purposes and personalized treatment. In fact this is another area where the future is just around the corner: The Steinbeis experts have developed intelligent implants about the size of a 2 cent coin. These implants can be used in minimal invasive procedures directly on tumors that cannot be removed surgically. If a tumor grows, the sensor measures decreasing oxygen concentrations on the sur-

face of the implant in combination with lower pH values in the surrounding tissues, and transmits this data to a receiver outside the body. The physician can then initiate therapy. Alternatively, the implant can act automatically and change the transmembrane potential of the tumor cells electronically with the aim of inhibiting tumor growth. The cancer is, so to speak, "deactivated electronically." This kind of closed-loop system makes it possible to react extremely quickly to changes in the tumor. Aside from avoiding serious side effects, this also protects the human body, with a much less detrimental impact on the quality of life for patients than conventional treatment.

The implants make it possible to take long-term in vivo measurements. In the future, it may be possible to use these devices to monitor the healing of broken bones, the condition of orthopedic implants, or the performance of transplanted organs. This is because even in such situations, the oxygen saturation of tissue is an important indicator of the condition of affected areas of the body, and the sensors on the electronic implants provide crucial information. The Steinbeis researchers have been working with the electronics company Texas

↑   An intelligent dental splint for diagnosing and treating teeth-grinding

An all-in-one medical device for taking vital measurements on a finger →

Instruments as part of a project aimed at optimizing their sensors and implants – and ideally miniaturizing them.

ELECTRONIC DENTAL SPLINTS USED TO STOP PEOPLE GRINDING THEIR TEETH

The intelligent dental splint works along the same lines as a closed-loop system. The splint is used to diagnose and treat bruxism (teeth-grinding), although in this case different kinds of sensors are used. The system is based on a dental splint made individually for each patient. The splint is fitted with a piezoelectric sensor, a radio transmitter, and its own power supply. The sensor's job is to measure chewing (mainly at night). Data is transmitted wirelessly to a receiver next to the bed or under the pillow. Stored data can then be transferred to a physician's PC via USB. By examining the timing and intensity of teeth-grinding, doctors can identify what might be causing the behavior. In addition to using the system for diagnostic purposes, it can also give immediate physical (vibrations) or acoustic biofeedback through a receiver unit. In the long term, stimulating the patient eventually helps them to stop grinding their teeth.

A POCKET-HELD DOCTOR

The researchers working under Bernhard Wolf have also used their sensor expertise to develop a handy all-in-one medical device, a kind of doctor in the pocket. Patients insert a finger once a day into an integrated sleeve equipped with sensors, which only need to take a single measurement to assess blood pressure, body temperature, pulse rate, oxygen in the blood, and hydration levels. Blood sugar levels can also be measured with a drop of blood and a measurement band. If patients give their permission, the all-in-one medical device will automatically send all measurements via radio signal to a database. This is done by a telemedicine system called COMES®, which was launched a couple of years ago. The physician treating the patient has instant access to patient data, so that the alarm can be raised and interventions can be made if abnormal values are detected. COMES® can also automatically alert patients and suggest appropriate action.

As we have seen recently under the current pandemic, it would be useful to lighten the load on doctors' offices. To a certain degree, future medical practice will therefore also involve telemedicine methods. One day patients will take their own measurements, but still stay in touch with the doctor's offices using digital technology. One major benefit offered by the all-in-one medical device is that it's hand-size and easy to use. It can be used at home or while out and about, not only by patients but also by nursing staff. It also goes a long way toward lightening the load on nursing staff in hospitals if they can take a whole range of measurements in a single step. The device also helps by sending information directly to digital patient files. This simplifies the often time-consuming task of documenting readings. The Steinbeis experts are currently working on a new generation of the all-in-one device, which will be even easier to handle and offer a particularly intuitive design.

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"DIGITAL MEDICINE MAKES IT POSSIBLE TO OFFER TREATMENT OVER SPACE AND TIME"

AN INTERVIEW WITH PROFESSOR DR. BERNHARD WOLF, STEINBEIS ENTREPRENEUR, FROM MEDICAL ELECTRONIC AND LAB ON CHIP SYSTEMS, THE STEINBEIS TRANSFER CENTER

Hello Professor Wolf. How far have we come on the digital transformation journey in health services – are things going quickly enough?

No, they're not. I think things are going much too slowly. Compared to the Scandinavian countries, we're about 15 years behind. Even southern European countries have made huge leaps forward compared to Germany. This is partly to do with the different technology standards that need to be introduced to the market, but also partly to do with the financial interests of the different institutions involved in public health services. Germany could have had a medical data network a long time ago, comparable with the German network for science and academia. But the fragmentation we've had until now will continue to hold things back over the next century and prevent digital solutions – that would benefit patients in this country – being expanded in the healthcare industry.

Which problems could rapid digitalization solve in medicine? And how would digital solutions be received by patients and physicians?

Digital medicine makes it possible to offer treatment over space and time. If it's applied responsibly and judiciously, it is very well received by patients, which is something I know from my own experience and contacts with digital service providers – such as the Medgate healthcare network in Switzerland. But many doctors are still skeptical about digital medicine because they're worried about losing patients. Also, some physicians are worried about being prosecuted for neglect of duty if they fail to intervene quickly enough or provide their patients with telehealth support in an emergency. Yet the Scandinavian countries have been successful in improving their standards compared to Germany, raising quality by up to 75% – depending on the illness – and they achieved that through a much more thinned out network of hospitals.

Bioelectronic sensors can be used to gather data directly from human beings. What are the data privacy issues with such sensors?

It's already possible to gather extremely precise health information on people without using invasive technology, but that doesn't seem to be a threat to data privacy. This issue only becomes critical if personal data "goes astray." But in principle, there are already encryption technologies that allow us to set up secure and interference-free data networks – as we've seen recently in the field of space travel, where even highly critical processes can be controlled over huge distances using sensors. Naturally, this level of security is also possible with medical data networks.

Do electronic sensors really have what it takes to make medicine less expensive?

Many medical conditions take a while to develop, so they don't just turn up like that; they could be detected early. Good examples of this are heart failure and strokes. This is where data recorded by sensors have an important role to play. If you measure blood pressure regularly and observe people's weight, and data can be collected periodically using a simple ECG implant in combination with pulse oxymetry, in roughly four out of five cases physicians are able to spot and react in advance to their patients' disorders, and that can save a huge amount of money. The devices for doing this, and the required sensors, have already been available for a long time – such as the all-in-one medical device we developed, which measures vital data through the patient's finger and sends it to the physician.

Won't the human factor get lost if medicine goes digital?

No, quite the opposite. Digital medicine always plays a supportive role – it makes it easier for doctors to get on with their everyday work and concentrate more closely on their patients, and that makes things more human. We also know from practical experience with telemedicine centers that in many cases they're able to help patients quickly because they get them to stop panicking and offer a more calm assessment of the acute situation. This also avoids many patients being unnecessarily admitted to emergency, and immediate treatment can be started based on what's really happening. It has to be advantageous to patients to have data immediately available in an emergency, so the attending physician can access information digitally and gain a direct impression of the patient's general condition. This also makes it possible to avoid complications caused by drug intolerances. That's the positive thing about individualized and personalized medicine.

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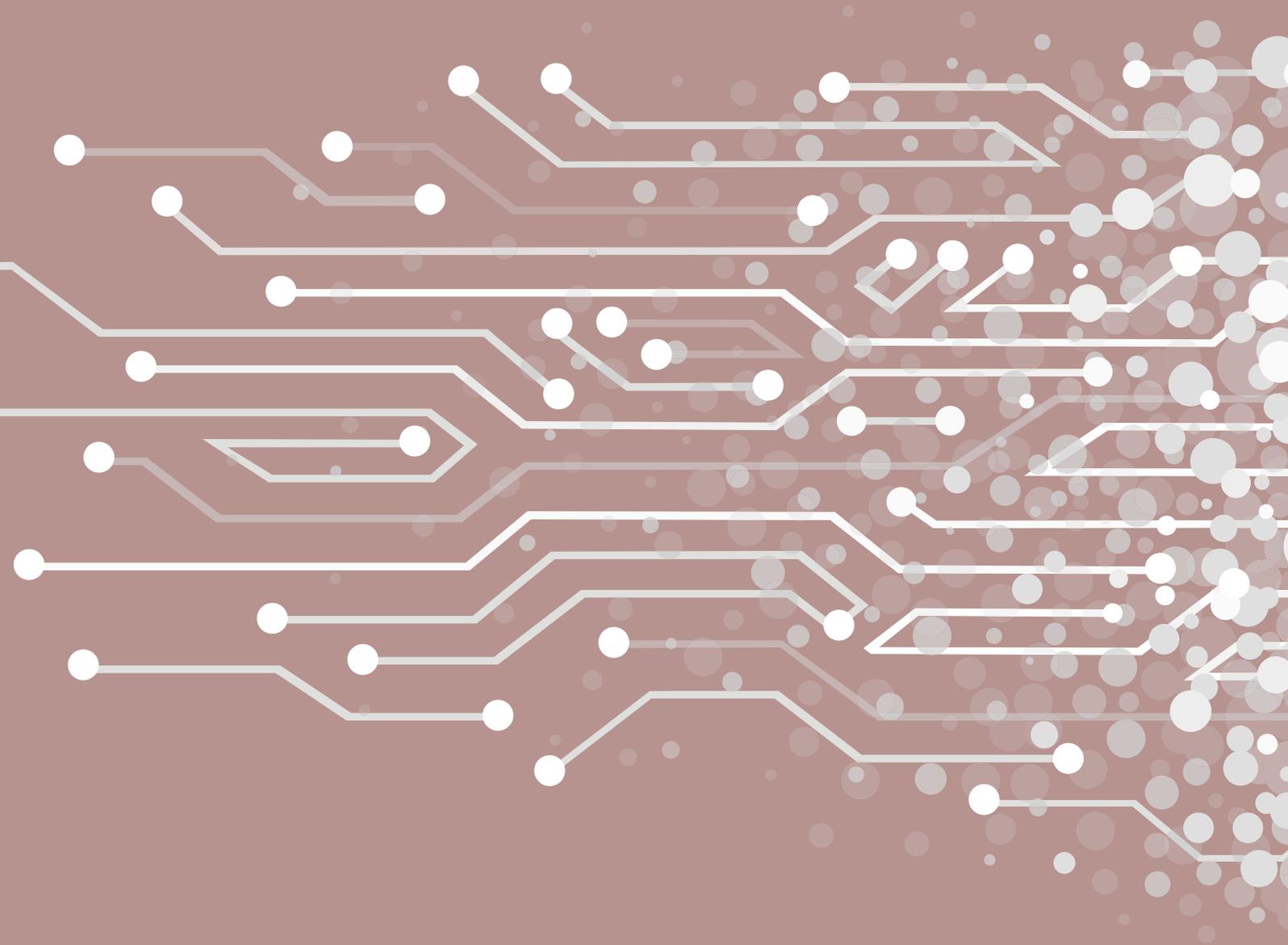
DATA – THE BASIS FOR TOMORROW'S BUSINESS MODELS

UNDERSTANDING CUSTOMER PROBLEMS AND SOLVING THEM SUSTAINABLY

The rapid growth of the internet has ushered in an enormous flood of data, bringing a whole new dynamic to information exchange processes. This development raises a number of questions – from ethical considerations regarding transparency and data protection to philosophical questions on the up- and downsides of ever-increasing amounts of data. There are also purely pragmatic considerations, such as whether these huge masses of data are genuinely useful or merely a burden. The answers to these questions depend not least on how data is handled and the underlying motivation. Kerstin Schenk and Professor Esin Bozyazi from Business Models of the future, the Steinbeis Consulting Center, have developed a meaningful and practical approach to mastering the challenges of data enabling and digital transformation, in this case for a medical technology company.

The internet is an incubator, greenhouse, and virtual marketplace for data of all kinds. When the collection of user data first began in 2001, only 8% of the world's population were able to go online. Today, less than two decades later, over half of the world's population is digitally connected via the internet, while the volume of data on the web is doubling every two years. The internet has expanded massively in recent years, and this technical progress has opened up uncharted digital territory with near-unlimited possi-

bilities. These developments are not only changing how people behave and act, they also affect business interactions and interpersonal communication on a fundamental level. The restrictions on public life due to the current pandemic have accelerated this trend of late. In this midst of this new reality – which we are all still adjusting to – a medium-sized medical technology company tasked the team at Business Models of the future, the Steinbeis Consulting Center with digitalizing its events and conferences. This included modernizing the company's conference systems, making it more professional, introducing collaborative processes, presenting its services and products at virtual conferences, and developing a dedicated concept for hosting and organizing virtual events.

BUSINESS MODELS FOR THE FUTURE: USING DATA INNOVATIVELY AND SUSTAINABLY

When Kerstin Schenk and Esin Bozyazi come to companies with their approach of "business models for the future," customers often ask how they can become future-ready and stay that way. As the two Steinbeis experts see it, the only ones who can answer this question are the companies themselves. After first looking at social developments, future trends, innovative technologies, and ideological currents, Schenk and Bozyazi always try to identify any customer needs

that haven't been met yet. To find these and understand them in depth, you need to know more about the customer. In this case, the Steinbeis consultants are taking a close look at the medical technology company's customers and their wishes. In the digital era, this process can be completely reinvented and organized in a modern way. Yet most of the time, this doesn't happen due to a lack of methods or ideas – and a failure to imagine the possibilities.

To help their customers establish their own business models for the future, the Steinbeis duo have developed a series of "learning snacks" that aim to build up a knowledge base that is always accessible, rather than information being shared in one-off workshops or training sessions. Schenk and Bozyazi consider it particularly important to first cultivate awareness of digital assets, since understanding data as a valuable asset and recognizing its value is one of the cornerstones for a successful business model for the future.

STEP 1: ORGANIZED DATA FORMS THE BASIS

The first learning snack Schenk and Bozyazi initiated was a 360-degree data discussion – an all-round perspective on data collection and data enabling. This makes it possible to develop a data management system that combines empirical research logic with economic efficiency and guarantees an approach that provides legal certainty while also being ethically justifiable and value-based. With this mindset, and taking a business modeling perspective, the Steinbeis duo then consider the business architecture and generate a development agenda that is visualized for greater clarity. As making good decisions always requires meaningful information, the analysis phase begins as soon as the data collection infrastructure has been put in place.

STEP 2: THE QUALITY OF THE QUESTION DETERMINES THE RESULT

For the analysis phase, the method of "question-storming" has proved to be successful. First, all questions relating to the defined goal are collected so that those most relevant to the result and goal can be singled out. In this case, the customer set an objective of defining and building a platform that would allow it to hold successful virtual conferences. This immediately raises a host of questions. How do we define success? What should the result be? How do we measure it? Is it about satisfied customers, or as many contacts as possible? What makes a virtual conference into an experience? Why do people participate in these kinds of conferences in the first place?

A 360-DEGREE PERSPECTIVE ON DATA COLLECTION AND DATA ENABLING

- **Methods of medical data collection:**
  Medicine teaches us the importance of having a strong foundation of data. The Steinbeis team follows this principle in its projects and safeguards the quality of data and information. Its maxim: "We serve people, but we believe data."

- **Ethical considerations regarding data collection:**
  Digital transformation is not only making it possible to collect data in even greater volumes, but also more precisely. In recent years, many discussions have revolved around whether or not data should be collected, and if so, which data. The Steinbeis team's guiding principle is to collect the data that it makes sense to collect.

- **The limitations of data collection as determined by the legal framework:**
  On May 25, 2018, the EU's General Data Protection Regulation (GDPR) came into force. It specifies very precisely the powers and obligations that companies have when collecting and processing customer, employee, and personal data. As well as the GDPR, additional stipulations apply to sensitive health data. Most of all, however, these regulations provide a useful rule of thumb when collecting data: as much as necessary and as little as possible!

- **Technical perspective: 'Tool tour' and innovative possibilities**
  One aspect that shouldn't be overlooked is the technical perspective. The two Steinbeis consultants aim to broaden horizons by providing an overview of innovative technical possibilities that transcend (technical and conceptual) limits.

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THE INTERNET IS AN INCUBATOR, GREENHOUSE, AND VIRTUAL MARKETPLACE FOR DATA OF ALL KINDS.

As experienced designers of business models for the future, it's not uncommon for Schenk and Bozyazi to reinterpret the customer's goal or add secondary aims and sub-goals during the process. The analysis phase has proven to be a valuable driver of innovations. To come up with business models for the future, the Steinbeis consultants think outside the box and assess the need to modernize from an overarching, big-picture perspective. In the project with the medical technology company, a deeper understanding of the drivers of future trends led to a new key objective being added: an iterative and agile process that combines the principles of divergent thinking (collecting information and customer experiences in order to generate ideas for solutions) and convergent thinking (focusing on certain areas and making decisions). The aim is to establish a future-oriented "digital analytics suite" that will act as a basis and early indicator for innovations in order to gear the business model to future developments. In some companies, development projects of this kind lead to new teams being formed, more agile approaches to collaboration, and even brand new departments and positions – but also ultimately to new services and products. Whatever the case, they bring a new mindset and culture of innovation into the company.

LOOKING AHEAD TO STEP 3: GENERATING IDEAS THROUGH BUSINESS DESIGN THINKING

Once the information has been collected, selected and aggregated, Schenk and Bozyazi will know the customer's deeper needs and the criteria that can be used to evaluate and measure the success of a virtual conference. Based on this, they will then begin to collect ideas for the virtual conference, with a central focus on people and the customer perspective so as to deliver a unique user experience. The process starts once the business design team has been put together and the design challenge formulated. For the medical technology company, a guiding principle – "We connect people with medicine and innovation" – was formulated to provide orientation throughout the creative process. This principle not only serves as a quality aspiration for the solution, but also for the process – it's important to develop a healthy approach here too, as technocratic digitalization processes need to center around people, whether they be customers, employees, or stakeholders. The Steinbeis consultants maintain this human focus in how they approach projects with customers. "As proponents and drivers of modern, open innovation approaches, we support progress through networks and the

sharing of expertise," explains Schenk. "That's why we regularly organize best practice workshops. If you're interested, we look forward to hearing from you – we'd be happy to take the time to develop workable future concepts with you!"

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#TECHOURFUTURE: THE FUTURE OF HEALTHCARE – MEDICINE, PEOPLE, AND TECHNOLOGY

EVERYONE IS TALKING HEALTHCARE – WE'RE (ALSO) TALKING TECHNOLOGY!

Following the successful kick-off in late 2019 of the #techourfuture series of events on current and future developments in the field of autonomous flying, the second event organized by the Ferdinand Steinbeis Institute (FSTI) in the summer of 2020 looked at the future of our health – excellent timing, even if the planned event format had to be adapted somewhat. Several online events were organized over the course of three weeks to give participants an opportunity to discuss future technology in the field of health and medicine, and enter into a virtual dialog with experts.

The Technologie*Begreifen ("Grasp Technology") initiative is sponsored by the Baden-Wuerttemberg Ministry for Economic Affairs, and even though the topics it focuses on were defined long before the coronavirus pandemic, the issues discussed at the most recent event – healthcare and medicine – could hardly have been more appropriate. The measures introduced to slow the pandemic mainly revolved around restricting social and physical contacts, leading to a number of economic hardships. At the same time, the exceptional circumstances highlighted a number of opportunities offered to our society and business by digital technology, and everyday advantages offered by new technology. Not only was there an exponential rise in people using digital communication and collaboration technology to work effectively from home, in the field of health-

care increasing use was made of the possibilities offered by telemedicine – by patients themselves, or to prepare digital anamneses before visiting a doctor. Increasing use is being made of robots to disinfect and clean hospitals (for example in Denmark), distribute drugs, or gather medical data, as is the case in a fully automated hospital in the Chinese city of Wuhan.

THE INTERPLAY BETWEEN MEDICINE, PEOPLE, AND TECHNOLOGY

The FSTI team that ran the #techourfuture event on The Future of Healthcare – Medicine, People, Technology examined the impact of emerging tech in the fields of healthcare and medicine in Ger-

many, also asking whether the coronavirus pandemic has accelerated the use of new technology. Due to COVID-19 restrictions, especially physical distancing rules, the second event in the #techourfuture series could not take place as originally planned with actual people present (at Pforzheim University in March 2020), but was rearranged as an online event series as part of the #techourfuture weeks from June 26 until July 17, 2020. Using virtual means, the participants were organized into three "tracks" and given the opportunity to get to know emerging technology close-up in the fields of healthcare and medicine – including how it works. There was also a chance to discuss opportunities and threats of the new tech with experts from science and business. The proceedings were streamed live by the Ferdinand Steinbeis Institute from the Haus der Wirtschaft (House of Commerce) in Stuttgart and a studio in Ludwigsburg.
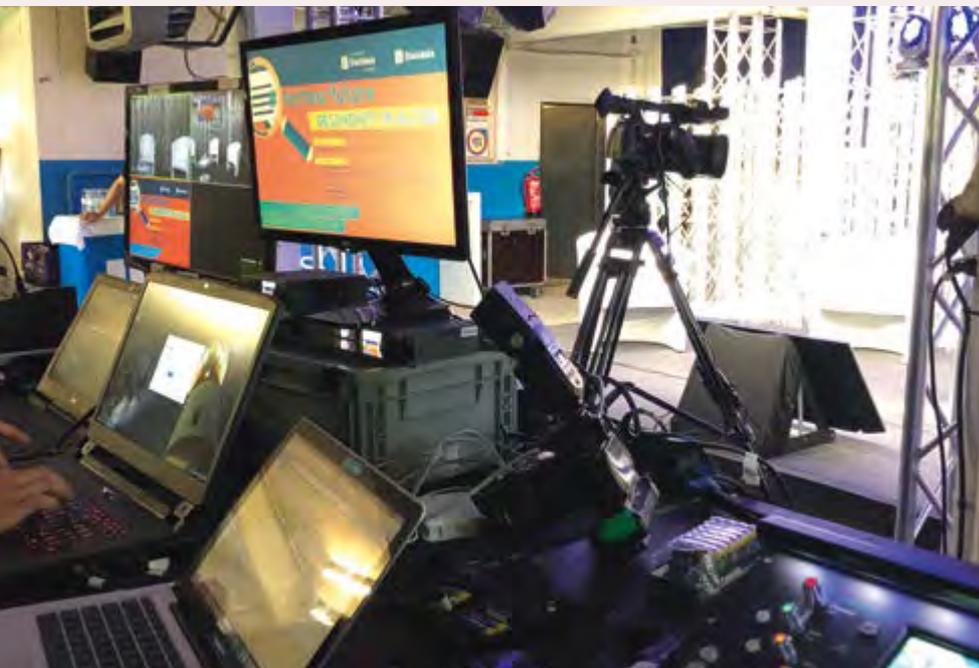
"At a time when all the talk is of the COVID-19 app in Germany, but it's not on every cell phone or being used by everyone, it makes you realize how important it is to be able to get a detailed picture of the possibilities and progress offered to healthcare by digital technology. That's why my interest was immediately piqued by the event, and its emphasis on the IoT – or the IoMT, the internet of medical things – and AI in medicine. The online approach made it uncomplicated for me to take part and the whole event was free from COVID-19 risks! The talks exceeded my expectations," says one participant about the series of events.

TRACK A: HEALTHILY NETWORKED

The first topic of the #techourfuture weeks on the future of healthcare was Healthily Networked. Professor Dr. Sascha Seifert, who lectures on pharmaceutical medical computer science and bioinformatics at Pforzheim University, explained how wearables such as bracelets and smartwatches work, allowing wearers to measure their own vital signs and monitor their health. The term "wearables" also refers to medical devices, however, such as hearing aids and heart pacemakers, which are increasingly being connected up with one another through the internet of things.

GETTING A GRASP OF TECHNOLOGY

The aim of the Technologie*Begreifen project sponsored by the Baden-Wuerttemberg Ministry of Economic Affairs, Labor, and Housing is not only to share what is called "linear knowledge" of future technology, but also to make current and future applications more tangible for the population – and to get people talking about them. Experiencing technology through a standard PC, laptop, or smartphone certainly has limitations at the moment. Nonetheless, even online there were lively discussions, an indication that there is a need and interest in actively thinking about future technology.

Given the current status of technology, the only senses that can be used to perceive what is happening are sight and hearing (although the next #techourfuture event may require use of the taste buds), but hopefully it will soon be possible to allow future technology to be experienced in a more realistic way again, in a more fitting setting. After the past events on the future of autonomous flying and the future of healthcare, #techourfuture enters its third round in the fall by focusing on the topic of The Future of Nutrition – Looking Beyond the Horizon. Why not join us as we examine in detail the future of nutrition, personalized and gene-edited food products, and meat from the laboratory.

Developments in the field of artificial intelligence are becoming increasingly useful for physicians in making therapy decisions. Dr. Tobias Preckel, a medical technology expert at Pforzheim University, explained how far self-learning diagnostic assistance systems had already come in providing important help in the everyday life of doctors, especially in the field of oncology.

TRACK B: O.R. 4.0 AND FORECASTING PANDEMICS

The series of events continued with the topic of O.R. 4.0 and Forecasting Pandemics. The emphasis during this part lay in the role played by robots in surgical procedures. Professor Dr. med. Stephan Kruck, Head of Urology at the Center for minimal-invasive Therapy and Urological Robotics at Siloah St. Trudpert Hospital in Pforzheim, provided the participants with a number of insights into the "intelligent O.R." and gave an enlightening talk on the conditions under which robots are already used in the O.R., as well as the advantages they offer. Professor Dr. Raphael Volz, who lectures on applied computer science at Pforzheim University, then introduced the models that are used to predict case

numbers arising from the COVID-19 pandemic, as well as application examples and their limitations.

TRACK C: EVERYDAY HEALTHCARE

For the final event, attention turned to everyday healthcare. This part of the series was moderated by Stefan Lob, a systemic coach and managing director of consulting firm Praxis für Führung – X.0. To do this, Lob invited five experts to present current trends in the fields of telemedicine and robots used in nursing.

Dr. Matthias Proske, Director of the Northern Black Forest Regional Association, and Professor Dr. Joachim E. Fischer, Director of the Mannheim Institute of Public Health, Social, and Preventive Medicine at the University of Mannheim, drew on their experience with the Digital Black Forest citizen participation program and described the particular demands of providing healthcare services in rural areas, as well as the help offered by digital solutions. Surgeon Angelika Walliser presented a number of actual telemedicine cases she has consulted on in recent months as part of the docdirekt project, including a patient from the Chinese city of Wuhan.

Dr. med. Thomas Wüst, who runs a private orthopedic practice, explained how holistic patient care can be improved by using recently developed technology. Matthias Struck, deputy head of smart sensing and electronics at the Fraunhofer Institute for Integrated Circuits in Erlangen, concluded the event by examining the role played by sensors and robots in day-to-day patient care: Robots are already in a position to enable new interactive approaches to the therapy of children with limited emotional abilities. In the future, there could quite conceivably be assistance systems for patients with dementia, believes Struck.

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POINTS OF VIEW

What impact does emerging technology have on healthcare and medicine?
We asked different participants of the #techourfuture event for their opinion.

Katrin Tomaschko | e-Health expert at AOK Baden-Wuerttemberg
"Digital solutions shouldn't just be used for the sake of it, but only when there's a real opportunity to improve care."

Jonas Sewing | Director of the Diakonissen Foundation Hospital in Speyer
"Running a hospital will be significantly different in the future compared to the way it is in 2020. The advent of robots will be particularly noticeable, whether that involves autonomous nursing carts or humanoid robots. Health workers will be given new tools to manage everyday tasks. So it will be particularly important to gain the buy-in of patients and staff."

Dr. Christiane Kohler-Weiß | Head of Theology and Education, Social Welfare Services
of the Protestant Churches in Wuerttemberg
"Digital transformation offers a diversity of opportunities to social services. Digital technology can make people who require care feel more confident about taking charge of their lives, encourage more people with disabilities to get involved, lighten the load on nursing staff or family members caring for relatives, and make processes more effective."

Prof. Dr. Dr. Sabine Meck | Steinbeis Entrepreneur at the Steinbeis Transfer Institute for Personality Research and Ethics
"The digital revolution presents all stakeholders with significant ethical challenges, particularly the provision of healthcare services. As a result, one of the major tasks of ethics may be to think about the dignity and well-being of people, just as much as the importance of trust, which is fundamental to health – which means the physical, mental, and social well-being of the individual."

Prof. Dr. Jörg Hübner | Managing Director of Protestant Academy Bad Boll
"Whether AI becomes a curse or a blessing depends on what we do with the technology and how we shape and influence it! Society still bears a responsibility for managing this technology, as does the individual."

Dr. Dietmar Merz | Director of studies for medicine and healthcare policy at Protestant Academy Bad Boll
"It would surely be wrong to categorically reject every example of progress in the field of digital tech. But I find it equally wrong to simply go along with every step of modernization without checking or challenging things. What matters for me is asking what is really useful for life and people."

→ More on this topic: **https://bit.ly/2X2WglU**

"IT'S IMPORTANT THAT EVERY INDIVIDUAL IS GIVEN A CHANCE TO GET TO KNOW A TECHNOLOGY"

AN INTERVIEW WITH STEFAN LOB, CEO OF PRAXIS FÜR FÜHRUNG – X.0 GMBH

It's no secret that despite the opportunities offered by new technology, some people fundamentally distrust it. Even if many people would not feel averse to innovation in the healthcare industry, they still have reservations. Stefan Lob, CEO of Praxis für Führung – X.0, talked to TRANSFER magazine about different ways to deal with skepticism and why critical discussion in this area is actually helpful. For some years now, Lob has been working with startups that introduce digital technology to healthcare and domestic use with the aim of linking up patients, doctors, and service providers. Lob moderated the Everyday Healthcare track at the second #techourfuture event on the future of healthcare.

Hello Mr. Lob. Why do you believe it is important to inform society about future technologies?

Digital solutions are entering more and more into our lives, across all age groups, professions, and private areas. So in Germany we need to find ways to bring as many people on board with digital transformation as possible and, importantly, gain their trust – although of course everyone will need to do things at their own speed. That's a huge challenge. But it also means we have to look at the topic from a critical angle. I think it's important to consider the fact that there are different groups of people within society, with different interests, but also different experiences of using technology.

What prejudices do your hear about new technology in the course of your work?

My job has involved working with a lot of suppliers of healthcare services – from nurses to physicians; we help them with digital transformation. In specific terms, this means for example that we develop small digital devices for communicating between different nursing personnel and people working in outpatient care, but also software that paves the way for telemedicine and televisits – communication between patients and doctors. The people who provide services, i.e. the nurses and doctors, are generally very positive about things, but we also hear criticism, for example when it comes to storing data safely. But similarly, patients also have their reservations. When I'm a patient, not only do I see benefits in having digital case files, which people like physicians or physiotherapists can look into. It's not a possibility that was open to us until now, except in big hospitals where

they might have several groups of specialists working together. But just like lots of other patients, I do have concerns about data privacy. What would happen if my personal data fell into the wrong hands? It's important that every individual is given a chance to get to know a technology and weigh up the opportunities and threats. It's important to give people support, but we also need to think about their misgivings. But we need to be honest and tell people that there's no such thing as 100% safe. We can try to make things 99% safe, and with some forms of technology that is possible.

We're currently working on a project with the Protestant social services in Baden, involving the development of a kind of WhatsApp service for people who need care, their relatives, and outpatient nursing providers. We're specifically addressing the requirements of people in need of care and their relatives. Currently, 75% of all nursing support in Germany is provided by relatives at home, with or without the support of outpatient nursing providers. Naturally that brings up lots of questions, from all angles, and that's something WhatsApp can help with. Despite this, lots of people are averse to using a service that came from the United States rather than

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a European supplier. That's where we come into play with our development services, which allow us to focus closely on the desires of the user.

Do people worry about things like technological breakdowns? Do you get the impression that people trust technology less than people?

I think it's less to do with technological breakdowns and more to do with people's lack of technical experience or previous negative experiences with technology. If we take telemedicine as an example – where despite trying several times to set up a video link, everything goes wrong because there's not enough bandwidth, so the only way for the doctor to speak to the patient is on the phone – it's quite possible that a patient won't want to make use of telemedicine any more. Technological setups are extremely important. And sometimes, especially with older patients, you need someone to explain the technology to them and how to use it. This has been underscored by experience with other projects.

Which new technologies in the field of health and medicine would you use yourself, or at least accept?

And which would you perhaps reject in certain areas?

If we stay with telemedicine, I've often used it myself. I work for the emergency services and we regularly have cases where we're with a patient and the telemedical emergency doctor gets added to the conversation by the control center. Because we can interact with one another, even if the emergency doctor's not actually there in the room, we can treat the patient better and connect with them. I've also had my first positive experiences with the use of robots at inpatient nursing facilities. And there are further new developments in the field of surgical technology, etc. Of course we have to make sure the new technology doesn't result in patients not being able to book appointments, or having more difficulty finding time with a doctor they trust or a specialist. Sometimes you really need to talk to somebody personally, not on a screen.

I think receiving help from telemedicine and digital technology will allow us to make healthcare services more effective. Digital transformation will enable us to change lots of processes, so that people who are available will be given more time to work with patients

– I'm convinced it will. I also believe that digital solutions will help us provide good healthcare services in rural areas. I strongly believe that digital solutions in this area are more of an opportunity to us than a threat.

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"I'M CONVINCED TELEMEDICINE WON'T BE A SUBSTITUTE FOR VISITING THE DOCTOR, IT'LL COMPLEMENT IT"

AN INTERVIEW WITH ANGELIKA WALLISER, GENERAL PRACTITIONER, SURGEON, AND HEAD OF REUTLINGEN EMERGENCY ROOM

Have you ever consulted a doctor as a telemedicine patient? Or do you have your doubts about telemedicine? Do you see telemedicine as a good way to provide medical services in rural areas and deal with doctor shortages, or do you feel strongly that doctors and patients should meet personally to provide proper treatment? TRANSFER magazine talked to Angelika Walliser, who runs her own doctor's office in a rural area, about telemedicine, the new options it opens up to us, but also people's reservations. Since last year, Walliser has been taking part in the docdirekt pilot project in Baden-Wuerttemberg. She talked about her experiences with the project during the second #techourfuture event.

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Hello Ms. Walliser. Why do you believe it is important to inform society about future technologies?

It's tremendously important. Progress can be unbelievably quick sometimes and overtake us on the outside rail. Patients have to find things out for themselves if they want to stay up to date. That's not something we can help with as doctors during consultations. So it's really important that patients get to know modern technology and start using it. For example, we're already seeing what's becoming possible during video consultations or over the phone when it's not possible to reach a doctor or receive medical care immediately.
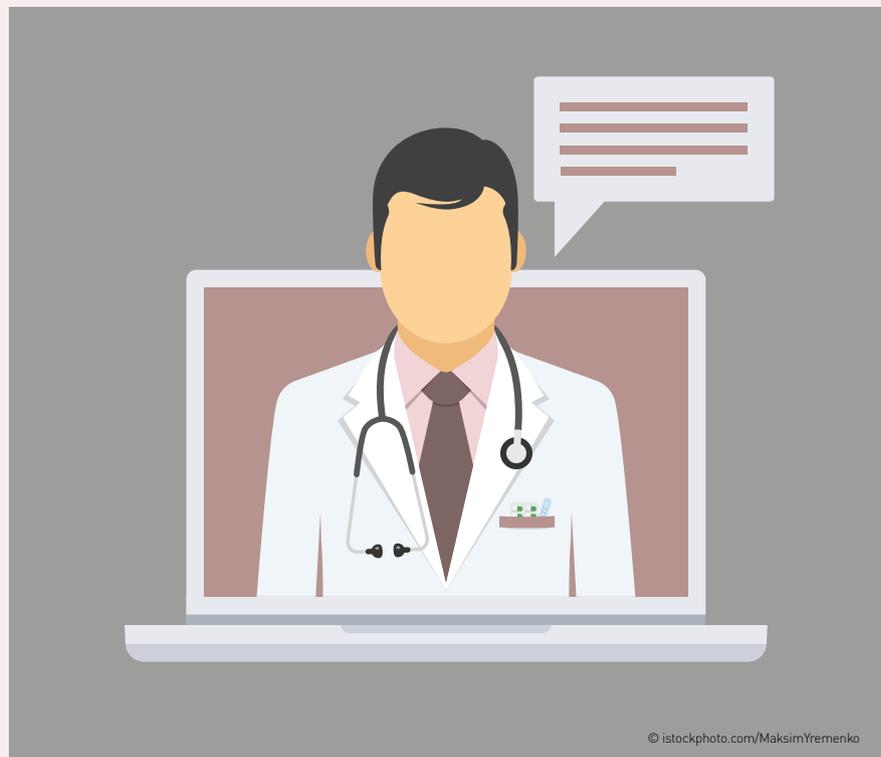
What prejudices do you hear about new technology in the course of your work?

I've been taking part in the Baden-Wuerttemberg telemedicine pilot project – docdirekt – for one year now. In conurbations, it's often difficult to quickly find an appointment with a doctor, and in ru-ral areas you have to travel long distances. It can be quite worrying for patients. Is my complaint urgent, or can it wait? Should I go to the hospital right now, visit a doctor's office as soon as possible, or should I wait? Understanding such questions and weighing up the situation can be extremely difficult for patients. Using telemedicine is a pretty good way to assess such issues. The patients that have already used the docdirekt service have given us positive feedback. But

IT'S IMPORTANT THAT PATIENTS GET TO KNOW MODERN TECHNOLOGY AND START USING IT.

of course it will still take a year or two to see how the patients who used the telemedicine service did afterwards. One issue that will need clarifying is how many patients actually went to see a doctor afterwards. Another is who has access to certain information and were there any problems with data privacy. That said, this is a data protection issue they have in all medical practices.

Of course people have reservations, but that's what happens when something new comes along. People are used to holding on to things they trust. The reservations I hear people express in the course of my work as a telemedicine provider are often quite straightforward. You just have to tune in carefully to patients and examine them properly to understand how to help them on the phone or via video. Of course sometimes people have an illness or symptoms that you can't simply clarify through a video call, for example something like chest pains. You need a stethoscope and usually lab backup and an ECG. But in lots of cases treatment via video call works quite well, for example if someone needs to treat a wound or they have a cough or cold. The way the consultation or treatment works is that the patient describes his or her symptoms on the phone and if necessary makes sure they have a picture or video. But of course it's also important to ask the right questions. With docdirekt, the first questions are posed by medical specialists who work for the association of statutory health insurance physicians, and it's they who decide whether to call a paramedic or whether a patient should be taken straight to the hospital. Of course

people have reservations that the patient might be misunderstood during a telemedicine consultation, but that can also happen in the doctor's office. In my experience, telemedicine sessions typically take longer than they would face to face. One thing I noticed during the coronavirus pandemic is that patients have taken well to the service. They've realized that there are lots of things that can be done over the phone. The current pandemic has played an important role in getting patients to accept new technological possibilities open to us.

Are there any other technological developments you could imagine making their way into the everyday business of doctors?

Lots of patients measure their oxygen levels, temperature, or blood pressure themselves. It would be useful if this information could be sent automatically to their doctors. Especially now with a pandemic going on, it would have been important to keep an eye on their measurements and raise the alarm if something doesn't look right. Or doctors could ring patients if they see that their measurements are beginning to worsen, because often patients don't notice that themselves. That would really lighten the load on doctors.

Which new technologies in the field of health and medicine would you use yourself?

I'm fundamentally open to new developments. I like finding out more about them and then I decide if I'm either for or against them. But of course patients also have

their doubts about certain things and they're worried they'll only be treated remotely, but I'm convinced telemedicine won't be a substitute for visiting the doctor, it'll complement it. I already have patients in my medical practice that I speak to on the phone. So there's not actually anything new about the idea. The only thing that's really new about docdirekt is that we treat patients we don't know, whereas when you're running your own practice, you're on the phone to your own patients. With your own patients, you know their medical history, whereas with docdirekt patients you don't have that previous knowledge. That's new.

One thing that's also really exciting is remote medical emergencies. The telemedical emergency doctor helps the paramedic remotely. This is really important because there aren't that many emergency doctors anymore. Data is transmitted to the control center at the Red Cross, for example ECG readings, and then the emergency doctor decides there and then which drugs should be administered and what the paramedic should do next.

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"PEOPLE HAVE BEGUN TO UNDERSTAND THAT WE CAN USE TECHNOLOGY TO ADD NEW VALUE"

AN INTERVIEW WITH MATTHIAS STRUCK, DEPUTY HEAD OF THE DEPARTMENT IMAGE PROCESSING AND MEDICAL ENGINEERING AT THE FRAUNHOFER INSTITUTE FOR INTEGRATED CIRCUITS IIS.

A T-shirt that measures your heartrate, shoes that count how many kilometers you've walked, a fitness tracker that monitors your sleep – these aren't visions of the future anymore, but reality. TRANSFER interviewed Matthias Struck, who spoke about robots in nursing at the second #techourfuture event, on the opportunities and challenges that these developments present, and why seeing your doctor face to face is still essential in times of AI. Struck's research at the Fraunhofer Institute for Integrated Circuits focuses on developing technologies that can be integrated into domestic environments to record, analyze, and network health-relevant vital signs on an everyday basis.

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Hello Mr. Struck. What challenges does digitalization pose for your work, particularly in medicine and medical technology?

We're a department for image processing and medical technology as part of the Smart Sensing and Electronics division. Our work revolves around three major medical technology topics. One, medical sensors. This is all about how to record and evaluate people's and patients' biosignals on an everyday basis. Two, artificial intelligence. We combine sensor data and evaluate it in detail to provide a basis for forecasting. Three, medical data communication. This is about tackling the question of how to send data from domestic settings to GPs, from GPs to specialists, from specialists to hospitals, and so on. We're focusing on all-round solutions so that ideally, data can be exchanged in a standardized format.

Why do you believe it is important to inform society about future technologies? What kinds of things need to be taken into account?

That's a very important question, thank you. I think it's tremendously important to keep society informed about these topics. What potential does artificial intelligence offer, and where do its limits lie? By setting clear boundaries, you can also offer people more security. In Germany people can be particularly skeptical about things; they worry about the "transparent patient." But illuminating everything about someone isn't the aim of artificial intelligence in medicine. Rather, the aim is to help doctors make better diagnoses and select better treatments. Everyone knows that doctors are only human. And wherever humans work, mistakes happen. With the aid of artificial intelligence – which can evaluate and analyze huge amounts of data, then apply the results to other patients and com-pare these results with the patients' disease progression – we can succeed in reducing error rates. This is the value that AI adds.

Do you think people are less tolerant toward technology or people?

I definitely don't think that AI will cause patients to lose trust in their doctors, because AI isn't intended to replace doctors. It's there to support them and to ask additional questions and suggest additional options in the background, such as whether any further differential diagnosis would be advisable. Its purpose is to ensure that nothing is overlooked. In the future, doctors will continue to make their diagnoses in person and explain them to the patient in person.

What prejudices do you hear about new technology in the course of your work, and how do you deal with them?

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THE AIM IS TO HELP DOCTORS MAKE BETTER DIAGNOSES AND SELECT BETTER TREATMENTS.

Data protection is of course an extremely important issue. If users and patients are going disclose sensitive information about their body and physical condition – and thus of course about potential illnesses – then they need to be sure it will be handled carefully. Most of all, we need to ensure that it's patients who decide what information can be seen by whom (which people and doctors), when, and why – and that their information is not misused. At Fraunhofer, we take this aspect very seriously. For instance, we have systems that use images to analyze people's faces and judge their emotions – whether they're sad, angry, frightened etc. – in real time. This is of course very sensitive information – for example, it could reveal that a particular person is often in a bad mood, which could be an indicator of depression or burnout. So we've developed privacy-by-design technologies to ensure that any images linked to individuals and their names is immediately deleted again as soon as the analysis has been performed, so that only the result is then disclosed. We do the same when recording biosignals like blood pressure and heartrate. This data is encrypted so it can't be viewed by third parties and only authorized individuals such as doctors can access it. I think Germany's strict data protection regulations mean that people are much more willing to trust German companies than, say, American ones, which handle data a lot less carefully. I also think that acceptance of such applications has risen in recent months due to the coronavirus pandemic. People have begun to understand that we can use technology to add new value.

At this point, it's important for me to re-emphasize that technology cannot replace face-to-face contact in person. But especially right now, in the midst of a pandemic, we're subject to certain restrictions and requirements, such as visits to care homes being reduced or forbidden. This is where technologies like Skype allow us to continue to see our families and interact with them in real time. But I don't think they'll be a "substitute."

Which new technologies in the field of health and medicine would you use yourself, or at least accept, and which would you reject in certain areas?

I'll start with the latter: Personally, I don't like having the feeling that I'm being monitored 24/7 without it being strictly necessary. I don't want to wear a T-shirt that measures my heartrate and blood pressure around the clock. I want to decide things like that for myself and be independent – without my data continually being recorded. So I can understand why people are skeptical of certain technologies. However, I'm very fortunate in that I rarely need to visit the doctor – I feel healthy and hopefully I am. But if I start noticing that that's no longer the case, I'd be the first to use health and medical technologies because I know the value they add. For instance, vital signs measured in a domestic setting are more telling than those measured at the doctor's. At the doctor's, I always have high blood pressure when I see people in white coats – I'm in an unusual environment and it stresses me. So high blood pressure readings in this situation are less relevant than if they're taken at home. Medical technology also provides a lot more data, and continuous data; at the doctor's, you only have a one-off measurement, and we've all had an off day on the day we saw the doctor – that doesn't mean you're ill. This is where technology offers us lots of opportunities.

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"DATA MUST BE PROPERLY PROTECTED"

AN INTERVIEW WITH PROFESSOR DR. TOBIAS PRECKEL (STEINBEIS TRANSFER CENTER FOR MEDICAL ENGINEERING & LIFE SCIENCES) AND PROFESSOR DR. SASCHA SEIFERT (STEINBEIS TRANSFER CENTER FOR E-HEALTH SYSTEMS AND MEDICAL INFORMATICS)

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Artificial intelligence, big data, the cloud – digital transformation is now also happening in all areas of medicine. But what will it mean for patients? And what role will data protection play? TRANSFER magazine spoke to Professor Dr. Tobias Preckel and Professor Dr. Sascha Seifert, Steinbeis experts in the digitalization of medicine, and discovered how important it is for medical advancements to gain public acceptance and how all stakeholders have something to gain by linking up technology and data protection.

Hello Professor Preckel, Hello Professor Seifert. Digital transformation and other kinds of technological innovation are accelerating the rate of progress in medicine and medical technology. How exactly does this development impact your work?

Sascha Seifert:
In essence, it's actually what my work is all about as a medical computer scientist and bioinformatic specialist. And digitalization is a given in my work per se, because it's about digitalizing medicine. On the one hand it's about helping with diagnosis in the future by using computers, but also smartphones. But on the other hand, it's also about things like making systems available to hospitals by offering digital solutions – systems that help them with decision-making. The second area is bioinformat-

ics. The current trend in this area is taking us away from time-consuming molecular diagnostic testing, using real samples, and trying instead to work first with models on computers. This is similar to what they do in the automotive industry, where first you create a model and conduct and evaluate it, before you build and test a real car.

Tobias Preckel:
That's also how I see it. Previously, you basically tried to study the biochemistry or development of a disease by examining individual metabolic pathways or specific molecules and their corresponding partners. These days, due to the availability of information and data processing systems, we tend to use a

more systematic approach. You try to spot correlations by looking at the data that's already available from different sources, and draw conclusions that way. We're moving away from detailed experimentation with individual components, so we're adopting a systemic approach by trying to develop models in advance – before embarking on elaborate investigations. Coming back to your question regarding the actual impact digital transformation has on my work, I'm more concerned with looking into the possibilities offered by digital solutions in areas such as diagnostics. DNA analysis and investigating the risk of disease based on DNA sequence would be impossible without digital technology. It merges several developments at the same time, especially when it comes to personalized medicine.

Why do you believe it is important to inform society about future technologies in the field of medicine? What kinds of things need to be taken into account?

Sascha Seifert:
I think it's extremely important because medicine will be driven by more technology in the future. The population is aging due to demographic trends. This means the number of people who will need medical support will rise, and this could lead to a drop in medical standards. But we want standards to stay the same. The question is: how? By introducing digital solutions, by avoiding the need to repeat medical examinations, and by ensuring that assessments or diagnostics are conducted more quickly or improve in terms of quality. So that means more and more use will be made of technology to keep the healthcare system on the same level it's on today, and maybe even improve it and make it less expensive. As things stand now, I see no other way forward.

Tobias Preckel:
I also think it's really important to keep people informed when it comes to new technological developments in medicine so you gain public acceptance. And

I think the main focus in this respect will lie in the central storage of patient records. These days there is a trend towards instrument-based diagnosis and our billing systems are set up in such a way that the acquisition and analysis of the patients' medical history is hardly being paid for, if at all, and it's the use of diagnostic systems that earns the money. So as a result, doctors are motivated to – whenever possible – use and apply their own diagnostics. But the result of this is that there's not only too much diagnosing going on, but also for example the diagnostic results of different doctors' offices are not being pooled. That's why I think there's a lot to be gained by storing patient records centrally. It would cut costs and improve the quality of diagnoses. And it could help avoid false diagnoses, because people would simply have access to more information.

And this is where I think things like artificial intelligence come in as a supportive instrument. There are plenty of

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examples of patients being admitted to hospital with acute symptoms and one of the first things they're asked is, "Is there a history of any conditions in your family? Is there anything we need to know?" In such a stressful situation patients are prone to forget that there's an increased tendency of increased blood coagulation in the family. If such conditions aren't reported and treated prophylactically, in the worst-case scenario you'll get thrombosis. These are the sorts of risks that can be avoided if you store information centrally.

Turning to you, Professor Seifert, you deal with the internet of medical things, i.e. cloud and big data applications. What opportunities do these technologies offer, and what obstacles do you face?

One of the biggest difficulties at the moment is gaining public acceptance. In Germany, we tend to suffer from techno-fear. This is something we need to tackle – consciously.

In terms of the opportunities, one aspect is that we're extremely sensitive when it comes to data privacy protection. This is a major advantage for us. The perfect example of this is the coronavirus app. In Germany, we came up with a solution that is marveled at throughout the world because it found an excellent way to implement the technology and data privacy. I think Germany's extremely strong in both of these areas and it has a good chance of being successful with this internationally.

And you, Professor Preckel: There's a growing trend toward individualized medicine. What conditions need to be met for this vision to become reality?

There's one aspect I find particularly important in this area, namely decentralized diagnostics. The way things work at the moment, with lots of indications, samples have to be sent to a big centralized laboratory. What that means is that there may be journeys happening, but also the diagnostic processes are centralized, which certainly offers cost benefits. But I could imagine that if you want to have more individualized healthcare, it would also make sense to carry out certain diagnostic examinations directly in the doctor's lab. There are already a number of startups and a large number of providers of diagnostic services developing smaller devices capable of analyzing samples automatically using cartridge systems; users don't need to do much themselves. I could certainly imagine such solutions becoming a growing trend.

Finally then, a more personal question: Which new technologies in the field of health and medicine would you use yourself, or at least accept, and which would you reject in certain areas?

Tobias Preckel:
One thing I think would be really useful – and I could imagine using it myself – would be something like an app that uses my personal health risk profile to suggest certain things and help me take prophylactic action.

We could use the problem with increased blood coagulation as an example. If I knew there were certain risks for me, in this case the heightened risk of blood cloting, I could use an app that would regularly remind me to exercise or drink an extra glass of water. Something I'd be skeptical about would be sending a sample of my DNA to a company to create a personal health risk profile for me or work out my genealogy, especially if it were in a country where they don't have proper data protection regulations.

Sascha Seifert:
I feel the same way. I'll take the example of electronic patient records. I think it's important that patients are promised more transparency when it comes to their personal information. For example, I can't remember if I was taking medication five years ago. I think it would be really useful if there were some kind of centralized tool. I'd have no problem with going through past entries with my doctor and looking for connections to see if perhaps an illness I had or a drug I was taking twenty years ago might be affecting my current health. But data must be properly protected.

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"PEOPLE WILL ONLY START TO TRUST FUTURE TECHNOLOGY IF THEY'RE KEPT INFORMED, THEY'RE EDUCATED, AND THEY'RE OFFERED TRANSPARENCY"

AN INTERVIEW WITH DR. MED. THOMAS WÜST, SPECIALIST FOR ORTHOPEDICS AND SPORTS MEDICINE

The key task of an orthopedic surgeon is to promote the development of the musculoskeletal system and to treat degenerative conditions. This task remains the same in times of digital solutions, although increasing use is now being made of new technological options. What those options are, why it's important to educate people, and how patients and physicians stand to benefit from emerging forms of technology were just some of the questions TRANSFER magazine asked the #techourfuture expert Dr. med. Thomas Wüst.

Hello, Dr. Wüst. Can we start by asking why you think it's important to keep society informed about future technology?

You can't do away with fears, reservations, preconceptions, and people rejecting useful and relevant medical technologies of the future if you don't provide objective information. You have to clearly formulate and communicate the meaning and purpose of using them. People will only start to trust future technology if they're kept informed, they're educated, and they're offered transparency. It's important to clearly show the benefits for people, patients, and society as a whole.

Speaking as a physician, an orthopedist, there have been major advancements in orthopedics over the last 20 to 25 years, especially in technological terms. And that's why it's always been important to deal with certain reservations and certain fears held by patients by talking about things. We will continue to experience huge leaps forward in technology in the future, due to digital transformation and artificial intelligence. So it will become all the more important to allay people's fears and to clearly show them the opportunities this offers. We have to explain in plain terms why we're doing what, and the consequences this will have. The other important aspect is that as physicians, new technology saves us

time so we can invest this "bonus time" in patients. I'm lucky in that I run my own practice, precisely because I want to give that time to patients. But patients generally spend an average of three to five minutes in the orthopedist's consultation room. During this time, we should go through medical records, conduct a clinical examination, and if possible even make a diagnosis, which if you're realistic is pretty difficult. This is where new technology could help us as doctors, but it also means that we need to invest time and effort to ensure we're familiar with this technology. But ultimately this does save us time, because for example we can be specific and provide quick information on our assessment or diagnosis – time we can invest in patients. And this raises patient satisfaction. It also makes treatment successful, because patients have trust in the physician and this leads to a good physician-patient relationship.

To consult patients properly, you need a good understanding of the

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very latest status of technology. How do you integrate that into your work if your day is already full, especially as a doctor with his own practice?

This is a really exciting topic. It is indeed a greater time investment, especially at the beginning, but looking back, overall it takes up less time. To work, a doctor needs effective structures and, extremely importantly, a good and motivated team. Your co-workers should enjoy trying out new things. We've just hired a sports scientist who's already spent time looking into artificial intelligence, which is helpful for everyone in the team.

It's important to make proper use of the interests and knowledge of every individual in the team. I believe that if you think together as a team and work across different disciplines, that already solves lots of problems. Working as an individual, I can only really manage a small part of the picture. Things

really do work better as a team – and quicker.

What prejudices toward new technology do you hear about in the course of your work?

I think lots of prejudices and fears about this topic have something to do with the concept that medicine can be something cold and alienating. These times are already fast-moving, and then the doctor spends much too little time going through medical records and conducting an examination – to save time. It's quite common for medicine to be accused of being mono-causal or only about symptoms. If you then add the fear that in the future, doctors will allow themselves to be "driven by machines," people have major reservations and the doctor-patient relationship starts to break down.

This is another area where it's important to educate patients. Many patients are

worried about the high costs of technological diagnostics, which are not met by the insurance companies; from my experience this is unnecessary, and if anything the opposite is true. Compared to other European countries, German patients are known to be more critical when it comes to new technology. This also seems to have something to do with the lack of connections between different services. We have to make it clear to patients that doctors will still be crucial and irreplaceable in the future, and by using new and efficient technology they will have more time for patients.

One thing we already do in my practice is to use the options offered to us by telemedicine. It's of paramount importance for the patient that you have an efficient approach to therapy. Digital solutions, telematics, and electronic patient records enable us to obtain and interpret information about patients anywhere we need to, in real time, and discuss this with different contacts. The recent pandemic has fueled this development because there's a greater willingness among the population to try out telemedicine due to current circumstances. But also in areas with a weaker infrastructure, where doctors are in short supply, telemedicine offers us an opportunity to keep the healthcare system running. Despite this, patients should always be given the choice of organizing a telemedicine session or speaking to somebody face to face. Naturally, telemedicine also has its limitations and that's something everybody needs to be aware of.

Another important issue when it comes to reservations is data privacy, although some good solutions have now been thought up for this. Of course patients initially have concerns when doctors look at their records. It's important to explain to them that they decide which doctors should be allowed to see their records. Another point I find extremely important in this context is electronic

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YOU CAN'T DO AWAY WITH FEARS, RESERVATIONS, PRECONCEPTIONS, AND THE REJECTION OF USEFUL AND RELEVANT MEDICAL TECHNOLOGIES OF THE FUTURE WITHOUT OBJECTIVE INFORMATION.

patient records. Patients can keep their information with them all the time – on all factors that are relevant – and this gives them more freedom to decide themselves.

Which new technologies in the field of health and medicine would you use yourself?

All of the things I just mentioned have an impact on me, too. If I'm a patient myself, I always try to get into direct contact with a doctor's office, with the people there, to establish a relationship of trust.

Something I personally find fascinating is the possibility of using digital technology – or to be more specific artificial intelligence – to make even more accurate diagnoses.

We've been working with the Fraunhofer Institute in this area to use AI solutions to evaluate gigantic volumes of data with

the specific aim of understanding a certain algorithm. We're dealing with patient records here, so it's important to explain to patients how information is being used, so they give us their consent and ultimately allow us to use their data.

Something that really interests me is analyzing movements of the human body from a holistic standpoint. This allows us to show how people move around when they walk – without having to X-ray them: the back, the position of the pelvis, leg joints, and footprints moving together in synchrony. This allows you to look at complex interactions and evaluate them accordingly. And this is exactly where we also want to use artificial intelligence: Doing something like this involves unbelievably large volumes of data, which we previously interpreted by relying on our experience, and we had to invest a huge amount of time just for this part of the process. In the future, evaluating this information will become

more insightful, accurate, and quick. It will be a holistic method that can be used on an interdisciplinary level. The process will show upward and downward influences on posture. Dentists and orthodontists will also play an important role. And the feet will be important, as well as the eyes and the inner ear. There are so many medical specialists involved in such an analysis. I find that incredibly exciting.

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STEINBEIS NEWSLETTER

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THE LIMITATIONS OF PRODUCTION

STEINBEISER PROF. DR.-ING. MARTIN KIPFMÜLLER DISCUSSES POSSIBLE SOLUTIONS TO THE CRISIS

Manufacturing has always adhered to similar rules, ever since the Industrial Revolution. Raw materials are taken and processed, using energy to convert them into products. The value this adds – the value added – is attributed to the company that sells the product. The value added is then invested in new production facilities and workers are paid wages, who in turn are able to buy products themselves. This upward spiral is currently turning slower and slower, argues Steinbeiser Professor Dr.-Ing. Martin Kipfmüller. In our latest Steinbeis Swipe! he suggests ways to get things moving again.

The circles of production until now were successful in fueling amazing levels of affluence, because they usually met some important prerequisites: There were sufficient raw materials and energy in place to raise production levels. So the number of products that were purchased kept rising. And the global population grows continuously, also fueling the demand for products. Perhaps more importantly, however, because people make products, they earn money, which they can then use to buy products themselves. To meet this growing demand, manufacturers churn out even more products, continuously striving to use less money to do so, for example by automating processes and saving money on workers. So long as the market

continues to grow, those workers won't necessarily end up unemployed (and disappear as customers); they just find work elsewhere. And this generates even more value added.

Presently, however, the German economy finds itself in a situation whereby fulfilling these conditions can no longer be seen as a matter of course. Raw materials and energy are becoming scarce, which makes everything more expensive. Measures introduced due to COVID-19 have destroyed value in the products bought by customers, making it likely that there will be a noticeable slump in sales in the coming years. And there's another new development fueled by the scarcity of resources. Because more and more drivers are switching to electric cars in parallel to this trend, German industry is relinquishing essential value added as a result of the coronavirus, in a core area: carmaking – or to be more specific, making engines and lots of other technologically demanding components in the powertrain.

So what can be done about this dilemma? Allow me to begin with the most tangible part: the crisis in German mechanical engineering. At the beginning of the Industrial Revolution, there was an uprising of weavers in Silesia, a signal that the spinning wheel of progress

could never be turned backward. In fact whenever emerging technology bursts into a market, it squeezes out old technology and sources of profit. This is one of the reasons why mechanical engineering firms in the automotive industry should always be on the lookout for new applications for their products, or more importantly: new products. We're very unlikely to witness a renaissance of the combustion engine.

Several major companies are leveraging their ability to make high-precision production machines to move into 3D printing – but that will never absorb an entire sector of industry. The know-how available in the industry may point to another way out, however. Similar to developing and producing robots, developing and making machines involves mastering the complex interplay between control units, drive technology, and mechanical systems – systems that epitomize product performance. So both fields – production machines and robots – involve the ultimate challenge: mechatronic systems. Japanese producers are already employing the same control and drive technology to make products in both areas – and are making a very successful job of it. A similar approach could pave the way for German mechanical engineering firms to enter the continually expanding market for robots and automation technology.

An initial stepping-stone technology could be milling robots, which you encounter in many areas. But this would still not be enough to replace crumbling markets. There is more and more potential to be found in robot applications inside and outside the factory floor – i.e. anywhere where doing business has been unprofitable until now due to the level of complexity, number of variants, or small batch sizes. Also, there are tasks in logistics that until now have been supervised by human beings for security reasons. First and foremost however, a lot more needs to be done outside factories, for example out in the fields, where we are hugely dependent on seasonal workers. Of course it's not worth keeping a machine on hand that only digs up asparagus for a couple of weeks every year, but could the same machine be used to harvest grapes in the fall? And couldn't this machine be owned by a cooperative that would hire its asparagus-picking or grape-harvesting device to farmers?

In the area of care for the elderly, sick, or disabled – where nursing can often be physically strenuous – exoskeletons could be used to get people moving again, and safe robots could help carry people, provide them with support, or move them to different beds.

When cleaning buildings and machinery, there are different ways to use robots for wielding vacuum cleaners, mowing lawns, or washing windows.

But in the long term, couldn't robots also replace light bulbs in the stairwell, water flowers, or take on other maintenance and janitorial tasks? There's another trend that suggests application scenarios for robots, which is more about addressing the lack of key resources. It's also an area in which the EU has just set an important signal by demanding that products be repairable. This poses a challenge for many business models. For smartphone makers, it can be quite damaging to business if their devices don't stop working after two years and they can't sell new ones. But what would happen if customers don't buy smartphones at all, but the ability to make calls, take pictures, or use apps? Would it then be possible that devices don't suddenly stop working, but for example only require a hardware upgrade? This would make it necessary to build production lines offering ultimate flexibility, so that Monday they upgrade devices sent in by producer A by replacing the camera, and Tuesday they insert new memory chips for devices sent in by producer B. To save resources, there will be the need to disassemble products, repair them, and overhaul them. There will be no more room for highly special-

ized machines. Instead, for things to be fully automated, ultra-flexible robots will be required, likely equipped with AI. And this will be essential for such a circular business model to work profitably.

So what will all the people do if their work is automated? There will be fewer low-skill jobs and society will have to start working out what to do about it. In all likelihood, it will be necessary to invest more in education to take care of complex tasks such as developing, reprogramming, and maintaining the new technology. Not every unskilled worker has what it takes to learn the complexities of engineering or computing in four years. But maybe this would be possible if the content they need to learn can be spread over six years. Also they may not need to delve too deeply into complex math. People would need to be allowed to learn at different paces or take things at a level of abstraction that is more suitable for each individual.

Also, it will not be enough to cram training in at the beginning of people's careers. The pace of technological advancement has been accelerating at breakneck speed in recent decades, so we can expect things to stay that way. What this means for companies is that it will no longer be enough for engineers to learn all the theory at the be-

ginning of their careers and "pick up the rest" afterward as they go along. More and more people in the world are developing technology these days, and this is accelerating the pace of development.

This accounts for the trends described above, for example in the mechanical engineering industry. Technological change will force firms to make products that no longer match the skills learned by workers at university 30 years ago. If there's heightened demand at a company for programming skills or AI methods, it will not be enough to send people on a course for a couple of weeks. This is where the major disadvantages of using AI, robots, or automation technology actually become an advantage. Our society will have to find ways to ensure freed-up working capacity does not spell job losses. Instead, firms need to invest properly in training staff. For example, if a firm needs 20% fewer workers, either staff (especially those with technical skills) should be allowed to study for a year, or firms should try approaches like putting one day aside each week for staff to do remote studies.

Only then will it become possible for companies to achieve the transition and, for example, transform from a mechanical engineering company into a producer of robots. And business leaders will only succeed in the market if they can find ways to change their companies and staff at the rate required to keep pace with technological advancement.

To ensure firms don't unwittingly pre-select the content of curricula, independent bodies can take on the task of training people in employment. Quite conceivably, private institutions such as Steinbeis could do this – at our Transfer Center, we are already preparing suitable offerings in the field of robotics – and these institutions could be paid directly by the companies.

It would be much better if society recognizes what needs doing and uses company levies to fund staff training, which for example can be organized at universities, online, or at specialized institutions.

If we don't adopt this approach and we don't come up with new products, the increasing levels of automation and plunging sales will result in companies having to shed workers and there will be further sales decline. If, however, firms are serious about investing in their workers, they can think up new products and markets. There are enough examples of markets that did not even exist at one point – online streaming, smartphones, data trading. But for this to work, firms and society will need to be both decisive and determined.

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PROF. DR. PETER NEUGEBAUER

OBITUARY

Steinbeis mourns the death of Prof. Dr. Peter Neugebauer, who passed away in April at the age of 55 following a short but serious illness. As well as his role at Karlsruhe University of Applied Sciences, Peter Neugebauer was extremely successful at the Steinbeis Transfer Centers for Automotive Testing and Automotive Engineering.

Peter Neugebauer was appointed by Karlsruhe University of Applied Sciences in March 2010, where he was responsible for the professorial chair for vehicle electronics at the faculty of mechanical engineering and mechatronics. His commitment and success in research on modern travel solutions and vehicle technology were reflected in the 2012 founding and subsequent development of the Research Institute of Energy Efficient Mobility (IEEM) at Karlsruhe University of Applied Sciences. Neugebauer was both the director and spokesperson for the institute since its foundation. His work for the Steinbeis Transfer Centers for Automotive Testing and Automotive Engineering, which were founded in 2010 and 2015 respectively, covered a variety of topics related to vehicle diagnostics, electronics development and testing, and embedded software, and many of his research findings found their way into business.

Steinbeis loses an enthusiastic and much-valued colleague in Peter Neugebauer, who was always highly committed to his work and focused on the application of scientific insight. Peter Neugebauer's expertise was most recently shared with us in the 1/2020 edition of Steinbeis TRANSFER Magazine, for which he wrote the editorial.

We will cherish his personal accomplishments and values. Our deepest condolences go to his family.
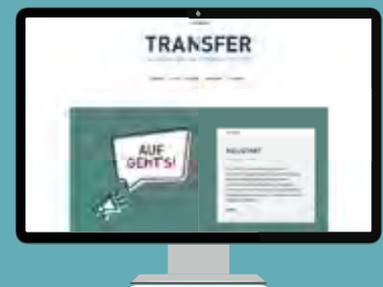
Prof. Dr.-Ing. Reiner Kriesten
Steinbeis Entrepreneur at the Steinbeis Transfer Center Automotive and Embedded and the Steinbeis Transfer Center for Automotive Engineering

Prof. Dr. Michael Auer | Manfred Mattulat
Steinbeis Foundation Board of Directors

WORLD-CLASS COVID RESEARCH IN ONCOLOGY

STEINBEIS EXPERTS INVESTIGATE THE PROGRESSION OF SARS-COV-2 INFECTIONS IN ONCOLOGICAL PATIENTS AS PART OF A CONSORTIUM PROJECT

How can the oncological treatment of cancer patients with COVID-19 be optimized? This is the question posed by experts working on a project called COVID Cancer Vision, which combines world-class R&D in the field of technology with fundamental immunological research. A variety of scientific partners are pursuing a common goal for the flagship project: the Steinbeis Transfer Institute of Clinical Hematology-Oncology, the Chair of Animal Physiology and Immunology at the Technical University of Munich, the Fraunhofer Institute for Optronics, System Technology, and Image Exploitation (IOSB), and the Fraunhofer Institute for Cell Therapy and Immunology (IZI). All have joined forces with the Bavarian bioinformatics company BioVariance and the OnkoMedeor Group, a consortium of seven oncological day clinics, to work together under the auspices of Cancer Centers Dachau.
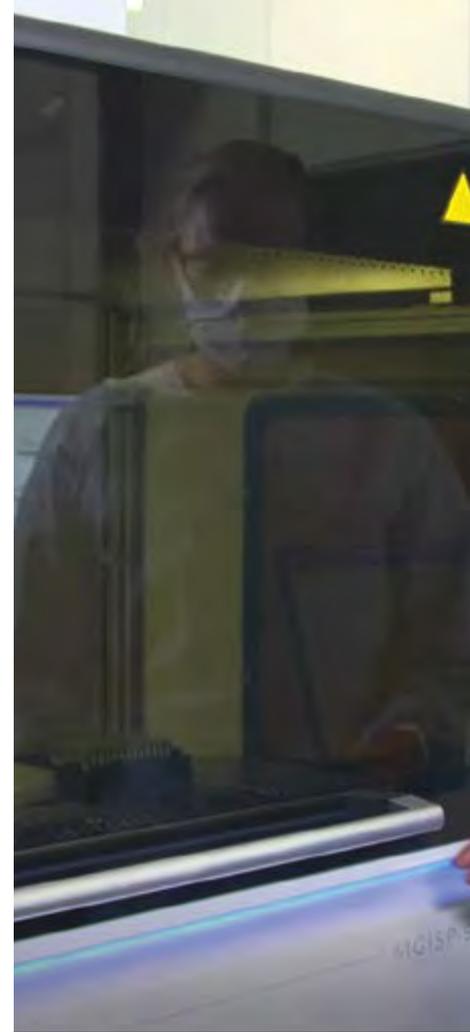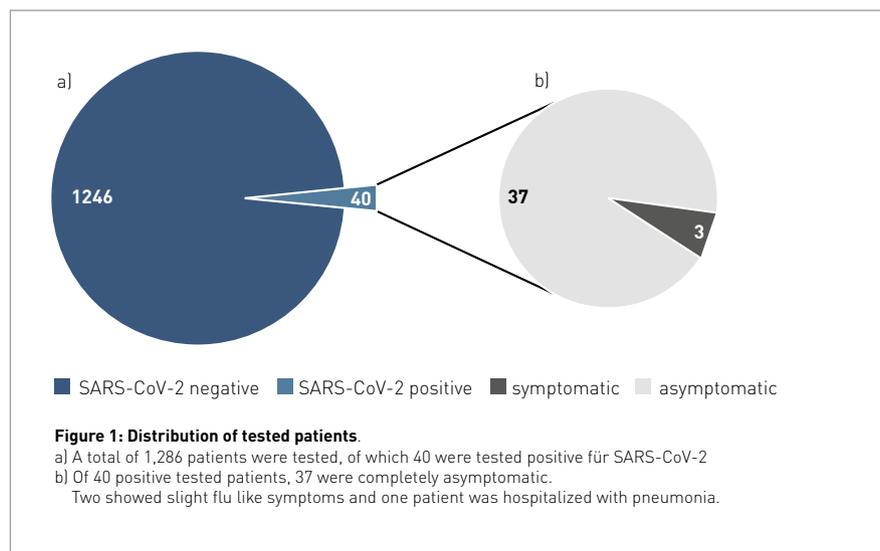
Between April 15 and 26, the team of experts carried out SARS-CoV-2 testing on all tumor patients at the day clinics. They were surprised that out of the just under 1,300 cancer patients tested for COVID-19, only 40 were positive and of these, only three showed symptoms. 37 of the 40 infected patients were thus asymptomatic carriers of COVID-19, even though most of them were currently undergoing regular chemotherapy. It was decided to continue chemotherapy treatment on all asymptomatic patients and this resulted in no unexpected complications.

To conduct experiments, experts working under Prof. Dr. med. Dirk Hempel at the Steinbeis Transfer Institute for Clinical Hematology-Oncology spent two weeks setting up an automated diagnostics line. The processing facility consists of extraction robots that automatically obtain COVID-19 viral RNA from swab samples and prepare a so-called master mix for subsequent real-time quantitative polymerase chain reactions (RT-qPCR). The line has also laid a foundation for single-cell gene sequencing immune cells. Such technology is a prerequisite for experimentation on humoral and cellular mediated immune responses with SARS-CoV-2 infections, and the aim is to examine more closely the causes of the unexpected course of the infection in tumor patients. This is based on the hypothesis that changes triggered by chemotherapy in humoral and cellular mediated immune respons-

Figure 1: Distribution of tested patients.
a) A total of 1,286 patients were tested, of which 40 were tested positive für SARS-CoV-2
b) Of 40 positive tested patients, 37 were completely asymptomatic.
   Two showed slight flu like symptoms and one patient was hospitalized with pneumonia.

Legend: ■ SARS-CoV-2 negative ■ SARS-CoV-2 positive ■ symptomatic ■ asymptomatic

↑ The automated diagnostics line in operation: Robots extract the COVID-19 viral RNA, prepare the polymerase chain reaction and perform single-cell gene sequencing

es could be responsible for the mild course of infection in cancer patients.

To optimize the care of cancer patients in the event of a second wave of the pandemic, it is important to identify biomarkers that allow the course of the COVID-19 infection to be predicted in cancer patients. The experts are assuming that biomarkers are developed as a result of an immunological response. As part of the project, the aim is to examine humoral and T cell mediated immune responses among COVID-19-positive cancer patients during the course of the infection. This will involve investigating anti-COVID-19 immunoglobulin M (IgM) and immunoglobulin G (IgG) antibodies, as well as immunologically relevant cellular sub-classes during the course of the infection.

After conducting flow-cytrometric cell sorting, the immune cells can be further characterized using single-cell gene sequencing. This cutting-edge technology will undergo continual development during the project so that later, it can also be made available for use in other areas, such as cancer research (precision oncology). To evaluate the colossal volumes of data generated by the experiments, the partners working on the project are using bioinformatic algorithms capable of machine-learning. The aim is to acquire data for immunological signatures that could be used as predictive biomarkers for the course of the infection. This involves comparing epidemiological and clinical data with the immunological profiles of tumor patients and evaluating data using bioinformatics.

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DISCOVERING THE WORLD THROUGH EXPERIMENTATION

EXPERIMENTATION WORLD IN ROTTWEIL COMBINES PLAY WITH EDUCATION

July 24, and everything was ready to go: Experimentation World on the Schule-Wirtschaft Campus in the Neckar Valley in Rottweil opened its doors and invited visitors to try experimenting with technology. It was an opportunity to introduce children, high school students, families, and anyone else who was interested in new things to discover the world of science and technology through play. Steinbeis provided backing for the project. As chairman of the supervisory board of the Schule-Wirtschaft Campus, the project was also supported by Dr. Volker Bucher, Steinbeis Entrepreneur at the Steinbeis Transfer Center for Surface and Coating Technology.

There were so many fascinating experiments to choose from at Experimentation World. For example, visitors could construct bridge arches from individual building blocks, let balls hurtle down tracks of different shapes, try out their spatial abilities, experiment with cog wheels, and much more.

Christine Schellhorn, director of Schule-Wirtschaft, a non-profit cooperative, opened Experimentation World to a smaller audience than originally planned due to the coronavirus pandemic. Thankfully, all of the sponsors who provided financial support for the projects, as well as contributions in kind and their

valuable time, were very happy to come.

So how did it all begin? In late 2019, a team working on a local project in Rottweil submitted an application for funding under the LEADER initiative. LEADER is a French acronym for Liai-

son Entre Actions de Développement de l'Économie Rurale, or "links between actions of development in the rural economy."

The 40 or more exhibits were made possible by a €126,900 subsidy from the EU and state funds, as well as donations from schools in Rottweil county, Steinbeis, and leading companies in the area. Despite the many challenges of COVID-19 regulations, the team succeeded in organizing the project in a matter of months.

Immediately next door to the experimentation hall in Neckar Valley stands a study center belonging to Furtwan-

gen University (HFU), of which Volker Bucher is the Dean of Studies. The center already organizes experiments for high school students from Rottweil. The aim is to extend experiments and practical studies, not only into other rooms at Experimentation World, but also into other places in the county, such as schools and businesses, in order to establish a structured, high-quality extracurricular educational framework in the region in the long term.

The team of experts comes from a diversity of areas. Involving a variety of representatives from state job services, school principals, chambers of commerce and industry, the county authority, municipal departments, the school department, and Schule-Wirtschaft Campus itself ensures that the initiative adopts many different angles and viewpoints.

The Schule-Wirtschaft Campus network allows managers in business to exchange views with schools and institutions and develop programs that make it easier for young people to enter the world of employment after high school. Further information: **www.campus-schule-wirtschaft.de.**

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A HYDROGEN ECOSYSTEM FOR THE HEILBRONN-FRANCONIA REGION – MADE POSSIBLE BY THE H2 INNOVATION LAB

STEINBEIS EXPERTS CONDUCT JOINT RESEARCH INTO THE POTENTIAL OF THE HYDROGEN INDUSTRY

There are number of reasons to use hydrogen as an energy source. Not only does it make it possible to store excess electrical energy, hydrogen can also be used in a broad spectrum of areas. Also, during "combustion" it mainly leaves behind water and this helps reduce carbon emissions and the need to burn fossil fuels. The Technical University of Munich has joined forces with Heilbronn University, the Ferdinand Steinbeis Institute in Heilbronn, and the Fraunhofer Institute for Industrial Engineering (Fraunhofer IAO) to examine the potential offered by the hydrogen industry to the Heilbronn-Franconia region. The main focus of the Steinbeis experts lies in the added value offered by hydrogen industry ecosystems.

Whether it's to fuel vehicles, provide heating, or act as a reducing agent in steel production, hydrogen has the potential to play a key role in achieving international climate protection goals. But to preserve the significant potential of hydrogen technology and add value to the German economy – or even build on potential – it will need to be researched in more detail and put to good use. Establishing and operating the infrastructure to use hydrogen technology will require the introduction of a comprehensive ecosystem, pulling together all key industry players. But this would open the door to new realms of high-value business services.

To understand the potential offered by the hydrogen industry to the Heilbronn-Franconia region and lay the necessary foundations for exploiting this potential, an experienced research consortium has been formed on the education campus in Heilbronn: H2 Innovation Lab Heilbronn-Franconia. The members of the consortium are the Technical University of Munich, Heilbronn University, the Ferdinand Steinbeis Institute in Heilbronn, and KODIS, a research and innovation center for cognitive service systems belonging to Fraunhofer IAO. The project is being initiated and sponsored by the Dieter Schwarz Foundation and Pakt Zukunft Heilbronn-Franken.

THE BENEFITS OF LOCAL LOGISTICAL NETWORKS

The aim of the project is to set up a pilot region, partly backed by the Federal Government as part of its national hydrogen strategy for developing hydrogen concepts. The Heilbronn-Franconia region appears to be in an ideal position to develop into a key business location for the hydrogen industry. One major advantage this area offers is its advanced logistics network, a large number of medium-sized businesses, plus a good number of big businesses. There are also a number of industry players specialized in hydrogen technology in the region, offering an outstanding environment for conducting research. As part of the H2ORIZON project, both the DLR Institute for Space Propulsion and ZEAG Energie already operate facilities in Lam-

poldshausen for generating sustainable hydrogen supplies. In addition, Audi is actively involved in hydrogen cell research at its development facilities in Neckarsulm.

THE KEY TO SUCCESS: ECOSYSTEM MODELING

The Fraunhofer IAO researchers working on the Heilbronn campus have been talking to stakeholders in business, science, and politics in order to map the key players of the hydrogen industry as part of a stakeholder analysis. "Meeting experts and conducting evaluations helps the project team to really get to know the different types of stakeholders in the region and build a regional hydrogen network. This will make it easier for regional project consortia to quickly pull together in the future and react to invitations to tender for research programs, development projects, and funding programs," explains Dr. Bernd Bienzeisler, project manager at the Fraunhofer IAO. In parallel to this, the Fraunhofer team is assessing the current status of research and the overall research landscape in the hydrogen industry.

The Technical University of Munich team on the Heilbronn campus, the Ferdinand Steinbeis Institute in Heilbronn, and Heilbronn University are starting by modeling a general H2 business ecosystem, with the aim of applying their model to the Heilbronn-Franconia region. "To produce meaningful results, it will be important to find a systematic way to categorize industry players and stakeholders within the context of the business ecosystem – also in order to assess the two topics independently of one another," explains Steinbeis expert Dr. Daniel Werth. Prof. Tobias Bernecker, who is managing the project for Heilbronn University, agrees: "We're adopting a holistic approach to allow us to spot gaps and systematically close them."

Based on this, the Technical University of Munich will use a model to merge different constellations of key players in the hydrogen industry in Heilbronn-Franconia. "Our main focus lies in the value streams between key players so we can highlight transformation scenarios and potential risks to the ecosystem," explains Dr. Markus Böhm of the Technical University of Munich. The project will result in a model for the hydrogen ecosystem in Heilbronn-Franconia. The results of the project are scheduled to be published in a study at a regional hydrogen event in 2021 on the education campus in Heilbronn.

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"IT IS KEY THAT ORGANIZATIONS HAVE A CLEAR STRATEGY AT ALL"

AN INTERVIEW WITH DR. STEFAN PASTUSZKA, LECTURER AT STEINBEIS UNIVERSITY

Typically, it is impossible to know upfront whether a strategy will be successful or not. Only time will tell. This is why it is all the more important for organizations to look carefully into strategy development. An expert who works intensively in this area is Dr. Stefan Pastuszka, lecturer for the online M.A./MBA (USA) general management program run by the Graduate School at the department of Leadership and Management at Steinbeis University. He teaches students and shares know-how and methods required to conduct projects in the field of strategy and foresight management. In a recent interview, he joined Nick Lange of the School of International Business and Entrepreneurship (SIBE), also at the Business School in the department of Leadership and Management, to talk about the challenges of agile strategy development.

Hello Dr. Pastuszka. The complex area of strategy development appears all over the place in your resume. What made you focus on this subject?

Strategy is one of the topics that have been with me all the way in my career. During my work for different companies, I learned to know plenty of different markets, business models, and strategic approaches. Meanwhile, I am active as a strategy and innovation consultant, helping people and organizations to bring clarity and structure into complex subjects so that they can gear themselves up properly for the future. It is a really good fit with my lecturing at the Graduate School in the Leadership and Management department at Steinbeis University, because my teaching focuses on strategy and foresight management.

What motivated you to publish yet another book on this topic?

When I was writing my first book, I had the idea of a canvas-based approach to strategy planning, similar to the well-known business model canvas. Actually, at that time there were quite a number of different canvas methods around, but not a single one dedicated to strategy, a topic that's so central and relevant to companies. There were two things that motivated me to publish a book on this topic. One had to do with the way people work with canvas models, which I find fascinating and productive. For instance, I'm constantly inspired by the way you can map and develop business models with the business model canvas. The second thing was my enthusiasm for the future and innovation. That inspired me to pull the two together and create an intuitive method in tune with modern thinking and ways of working – a tool that makes it easier to improve decision-making for the future.

How important would you say a good strategy is for a company? What are the consequences of a "bad" strategy?

Actually, the most important thing is that companies have a clear strategy at all. Especially when looking at small and

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WHENEVER COMPANIES PURSUE A CERTAIN BIG GOAL, THERE ARE TYPICALLY SEVERAL POSSIBLE PATHS THAT COULD BE TAKEN.

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medium-sized enterprises, there are some that do not spend much time on formalized strategy development. Frequently, top managers do have a strategy in their heads, but often there is no structured and documented discussion about it.

Whenever companies pursue a certain big goal, there are typically several possible paths that could be taken. Some of those paths may take them on detours, and some may turn out to be dead ends. On the wrong path, companies therefore either don't reach their goal quickly

enough, or in the worst case they do not get there at all – and the available resources are not used properly. But it's only afterward that you can judge whether a strategy was "good" or "bad". Therefore, one has to concentrate on the path that looks most promising from the current standpoint.

What is the typical approach to strategy development? And what's the difference between conventional strategic planning methods and your model, the Strategy Explorer?

In my experience, the approach to strategy development strongly depends on the individual company. Big companies often use elaborate processes for developing strategies. These include certain cycles in which strategies are created, modified, presented, and signed off. But of course that requires the right resources, which smaller companies often cannot afford. And more often than not, they do not have dedicated strategy experts to spend time looking into topics in detail. In many cases, people who are not strategy professionals have to do the main work. In terms of tools, they select singular methods from from the big box of strategy development tools and combine them for their own purposes. But even that takes a certain amount of expertise, otherwise it becomes noticeable in the results. If all you have is a hammer, every problem might look like a nail. The M.A./MBA (USA) seminars I run for the Graduate School degrees at the department of

Leadership and Management at Steinbeis University allow students to learn the different tools of strategy planning, and apply these directly to their own management projects. I think it is a good starting point for transferring this knowledge into companies.

The Strategy Explorer is basically constructed around well-established standard methods, although in a compact format and embedded into an overall process. One of the difficulties with using disconnected tools in companies is that, for example, different teams conduct assessments based on different premises in the process. The difficult bit is to then to re-connect these results. With the Strategy Explorer, this problem does not arise because from the very beginning the team draws an overall strategic picture – so the overarching goal and chains of reasoning are always clearly visible for everyone.

The Strategy Explorer encourages strategy development in a diverse team, mapping all key findings on a single page. This gives people clarity and structure, and it forces them to focus on the essentials. In principle, you can see this new kind of strategy canvas like drafting a game plan in sport. For example, you have a long-term goal and look at the strengths and weaknesses of your own team or the opponent. The Strategy Explorer takes you through the process of strategy development in six steps. These start with defining the subject, cover the vision and mission and continue with analyzing the business environment and understanding your strengths, weaknesses, opportunities, and threats, as well as their implications. Finally, you pull everything together and prioritize potential big steps and strategic options that could be taken. As a result, you formulate the most promising way forward: your strategy. By allowing companies to work out everything on a single piece of paper, the Strategy Explorer ensures they don't get bogged down by details. Instead, they maintain an overview and stay on the right strategic flight altitude.

How does your model help companies going forward?

The Strategy Explorer is a method that helps companies identify promising strategies for the future – within different areas, within a compact time frame, and based on active participation. These strategies can be created quickly and flexibly, looking at things from a number of different angles. In many cases, teams finish the work within a day. Depending on the mode of work, and potentially additional research that may be needed, the initial results can be seen as a kind of strategy prototype, and this can be taken forward and checked again, fine-tuned, and translated into concrete actions.

Stefan Pastuszka describes his new strategy development tool in his recent book, "Strategy Explorer – das Strategiewerkzeug für Teams. Für jedes Business die passende Strategie entwerfen" (German).

For more information, go to **www.strategy-explorer.xyz.**

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MAKING BETTER DECISIONS – QUICKLY, OPENLY, EFFICIENTLY

CLOSE COLLABORATION IN DESIGN SPRINTS – THE WAY TO MAKE DECISIONS EVERYONE CAN AGREE TO

As the rate of change accelerates – not only in society, but also in the economy and in terms of technology – companies and their employees face a constant stream of new challenges. There's no single way to cope immediately with all challenges when problem-solving, but there is a collaborative tool that can help companies with decision-making issues: the Lightning Decision Jam, a kind of design sprint developed by AJ&Smart. Wolfgang Natzke of the Steinbeis Transfer Institute for Business Management and Innovation describes how to apply it to business problems.

The challenges we meet time and time again at companies, in a world of increasing complexity, are often captured by the acronym VUCA, which stands for volatility, uncertainty, complexity, and ambiguity. It's not surprising that the problems companies find themselves

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THE MAIN ADVANTAGE WITH OUR WORKSHOPS IS THAT IT DOESN'T TAKE MUCH TIME TO COME UP WITH TANGIBLE AND UNDERSTANDABLE SOLUTIONS TO PROBLEMS.

having to solve are changing more and more rapidly, are getting bigger and bigger, and are becoming more and more complex. Against this backdrop, a bulletin released by the World Economic Forum on The Future of Jobs puts complex problem-solving at the top of a list of the most important skills required by employees in 2020. But it's not only becoming more difficult to solve problems: Distorted opinions and deficiencies in team meetings also have a negative impact on decision-making.

There are a number of methods that can help companies with problem-solving. One such method is a kind of troubleshooting sprint that is also a useful point of entry for improving the problem-solving skills of employees and teams. It can also diminish cognitive distortion and poor communication. Steinbeis expert Wolfgang Natzke has been working with Dr. Marcus Liehr of zagmates and Maren Fischer of Freshworks to create a workshop format that allows the design sprint technique to be applied to business situations.

DESIGN SPRINTS – START WITH CHALLENGES, LOOK FOR SOLUTIONS, AND MAKE DECISIONS

A design sprint is a structured and moderated workshop based on a clearly defined series of processes. The aim is to quickly identify pertinent challenges relating to a task with other team members in order to come up with solutions and make decisions. The team is taken through four stages during the workshop. Each is subject to clear time constraints, such that depending on the size of the team and the depth of the topic being looked at, a workshop can last between 30 and 90 minutes. In addition, there are a number of rules that must be adhered to during the workshop. One of the most important ones is that workshop participants have to pursue a common goal, even if individuals work by themselves during certain stages. As a result, there are times in the workshop when people won't talk to each other. Instead, everyone captures their thoughts and ideas on Post-its. The idea of this rule is to prevent the workshop from be-

ing dominated by individuals. All input provided by participants should be taken at face value and not judged according to who it came from. Ultimately, this rule is one of the reasons why design sprints are not just good for on-site events, they can also be organized to take place online using digital whiteboards. The following provides an example of how the tool works.

PUSH SALES WITH THE HELP OF A DESIGN SPRINT

The aim during the first stage of a sprint is to pull together all information pertinent to solving the problem. To do this, a "sailboat exercise" is used. In keeping with this analogy, the team starts with things that could move the boat forward, like wind in the sails. In this example, every participant is asked to use Post-its to write down anything that would help the company access new sales channels, so for example they could write "We successfully gained access to another new sales channel two years ago." All of the Post-its are then stuck on the whiteboard.

The next step is to use Post-its again to capture lots of things that slow the company down, hold it back, or even harm it – the anchor under the sailboat. Depending on how clearly the original issue has been captured, at this point it helps if all of the participants now define the goal more precisely, for example should turnover be raised to a certain value within the next year. Coming back to the sailboat, this is like defining which port should be sailed to. To capture topics in as much detail as possible, it's important that the participants list plenty of factors during this stage of the workshop and that they're not impeded by having to get things right – so it's about quantity of ideas rather than quality.

Because the workshop is about solving a problem, at the next stage the team takes on the biggest problem faced by the company trying to access the new sales channel. Again, there's no talking during this stage. Instead, participants pick the biggest problems themselves by sticking dots on the Post-its. The remaining stages of the workshop concentrate on the problem with the most dots. So with the example of accessing a new sales channel, the main problem could be something like the company having no previous experience with a new kind of sales channel.

The aim of the third stage of the workshop is to come up with as many ideas as possible for solving the main problem identified at stage two. To finish the workshop, stage four looks at different ways to implement the best ideas. To do this, first the ideas generated at the last stage are prioritized. This is done in the same way as the second stage with sticky dots. Finally, the best solutions are placed on a 2 by 2 matrix according to expected impacts and effort.

To conclude the workshop, implementable measures are worked out for the solutions that should have a major impact for a relatively small effort. Depending on the nature of a problem, it may make sense to express these measures as an experiment within a fixed time frame so it can be checked how effective measures will be without going to too much effort. In the example described above, two weeks could be spent setting up interviews with customers who already buy through the sales channel.

THE ADVANTAGES OFFERED BY DESIGN SPRINTS

"The main advantage with our workshops is that it doesn't take much time to come up with tangible and understandable solutions to problems. This is especially the case when you compare results directly with open-end and unstructured discussions in meetings, which often finish without coming to any conclusions, or issues get added to a 'backlog' of other topics," explains Steinbeis Entrepreneur Wolfgang Natzke. As all input generated by a design sprint is captured in writing, you also don't lose sight of ideas. Instead, they can be followed up later. In addition, the structure and rules used for the workshops mean that many distorted views, which could otherwise have a negative impact on decision-making, are put aside or at least minimized. To improve a company's or a team's ability to solve problems, it is of course not enough to arrange the occasional design sprint workshop. Instead, design sprints should be an integral part of collaborative troubleshooting.

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PEOPLE AND ROBOTS – A STRONG TEAM

## STEINBEIS EXPERTS IN FRIEDRICHSHAFEN USE ROBOTS TO PROVIDE ASSISTANCE TO PEOPLE WITH DISABILITIES

Modern human-robot collaboration makes it possible for people to work on tasks side-by-side with robots. But if you look closer and examine how collaborative robots (cobots) are actually used, it's immediately apparent that until now, very few scenarios exist where this makes sense. The reason for this is that most potential tasks can also be carried out "cooperatively" – meaning that humans and robots take it in turns to work on something (such as a component). To identify genuinely collaborative scenarios, the Steinbeis experts at IWT Wirtschaft und Technik in Friedrichshafen decided to think outside the box and look into a new concept that would allow cobots to provide reliable support to people with disabilities. This would make it possible for robots to help assemble parts by compensating for physical shortcomings caused by disabilities.

Working with robots provides a number of benefits to workshops, as well as the disabled people who work in them. In 2018, there were 736 workshops for disabled people in Germany, employing roughly 310,000 people. Because most employers are currently unable to fulfill official requirements for employing people with disabilities, there is strong demand for integrative approaches. In 2016, 60% of German companies had to make financial amends because they failed to employ a certain percentage of severely handicapped people. They could limit such payments by integrating cobots into certain processes.

ROBOTS ARE ABOUT MORE THAN HI-TECH – THEY ALSO NEED ACCEPTANCE

This hitherto unorthodox partnership model raises some important questions, however. Can robots really provide disabled people with useful support, especially with different types of processes, or can they supplement certain process-

es? How do people with or without disabilities react to the idea of working with robots? Kris Dalm, a project manager at IWT, looked at these questions as part of a research experiment into "robots in collaboration with people with disabilities in industrial assembly." The acronym for his project: ROKMI. He was actively supported by a project team consisting of Rohan Sahuji, Ankita Surgade, and Melanie Schirmer. "ROKMI is not so much about addressing technical issues, it's more about topics such as acceptance and user-friendliness. There's no point in introducing collaborative technology if you don't consider beforehand whether the target group will actually take to the concept and whether they can work with it," says Dalm, outlining the main emphasis of the project. He believes that cobots offer huge potential to create jobs for people with disabilities and make processes more profitable: "Imagine an assembly contract comes in involving ten tasks and for one reason or another, the people working in assembly can't carry out one or two of the tasks.
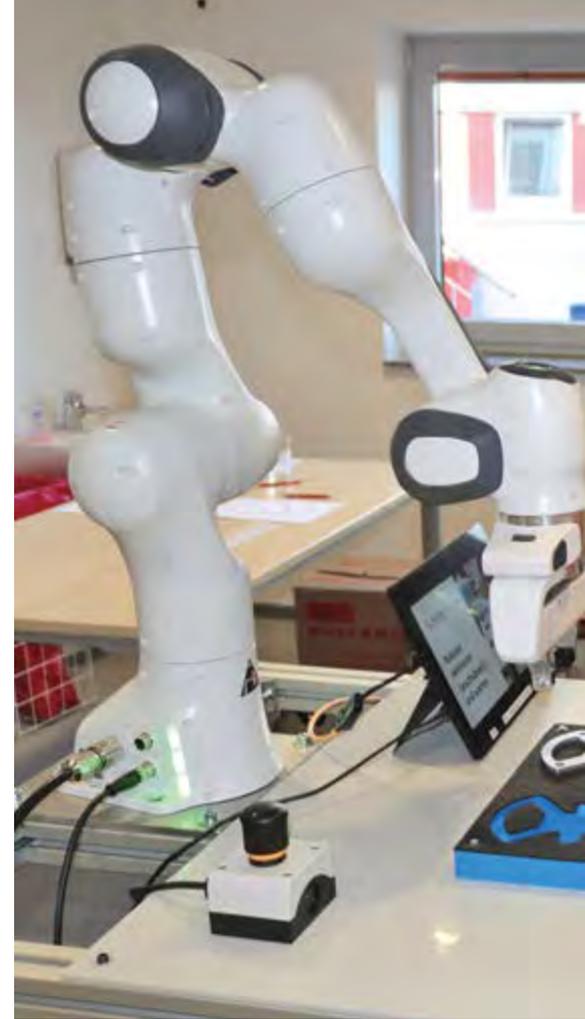
This is where it would be good to add a cobot." Previously, workshops for the disabled were forced to turn down contracts, or supervisors had to jump in and do certain tasks themselves. It would now be possible to use a collaborative robot to allow disabled people to take on such tasks themselves; assembly contracts that were previously considered too challenging could be taken on without problems.

The project team invested a great deal of time talking to three workshops for the disabled – the Liebenau Foundation, the IWO integration workshops in Weingarten in Upper Swabia, and Lindenberger Workshops. It then developed a method that can now be looked into in more detail for ROKMI. The workshop directors expressed concerns about whether line supervisors at the workshops would be able to program robots themselves, even if they only require small adjustments. If they are unable to cope with reprogramming, they would have to pay specialists to reprogram the robots in-

This is what teamwork looks like: Daniela Heinl (right) works together with a cobot on a workpiece.

periment involved a test group of 30 respondents in parallel to 30 respondents in the control group.

The result of the project is that collaborative robots will now possibly be put to use, for example in a production process used to make vegetable slicers in a workshop for the disabled. This process involves adhering a blade to a plastic part. The blade is extremely sharp and it's not uncommon for workshop staff to injure themselves. This would be an ideal place to use a cobot, which could position adhesive on parts and repeat the process time after time. It would even keep protocols in case of product returns. The robot would also be able to join blades to plastic parts. The blade is difficult to handle and presents a danger to operatives, who would then no longer injure themselves. There are further potential application areas for cobots, such as lamp production, pick-by-light processes for mounting cables, the production of document shredders, and packaging tasks.

stead and not only would that make using cobots unprofitable, it would actually be unaffordable to them.

LIVE TESTING OF COBOTS: TEST PASSED

Taking this concern as the starting point, the team decided to see what would happen if cobots were used to help people with disabilities by designing a research project broken down into two experiments. For the first experiment, they looked at acceptance and the user-friendliness of collaborative robots when working alongside people with disabilities. They found that operatives were quite happy to work with a mechanical assistant and even considered support from a robot a kind of "status symbol." Unlike people without disabilities, the disabled operatives didn't see collaborative robots as some kind of competition or something that would pose a threat to their jobs. Instead, they were actually grateful for the support.

The second experiment also looked at acceptance and the user-friendliness of collaborative robots, but the design was extended to also look at people without disabilities. In addition to investigating the same tasks looked at for the first experiment, the IWT experts also examined the extent to which people with no understanding of the technology would be able to carry out simple programming themselves. This would have been inconceivable in the past, because robots used to be much more complicated and even with specialist knowledge they required a great deal of effort to program. These days, many robots used in manufacturing have highly intuitive controls so they can even be managed by people without specialist knowledge. Most programming can be carried out via touch-screen – so it feels more like you're using a smartphone than programming a robot. To gauge acceptance and user-friendliness, the team asked operators to complete a questionnaire. Most respondents had no problems whatsoever programming the robots. Each ex-

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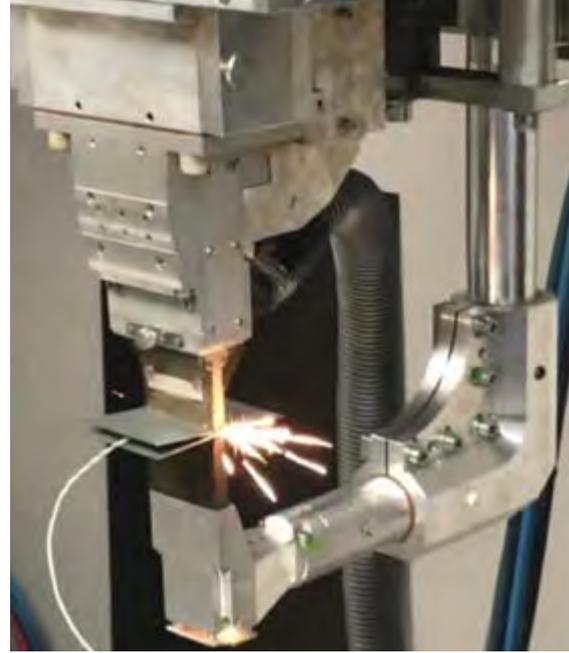stefanie.rist@steinbeis.de (author)

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THE PROTECTION PROFESSIONALS

WORKING IN COLLABORATION WITH ISOCOLL
CHEMICALS, STEINBEIS DEVELOPS AN ELASTOMER
SURFACE COATING SYSTEM BASED ON
FILLED BUTYL RUBBER

There has been a sharp rise in demand for new materials with predefined electrochemical and mechanical properties, primarily because of the inability of existing materials to meet current environmental requirements. There is particularly strong interest in natural rubbers and synthetic rubber polymers, whose properties can be altered by using modified fillers and adapted production methods. Butyl rubber is made from different types of synthetic rubber materials and in many respects is superior to other kinds of artificial rubbers, as well as epoxides and silicones. Intelligent Functional Materials, Welding and Joining Techniques, Implementation, the Steinbeis Innovation Center in Dresden, joined forces with chemicals specialist Isocoll to develop a butyl rubber compound capable of meeting high electromagnetic protection requirements.

With its low shear modulus and low elastic linear deformation, butyl rubber does not count as a structural adhesive and is frequently used in automotive fields, air conditioning systems, ventilation, metal engineering, construction, the glass panel insulation industry, and solar modules – particularly for adhesive, coating, or sealing purposes. It is even used to shield elements from corrosion on bridge cables and other components found on bridges. Depending on actual needs, the properties of butyl rubber sealants can be adapted by adding fillers, and this opens the door to new applications. For example, by mixing in metallic particles, the specific electric resistance of natural rubber can be adjusted to achieve values ranging from 10^{12} Ωcm up to < 2 MΩ.

TAKING A CLOSER LOOK AT BUTYL RUBBER

As part of a research and development project with Isocoll, the Steinbeis Inno-vation Center experts at Intelligent Functional Materials, Welding and Joining Techniques, Implementation, succeeded in embedding mineral and metallic fillers in rubber to create a butyl rubber material that delivers corrosion protection, electrical conductivity, and electromagnetic shielding properties. The aim of the collaborative project was to determine new application options for the butyl rubber material by introducing fillers and adapting electromagnetic compatibility (EMC) to different application scenarios. To achieve this, the specialists introduced highly conductive and anti-corrosive fillers to the butyl rubber material, focusing mainly on carbon black, graphite, aluminum, copper, nickel, and iron. In addition to examining EMC protection, the adhesive properties of the processed butyl rubber were investigated for corrosion on the surfaces of engineered metal housings. There are a large number of areas in which such materials may be used, from surface coatings on electrical modules (where shielding properties are required), to electromagnetic housings and module shields, and even corrosion protection coatings with electrical dissipation properties between joined metal sheets.

The developed butyl rubber material was subjected to extensive testing and evaluations using special test rigs. The aim was to look at corrosion properties and electromagnetic protection. The experts working with Isocoll conducted a comprehensive battery of tests on material and technological performance. To understand EMC shielding properties, it was necessary to introduce particles to a sealing material. Each filler was chosen for its particular diamagnetic properties and low residual magnetism. In keeping with technical requirements of Isocoll, defined quantities of carbon black, graphite, copper, and aluminum were mixed into butyl rubber according to defined shapes and geometries. To do this, the team laser-welded metal sand-
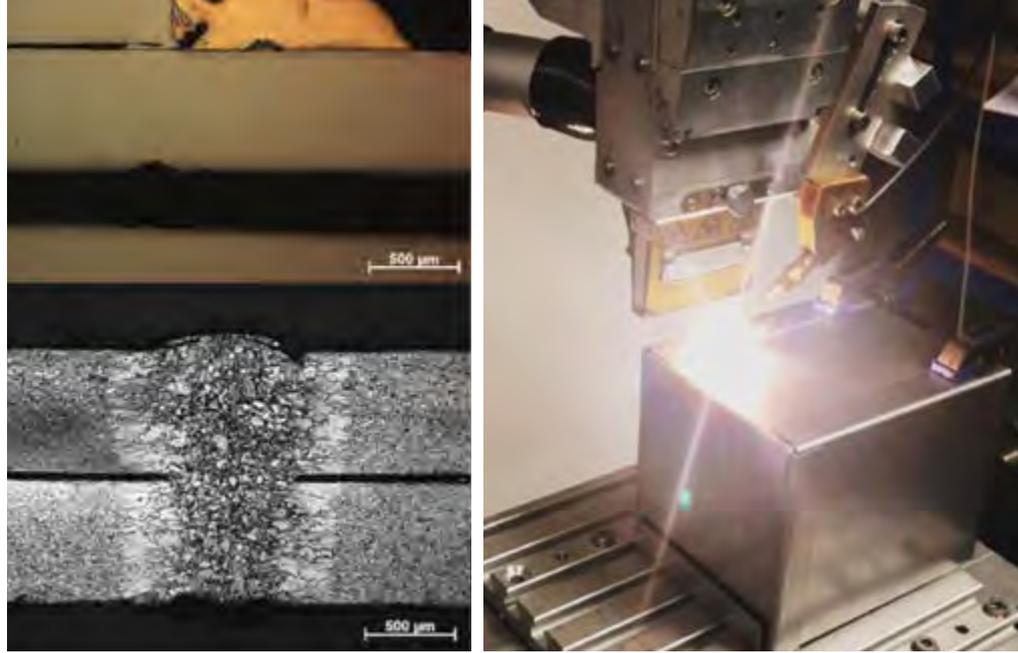
↖
Joining technology development:
laser welding and soldering of joint connection
in sandwiched material (metal – butyl rubber filler
compound – metal)

wich structures using thermal joining processes, filling the sandwiches with different types of butyl rubber. Each sample then underwent artificial aging processes and was subjected to corrosive stress in special housing boxes.

FILLERS INFLUENCE ELECTRICAL CONDUCTIVITY

Measuring and testing techniques were defined for determining the electrical conductivity and electromagnetic shielding properties as a function of sample thickness, the nature and size of embedded filler particles, and the proportion of particles compared to the butyl rubber filling medium. To assess electrical conductivity, material resistance was measured based on so-called real and imaginary impedance. Impedance is

↗
Results of electrical resistance testing and assessment of EMC shielding shown by type and volume of embedded fillers in butyl rubber compounds:
a) real impedance readings: electrical resistance by frequency and filler type; with aluminum foil versus without aluminum foil
b) X-ray assessment of filler particle distribution in the butyl rubber particle matrix
c) shielding effectiveness of samples by frequency value, filler type, and filler proportion.
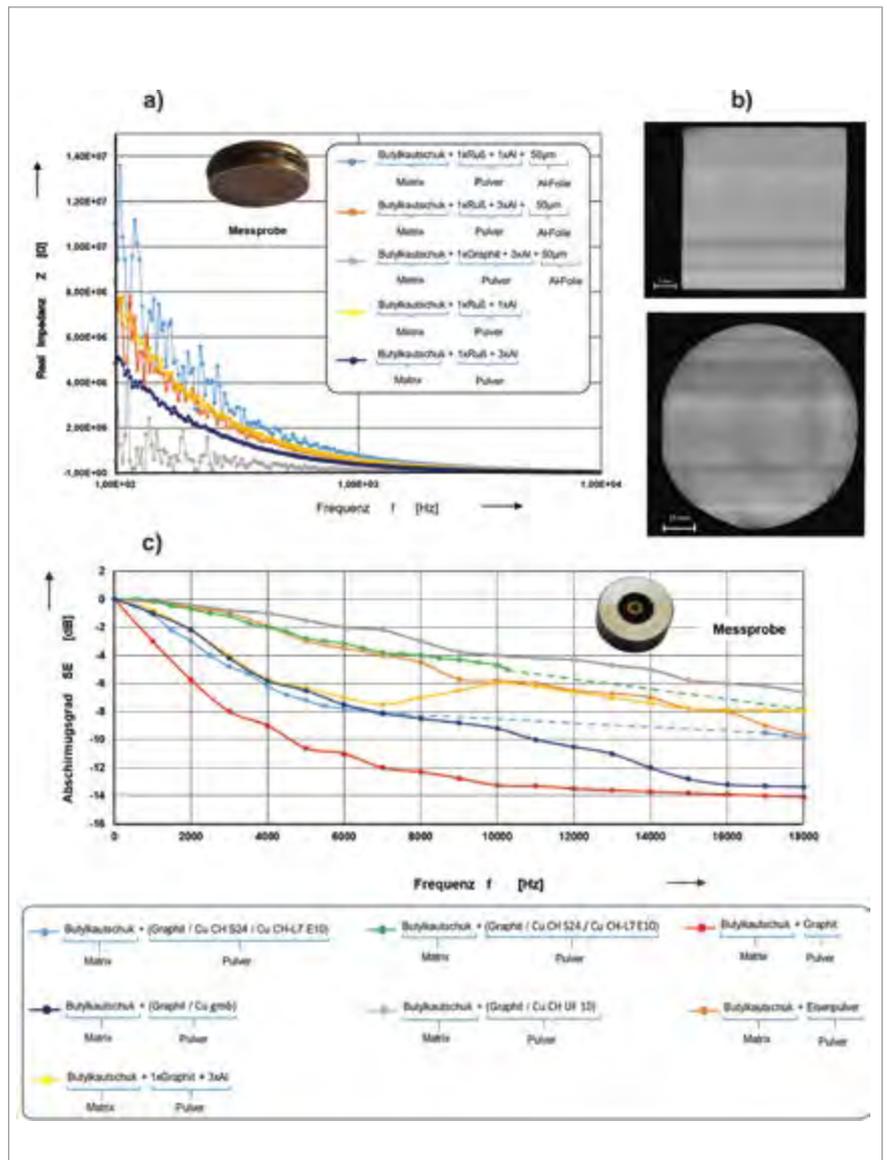
an important parameter for the characterization of electronic switches, components, and materials used to make technical parts. The technique chosen to take measurements was the RF I-V method. The measurements showed that two filler mixes achieved the lowest scores. One was a mixture consisting of butyl rubber and 5% graphite, 45% Cu CH S24 and 10% Cu CH-L7 E10. The other consisted of 1/3 of butyl rubber, carbon black, and graphite respectively with an aluminum foil. Introducing electrically conductive fillers significantly raised the electrical conductivity of the butyl rubber material. Depending on the type of filler used and which material it was combined with, compared to unfilled butyl rubber materials, electrical resistance dropped by up to 99.99%.

BOOSTING SHIELDING PROPERTIES

In addition to looking into electrical conductivity, the experts also examined the shielding properties of butyl rubber samples for the research project. To do this, measurements were carried out using reflection measurement methods. The material parameters were then used to calculate shielding effectiveness. To determine the required material parameters, each sample was placed in a coaxial gauging cubicle and measured using a network analyzer. These measurements produced excellent results for all examined samples. Changes in the shielding properties of the rubber resulted in a rise in the shielding effectiveness (SE) of the butyl rubber material from around 0 to 55 dB. This modi-

fication was the result of adding filler powder particles and aluminum foil to the butyl rubber filler. Introducing filler particles without the metal foil also delivered excellent shielding properties, with an SE value of 14 dB for samples consisting of butyl rubber and 45% graphite. By adding a high proportion of materials that are highly conductive to electricity, such as copper, aluminum, and graphite powder, with the addition of aluminum foil, excellent results were achieved for the composite samples. Changing powder particle sizes and varying proportions within the butyl rubber matrix resulted in further improvements to shielding properties.

Producing fillers by using material fibers that are highly conductive to electricity,

↙ Achieved shielding effectiveness and electrical resistance of the examined filler compounds in the butyl rubber filler.

TYPE OF FILLER	SHIELDING EFFECTIVENESS [dB]	
butyl rubber + (carbon black + Al - 1:3) with aluminum foil	45-55	shielding effectiveness [dB] up to 110 MHz
butyl rubber + (carbon black + graphite - 1:3) with aluminum foil	38-42	
butyl rubber + (carbon black + Al - 1:3)	8	shielding effectiveness [dB] up to 18 GHz
butyl rubber + (5 % graphite / 60 % Cu CH S24 / 15 % Cu CH-L7 E10)	10	
butyl rubber + (5 % graphite / 45 % Cu CH S24 / 10 % Cu CH-L7 E10)	7	
butyl rubber + (5 % graphite / 75 % Cu rough)	14	
butyl rubber + 45 % graphite	14	
butyl rubber + 75 % iron powder	10	
TYPE OF FILLER	IMPEDANCE [GΩ]	
butyl rubber + (carbon black + Al - 1:3)	2	butyl rubber – filler powder
butyl rubber + (5 % graphite / 45 % Cu CH S24 / 10 % Cu CH-L7 E10)	≈ 0,002	
butyl rubber + 45 % graphite	≈ 0,003	
butyl rubber + (carbon black + graphite - 1:3) with aluminum foil	≈ 0,002	butyl rubber – filler powder + Al-foil

butyl rubber compounds with fillers
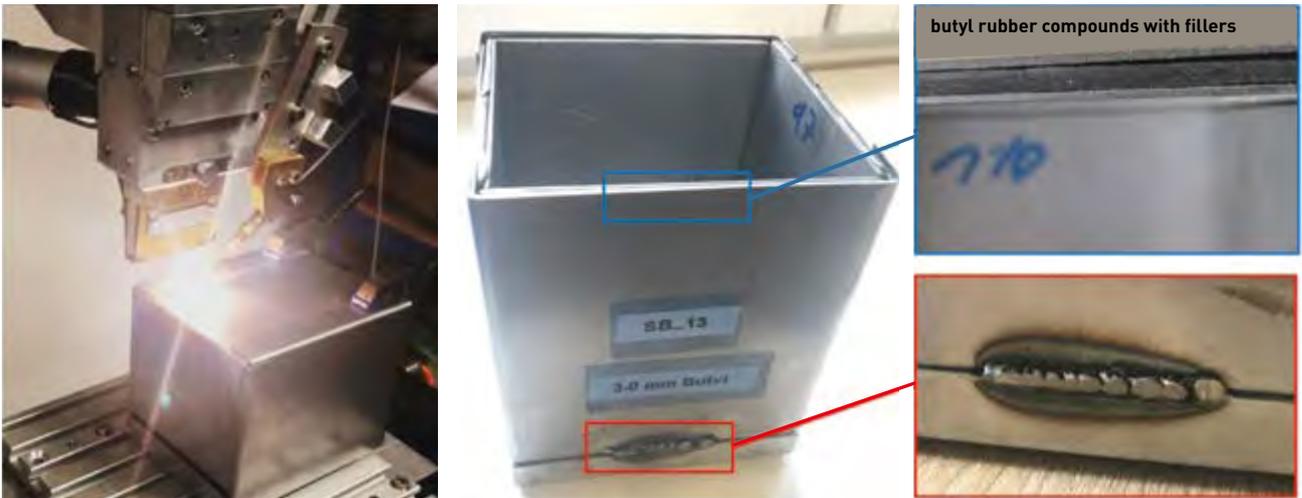
↗ Construction of the demonstration unit by joining individual parts using laser soldering, shown here with a combined filler material comprising aluminum foil and powder.

such as copper and aluminum fibers, also resulted in good shielding properties. Using highly permeable filler materials makes it possible to improve electromagnetic absorption properties while maintaining reflection values. Compared to unfilled butyl rubber materials, the project team achieved a positive change in butyl rubber shielding properties of between 96 and 99.999%.

Steinbeis and Isocoll Chemicals have now achieved the goals they set for themselves and consider the project a success on all fronts. Introducing electrically conductive fillers to butyl rubber used as embedded components raised electromagnetic conductivity scores (EMC values) as hoped, and delivered corrosion protection and joining properties. At the same time, the demonstration units set up to assess results also led to some interesting observations. "By forming, welding, and soldering the materials, we gained detailed insights into the potential processing options offered by the demonstration units, and the kinds of effects we can expect when it comes to electromagnetic shielding," concludes Steinbeis Entre-

preneur and associate professor Dr.-Ing. habil. Khaled Alaluss. "Overall, the project allowed us to prove that introducing fillers to butyl rubber contributes significantly to EMC shielding effects and it's possible to continue the processing of sandwiched structures, based on the butyl rubber that was used, with laser welding processes and laser soldering."

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FOCUSING ON EXCELLENCE: GREEN TECHNOLOGY IN EMERGING MARKETS

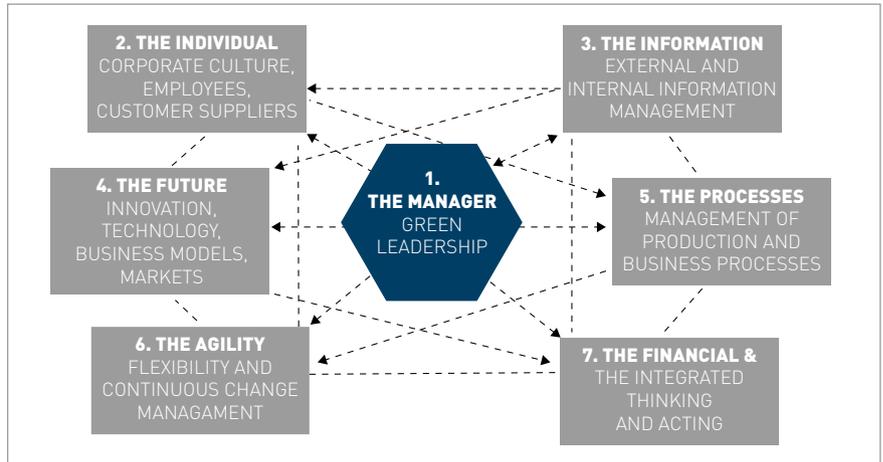## USING INTEGRATED TECHNOLOGY MANAGEMENT TO GENERATE ENERGY FROM WASTE
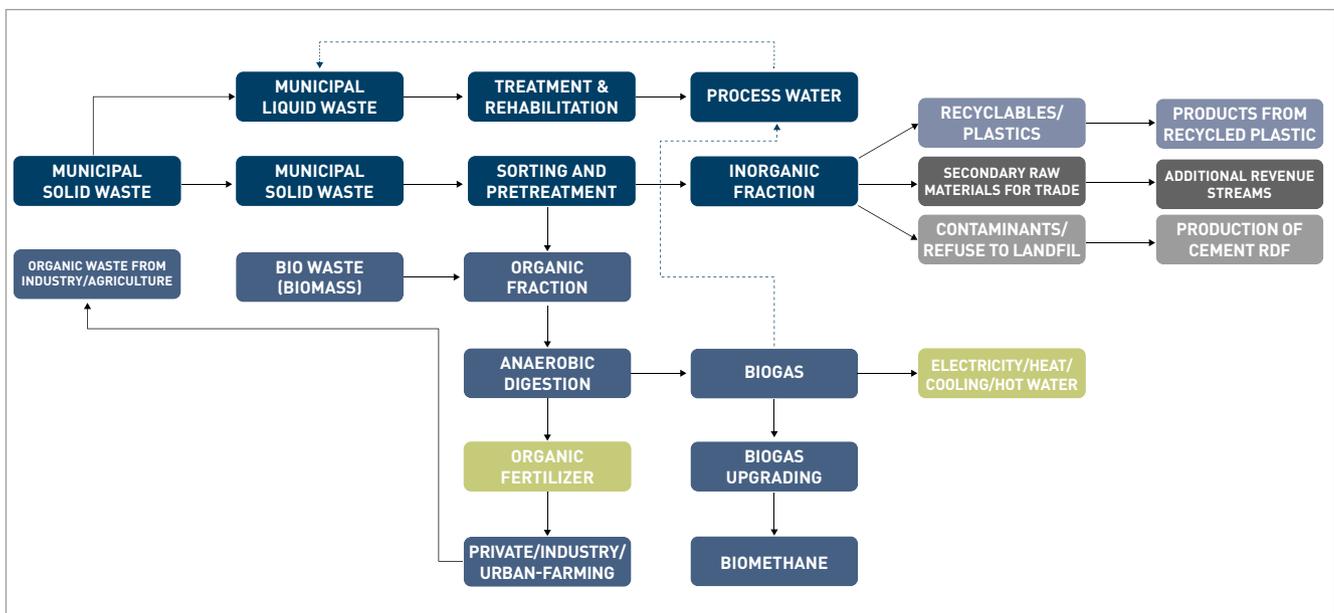
↗   The elements of integrated waste management

What can be done to make mega-cities more resilient? And how can their carbon footprints be reduced in the long term? One answer to these questions is the use of latest technology for integrated waste-to-energy systems. Steinbeis Transfer Institute Steinbeis Global Institute Tübingen (SGIT), is working in partnership with Export-Akademie Baden-Württemberg to set up centers of excellence for green technology in emerging countries, not only to promote technology transfer into these countries but also to help with the management of green projects. The centers of excellence are also looking at other forms of green technology used in water treatment, healthcare, staff training, farming, green products, and services, including corresponding production

processes. Generating energy from waste in combination with the Green IMLead® management concept is just one example of the impact the Steinbeis experts have in supporting successful technology transfer projects.

Finding intelligent ways to combine and manage technologies makes it possible to sort waste efficiently. This also enables up to 99% of waste from municipal, industrial, and agricultural sources to be reused. Collecting, sorting, and preparing waste for processing not only involves separating garbage into organic (food, energy crops, manure, etc.) and inorganic waste (metal, glass, impurities, etc.). Inorganic elements can be recycled or upcycled, and biomass can be fermented to create biogas, thus mak-

ing it possible to produce biomethane or use biogas for heating and power generation. One further step is to refine fermented biomass to create bio-fertilizer containing zero residues of plastic, pharmaceuticals, or other hazardous materials. To establish reliable concepts of circular recycling in countries like India, South Africa, and Uganda, it's important to involve local authorities, since they will be responsible for collecting garbage and energy supplies. To manage resources on the waste input side of the equation (solid and organic wastes; waste water) and the output side (recycled and processed materials, thermal power, energy sources, biomethane), existing technology has to be adapted to local conditions, and specialists and managers must be recruited and educated.

↗

The Green IMLead® concept for integrated technology management and leadership

The Steinbeis Transfer Institute Steinbeis Global Institute Tübingen is currently working with Export- Akademie Baden-Württemberg to set up centers of excellence for green technologies. Their focus lies in setting up centers in selected regions, and one such unit has already been set up in Hyderabad at the Steinbeis Centre for Technology Transfer India. Staff at the center work on green technology consulting projects and they also run training and education programs. Further partnerships are in place in a variety of countries, including Namibia, Russia, South Africa, Ukraine, Uganda, and Vietnam.

GREEN IMLEAD® – BRINGING MANAGEMENT TOGETHER WITH TECHNOLOGY

The Steinbeis experts in Tübingen are using a management concept to provide a methodical framework for managing integrated waste technology: Green IMLead®, which stands for integrated management and leadership. The idea is to pool different approaches to technology and management with a focus on managers and project leaders responsible for spearheading specific green projects. Managers are equipped with ̋green ̋ leadership skills for managing individuals such as staff, suppliers, and customers. They also bear responsibility for managing external (market and business environment) and internal information (data gathered from processes, product data, data derived from infrastructures). These days, managing information has strong overlaps with digital solutions, artificial intelligence, and Industry 4.0 solutions (connected factories). ̋Innovations with a bearing on emerging technologies and business models are an important prerequisite for dealing with current and future market requirements, ̋ says Steinbeis expert Professor Dr. Bertram Lohmüller. Suitable production and business processes are required to manage integrated waste management systems, but they tend to be overhauled in faster and faster development cycles. As a result, it ̓s important for managers to be agile and possess the right change management expertise. Ultimately, all of these activities need to be financed and all fields need to be connected and integrated into one another. This should also be reflected in the know-how offered by managers and scientists in adopting integrated action and thought.

SUCCESS LIES IN LEADERSHIP, INFORMATION MANAGEMENT, AND INNOVATION MANAGEMENT

To set up centers of excellence, the project team investigated the various factors that dictate successful technology transfer when generating energy from waste. They found that the most important key success factors are leadership, information management, and innovation management. Other identified success factors were social and regional integration and training given to staff, who should be in a position to manage complex technological processes. This is the reasons why the centers of excellence for green technology will in future focus on frugal innovation and the implementation on trainings and advanced educational programs.

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SEEING IS BELIEVING –
THE QUALILEO MONITORING SYSTEM

A BRIEF JOURNEY INTO THE REALMS OF AUTOMATED INDUSTRIAL QUALITY ASSURANCE

The experts at Steinbeis Qualitätssicherung und Bildverarbeitung GmbH (SQB) believe in looking at things in detail ... and looking again. The team in Ilmenau has developed a smart fault recognition system called Qualileo, which will be used in production facilities and manufacturing processes for automated industrial quality assurance purposes.

The tool has "quali" in its name because that's what it's all about. The Qualileo monitoring system memorizes sample materials and compares these to objects that require checking. It is capable of spotting deviations on an area measuring up to 500 x 500 square millimeters, marking defects on an image, making suggestions based on its examination, and placing faults into categories. This makes it possible to automate and document visual checks for quality management purposes. It also makes processes more reliable.

BIG STORAGE SYSTEMS FOR LOTS OF INFORMATION

The storage system used by the monitoring system not only has to be big enough to cater for a large number of samples (digital twins) and produced parts (QA'ed parts), it also needs to cope with corresponding checklists and parameter settings. For example, it may have to deal with medium-sized production batches, or even small volumes down to batch sizes of one, possibly involving continuous changes in assortments.

The new technology allows the Steinbeis experts to meet a variety of requirements relating to management stand-

The smart fault recognition system Qualileo combines simple operation and automatic recognition with high precision.

THE QUALILEO MONITORING SYSTEM MEMORIZES SAMPLE MATERIALS AND COMPARES THESE TO OBJECTS THAT REQUIRE CHECKING.

ards. These mainly relate to documentation and traceability, from DIN standard EN ISO 9001 to IATF 16949 automotive regulations and VDA 6.1, but also Good Manufacturing Practice (GMP) in the pharmaceuticals industry, MPG medical regulations, and the DIN standard EN ISO 13485.

EFFICIENT QUALITY MANAGEMENT

The experts at SQB believe that the Qualileo monitoring system makes a significant contribution to simplifying checking procedures and managing monitoring schedules. "Learning and storing samples and QA'ed parts will make our work more efficient because we will be able to check all parts in user-specified monitoring zones and the technology is extremely ease to operate," explains Prof. Dr.-Ing. habil. Gerhard Linß, director at SQB. Aside from versatile monitoring functions, Qualileo offers a modern design, a high-definition live image and zoom function, and the facility to export QA results. "By using a smart fault-spotting system, we prevent flawed parts slipping through the net due to fatigue or subjective decisions. We also answer the need to achieve zero-error production and significantly cut monitoring and defect costs caused by faulty parts not being picked up," adds Steffen Lübbecke, director at SQB.

WHICH FEATURES ARE IMPORTANT DURING VISUAL CHECKING?

- Surface defects (scratches, surface depressions, chipping, paint defects, blistering, streaks…)
- The incidence or absence of certain characteristics or material attributes
- Different colors
- Plug-pin connections, cable colors on connectors
- Missing/non-existent quality features
- Burrs on plastic and metal parts
- Deviations in macro-contours
- Circuit board assemblies
- Multiple objects in single images (counting)
- Completeness of packaging
- Quality of writing and letter recognition/print checking
- Data codes
- Color comparisons; measurement of color references
- Sink marks on plastic parts
- Welding lines on plastic parts
- Residual stress in components

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LEADING BY USING PSYCHOLOGY

STEINBEIS EXPERTS RECOMMEND DOVETAILING PSYCHOLOGY WITH
BUSINESS AND APPLYING IT TO THE EVERYDAY SITUATIONS FACED BY MANAGERS

Specialists and managers face a number of big challenges in day-to-day business. They often have to cope with difficult conversations and are forced to deal with difficult people. One challenge they face is knowing how to decipher confusing conflicts and feel confident enough to suggest solutions. Teams need help in solving the tasks they have to work on. In addition, managers should (and would often like to) bring people on board when it comes to moving the organization forward and making decisions that everyone feels they can subscribe to. It is therefore good to know that tools and methods exist for them to manage challenges properly. One such tool is a seminar on leadership psychology offered by Leadership Psychology, HR and Organizational Development, the Steinbeis Transfer Institute based in Gosheim. The seminar places emphasis on merging theory with practice.

To fulfill your role as a leader, you need to be conscious of the psychological understanding that such a position entails. One thing you will certainly need is a solid understanding of the fundamentals of communication and personal psychology, because this helps in analyzing difficult situations and working out suitable ways to deal with them. As far as possible, it is important to remain confident about your ability to take action, without feeling that you have to give in – so you have to know what sort of a person you are yourself and how others tick. Of course sometimes this can potentially lead to more conflict, but it is also an opportunity. The Steinbeis experts in Gosheim outside Rottweil base their seminar on the Riemann-Thomann model, which helps people understand needs and limitations, as well as the upside and

downside of their own character and that of others. A key aspect of the model is exploring how much closeness or distance people need (or can put up with), how long they want things to last, how much change they look for, or how much they can cope with. Based on these insights, managers can work out if people are working in areas where they can play to their abilities or personality, or whether in the worst case scenario, they'll have burnout.

As everybody knows, communication can be difficult – but why? The first issue is how we perceive messages when we receive them. The second is how we can prevent misunderstandings or solve them. The four-sides communication model of Friedemann Schulz von Thun provides a useful tool for understanding

interactions in business. By combining this model with a discussion guide to prepare carefully for complex meetings, managers can find ways to manage situations professionally.

THE INNER TEAM – UNDERSTANDING YOURSELF AND OTHERS

Another model shared in seminars by Steinbeis Entrepreneur Ute Villing and Stephan Bußkamp of the Schulz von Thun Institute in Hamburg is called the Inner Team. This helps managers spot ambivalences in themselves and others. It also explains why people sometimes behave differently than they intended. As with other influences, it's important to understand yourself and others in this respect in order to get along with one another. One seminar

delegate, a manager at a major company in the manual trades, summarized his experience: "You get to know yourself better; you're also challenged to think more about yourself. If you understand yourself and accept the way you are, you can start trying to understand others, their interests, their expectations, and their reactions. It's a good basis for developing your own character. I now understand better what makes me and other people tick."

PRACTICE, PRACTICE, PRACTICE

According to Ute Villing, the only way to truly understand some things is to practice. She therefore offers the participants on her courses the opportunity to join practice and training sessions after each training module. The feedback from delegates shows that this is the right approach. As one young manager from a financial company concluded, "By discussing cases, reflecting on things and using the ideas in the day-to-day situations I face as a manager, I've coped with lots of situations that I previously thought were impossible." And that's precisely what the courses are about: In addition to learning how communication works in theory, the course participants are also introduced to the tools and techniques that will help them deal properly and constructively with problematic situations in practice, as well as dealing with difficult people.

A variety of examples are discussed during the evening practice sessions: people you have a tough time with such as colleagues, bosses, clients, or even people outside of work; teams that don't seem to get on with one another and perform way below their abilities; decisions that don't actually result in action being taken because project members throw a spanner in the works; targets that were set a long time ago, but for some reason or other never seem to be achieved.

LEADERSHIP PSYCHOLOGY SEMINAR

Module 1: Communication and leadership – fundamentals
This module looks at fundamental models that help in developing a detailed understanding of human and interpersonal processes.

Module 2: Constructive meeting management – a foundation
Course delegates learn how to give appreciative feedback, listen proactively, understand non-verbal communication and underlying motivations, prepare systematically for meetings, how to lead, and how to cope with conflict during conversations.

Module 3: Dealing with conflict – with confidence and competence
The third module is an opportunity for course delegates to learn how to apply the situation model and models for dealing with conflicts to actual situations, how to spot conflict coming, how to identify viable solutions, and how to create a culture of disagreement that is fair.

Module 4: Managing teams – with each other, in one direction
In this module, the emphasis lies not only in formulating, discussing, and developing team goals, but also in spotting, highlighting, and defusing conflict early, in systematically learning from experiences involving success or failure, in improving performance, work satisfaction, and the team atmosphere, and also in challenging your own leadership style.

Module 5: Moderating decision-making processes
Finally, the course participants learn how to structure meetings at work in a meaningful way, how to make decision-making transparent and understandable, how to capture binding results, how to recognize the root causes of conflict, and how to deal with difficult team conversations in such a way that people can talk about things openly and come to a clear conclusion, rather than feel awkward and go quiet.

→ **Duration: 10 daytime seminars and 15 evening practice sessions**

The next course starts in January 2021. For further information, go to **www.führungspsychologie.info**

People benefit from the seminars on a number of fronts. Not only can they build on their skills as a manager, they also forge networks. "The only thing I regret now is that I didn't do the course earlier. The new things I learned help me every day, not just at work," says one course delegate, who runs a family business and is already experienced as a manager.

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RESTART YOUR FUTURE – SUCCESS NURTURED BY NETWORKS

BWCON HELPS SMALL AND MEDIUM-SIZED BUSINESSES MANAGE ORGANIZATIONAL TRANSFORMATION

Developing new areas of business can be time-consuming and is a drain on personnel resources. Yet it plays an important role in fueling growth and securing the success of a company. It is particularly challenging for small and medium-sized enterprises (SMEs). This is where bwcon comes in, with its Restart Your Future program, by working alongside customers at business workshops and open seminars to identify different ways to enter new fields of business. The Steinbeis experts at bwcon believe there is a major opportunity for companies in Baden-Wuerttemberg to set up collaborative projects and make better use of investment programs offered by European bodies, the German government, and the state.

According to a Haufe survey of 1,600 managers, at the height of the lockdown at the end of April, the majority of companies still felt optimistic. Why? Because in a very short time, they had made tremendous progress in digital technology and had introduced more flexible working practices. Being cut off and having to slow down had released undreamed-of levels of creativity. Starting with a blank piece of paper, teams found new ways to collaborate. In record time, business leaders shifted production capacities to short-supply products. Futurologist Matthias Horx has painted

a picture of a future scenario, closely based on the valuable achievements that resulted from the pandemic. There is a new sense of solidarity, a growing acceptance of digital tools, plus an upturn in the climate protection movement.

WHAT COMES AFTER CREATIVITY – PARALYSIS?

Only three months later, in July, many economic indicators – such as the truck driving index generated by the German toll road scheme – showed a significant spike in activity. Exports picked up again and the Chinese economy grew by 3.2% in the second quarter, fueling hopes that there would be rapid recovery. But despite all the positive signals, economic growth in Germany is still fragile. Currently, many companies are still receiving subsidies for short-time working programs and benefiting from the temporary amendments to insolvency law, which were due to end in September. Experts are concerned that there will be a slew of insolvencies in the fourth quarter, irrespective of a second wave in COVID-19 infections. Compared to the summer of 2019, unemployment has risen 46%. A growing number of metalworking and electronics specialists have been struck down by unemployment – skilled workers that were previously highly sought-after.

SAFEGUARDING THE FUTURE THROUGH INVESTMENT

Mechanical engineering has come under particular pressure – as has the automotive industry, which had already slipped into recession the previous year. The general recession fueled by the lockdown has only made bad things worse. A decline in orders has heightened the pressure on liquidity with a knock-on effect on investments in future technology. Yet this is precisely what the economy needs in order to turn things around again by itself. In his book How to Save Our Economy, ifo President Clemens Fuest warns of "coronavirus-sclerosis" if investments are withheld. Politicians are also attempting to provide European, national, and state incentives in the form of investment programs, with initiatives such as the European Green Deal and similar domestic programs, which lay a strong emphasis on sustainable changes in

the economy against a backdrop of climate and environmental protection.

AN IMPORTANT OPPORTUNITY: NETWORKS

The necessary restructuring of industry in Baden-Wuerttemberg will require joint initiatives between companies. In recent years, businesses have become increasingly dependent on one another, the result of substantial fragmentation within individual stages of the value chain. Declining orders from OEMs have triggered a dangerous downward spiral, particularly in the automotive supply industry and among related mechanical engineering companies. The first to be affected by insolvency problems are small companies at the extremity of the value chain, who as a result have a low public profile. Powerful networks between companies also offer an opportunity, however. They allow firms to leverage innovation net-

works and unveil the opportunities presented by promising forms of technology such as hydrogen. But to do this, companies need to be creative and open to change. They also need professional networks. Industry associations, chambers of commerce, and business clubs have the potential to support their members in becoming more active by translating the interests of individual members into important alliances.

BWCON REBOOTS THE FUTURE

This is a goal also being pursued by bwcon, an enterprise belonging to the Steinbeis Network. Its Restart the Future program is aimed at supporting SMEs with the processes of business transformation. A one-day taster seminar held in the St. Georgen Technology Center on September 17, 2020 allowed participants to experience the efficiency and effectiveness of different innovation techniques in combination with business

opportunities offered by the European Green Deal. The open workshop benefited from interaction between different companies, providing a useful starting point for innovation networks. The number of participants was limited to 20 due to hygiene and social-distancing regulations.

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FIT FOR THE FUTURE: INDUSTRY 4.0 IN VOCATIONAL TRAINING

THE CHALLENGES FACED BY EUROPEAN SKILLED WORKERS AS A RESULT OF DIGITAL TRANSFORMATION

Erasmus+ is a European funding program aimed at supporting cross-border initiatives with a bearing on vocational training. One such initiative is called A.U.T.O. 4.0 – Understanding and Achieving Automotive Training Outcomes 4.0. As a partner on the project, Professor Dr. Dr. h.c. Georg Spöttl, entrepreneur at the InnoVET Steinbeis Transfer Center, has been examining the challenges faced by skilled workers in automotive production as a result of the increasing introduction of Industry 4.0 technology.

The main emphasis of the A.U.T.O. 4.0 project lies in an important question: What impact does implementing Industry 4.0 (connected manufacturing) – and with this, networked production processes – have on the competences and vocational profiles of skilled workers? The answer to this question interests a number of project partners in Italy, Germany, Spain, and the UK.

Numerous studies have already ascertained that Industry 4.0 is extremely likely to result in more automated processes and that, for example, this could threaten nearly half of all jobs in the United States. Of course such predictions have to be treated with caution, because a large number of factors are aggregated for making such assessments, particularly when it comes to work practices and occupations. Studies focusing more on understanding requirements indicate that there is one key factor that is extremely important when it comes to the approaches used to organize work processes and jobs at European companies. This raises important questions regarding interactions between people and connected factories, as well as what types of digital technologies are used. In summary, there are three scenarios in this respect:

■ **The tool scenario:**
 The expert systems that are developed are more like tools for skilled workers. Designing different types of technology provides skilled workers with a number of ways to carry out key tasks on the shop floor.

■ **The automation scenario:**
 As smart, self-controlled technology is increasingly introduced to machines, production, and logistics, it limits the sphere of influence of skilled workers resulting in a "devaluation" of their qualifications.

■ **The hybrid scenario:**
 Developing new ways of interacting and collaborating with technology when managing and controlling systems leads to new requirements for skilled workers, because humans and machines need to work together. The type and quality of requirements are then ultimately dictated by the nature of work planning.
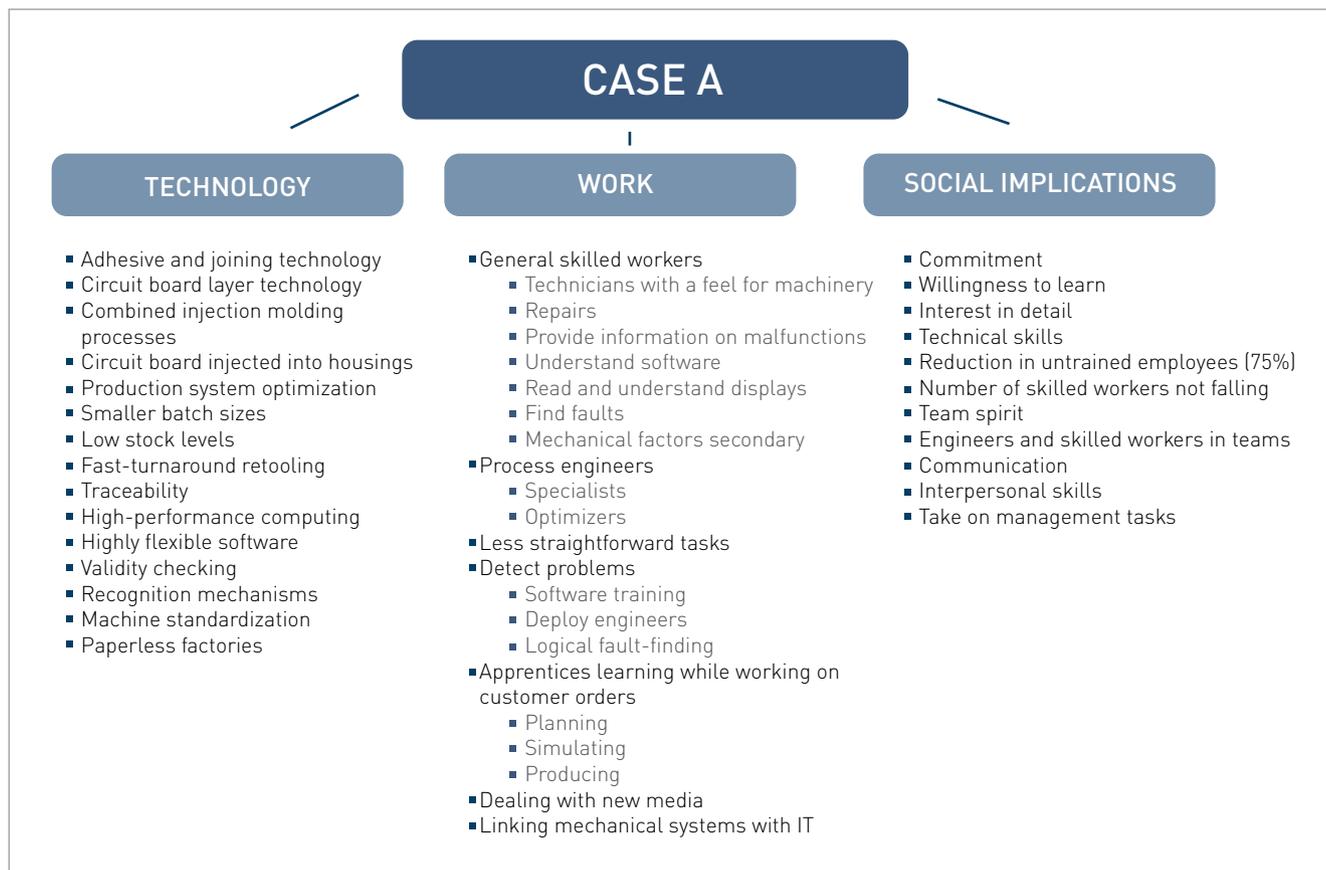
Which of these three scenarios will become a reality will depend on approaches to work planning and the impact these have on how certain types of technology are used. The existing qualification levels of skilled workers have a significant single influence on such processes.

CONTINUAL CONNECTEDNESS – A SOCIAL PHENOMENON

For many companies, it's not clear which direction developments will take them in when it comes to digitech. To make things worse, as more and more factories become connected as a result of the digital solutions that are required for Industry 4.0, they face a number of imponderables when it comes to actual work processes. This does not prevent

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WHAT IMPACT DOES IMPLEMENTING INDUSTRY 4.0 (CONNECTED MANUFACTURING) – AND WITH THIS, NETWORKED PRODUCTION PROCESSES – HAVE ON THE COMPETENCES AND VOCATIONAL PROFILES OF SKILLED WORKERS?

CASE A

TECHNOLOGY

- Adhesive and joining technology
- Circuit board layer technology
- Combined injection molding processes
- Circuit board injected into housings
- Production system optimization
- Smaller batch sizes
- Low stock levels
- Fast-turnaround retooling
- Traceability
- High-performance computing
- Highly flexible software
- Validity checking
- Recognition mechanisms
- Machine standardization
- Paperless factories

WORK

- General skilled workers
  - Technicians with a feel for machinery
  - Repairs
  - Provide information on malfunctions
  - Understand software
  - Read and understand displays
  - Find faults
  - Mechanical factors secondary
- Process engineers
  - Specialists
  - Optimizers
- Less straightforward tasks
- Detect problems
  - Software training
  - Deploy engineers
  - Logical fault-finding
- Apprentices learning while working on customer orders
  - Planning
  - Simulating
  - Producing
- Dealing with new media
- Linking mechanical systems with IT

SOCIAL IMPLICATIONS

- Commitment
- Willingness to learn
- Interest in detail
- Technical skills
- Reduction in untrained employees (75%)
- Number of skilled workers not falling
- Team spirit
- Engineers and skilled workers in teams
- Communication
- Interpersonal skills
- Take on management tasks

↗ Results of a case study involving an automotive supplier (Source: Spöttl)

them from forging ahead with implementation, however, as confirmed by studies on the diffusion of Industrial 4.0 technology. But it is not so much technological transformation that creates uncertainty, but the rate at which digitech is introduced to processes and the pace of connectivity within subsystems, resulting in highly complex units. Everyone needs help in coping with the increasing levels of technological complexity in society and at work. One particular challenge for the vocational training system is an anticipated intensification in connected systems. This phenomenon is often now referred to as hyperconnectivity. "Hyperconnectivity has become a defining feature of modern society and thus a systemic point of reference for stakeholders in interacting with one another in the education and employment system of the future," explains Steinbeis Entrepreneur Georg Spöttl.

CASE STUDY HIGHLIGHTS THE CHALLENGES OF DIGITAL TRANSFORMATION

To make meaningful statements about the changing requirements faced by skilled workers, it makes sense to examine changes in the nature of skilled work and the skills employees are expected to offer below academic qualification levels (Level 6, European Qualifications Framework). As a starting point, it is assumed that digital solutions will change tasks and work processes, and thus the vocational reference framework will also change.

In the first example (Case A), it becomes clear that companies with an international focus faced a variety of challenges in 2019 due to the increasing introduction of Industry 4.0 practices. Diagram 1 provides a summary of findings at an auto-motive supplier employing 1,500 people, 60% of whom were trained as skilled workers. As the overview shows, it is no longer just technological emphasis that is important. There are also shifts in the type of work carried out and social implications.

One prerequisite in the case of the automotive supplier was that skilled workers have technical training in order to understand mechanical and electronic systems, also so they are capable of analyzing defects. Skilled workers must be able to provide key information on the nature of faults to the people who are responsible for actually repairing and eradicating them. With straightforward faults, skilled workers must be in a position to carry out repairs themselves. But to do that, it is necessary to send them to the "front line" for around 12 months during their basic training.
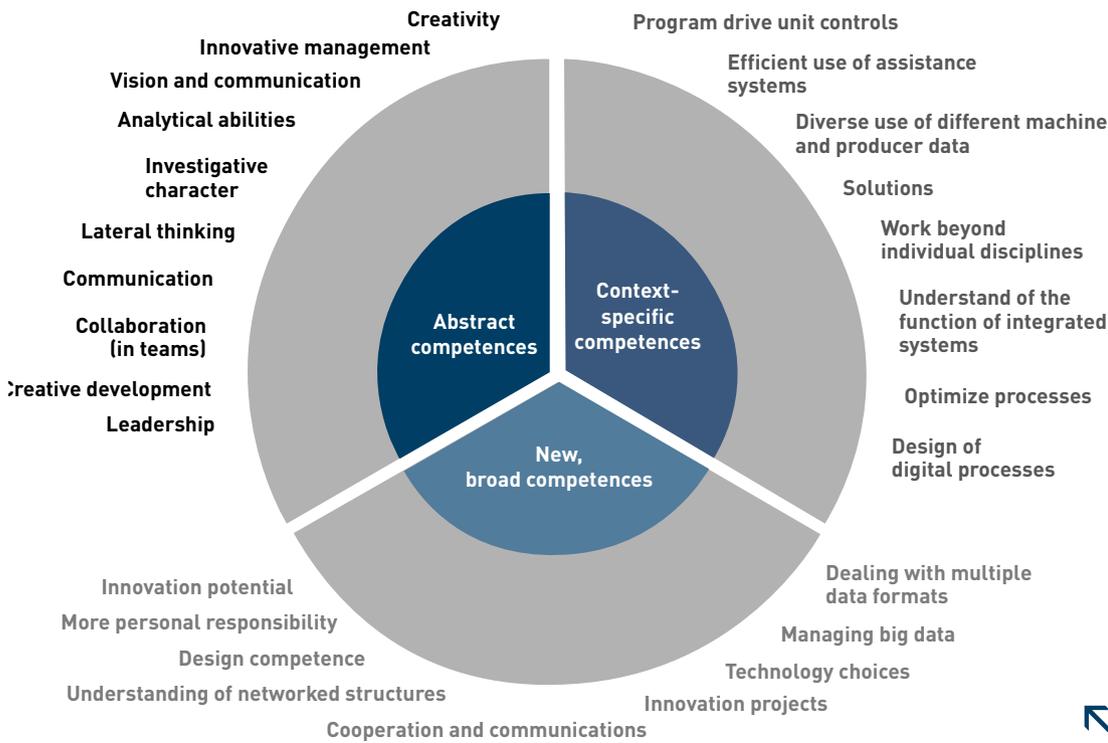
Industry 4.0 Skills Radar
(Source: Spöttl)

The head of production at the company examined for the case study defines skilled workers as people with a certain degree of commitment, who learn continuously, who have a particular interest in what makes machines tick, and – ultimately – who can describe in detail the processes followed by machines. He estimates that a good 70 percent of staff in his department would count as skilled workers if there were no longer any of the old, manually operated lines.

USING THE INDUSTRY 4.0 SKILLS RADAR FOR ORIENTATION PURPOSES

Change is sweeping through the automotive supplier market on many fronts, from the introduction of digital media, to software-driven diagnostic equipment and interdepartmental collaboration. This rate of change applies similarly to social factors, affecting not only interpersonal and communication skills, but also people's willingness to learn new things, commitment levels, people's eye for detail, and being prepared for management roles.

The study conducted by the A.U.T.O. 4.0 project partners identified 19 qualification profiles for categories of skilled workers, all beneficial in coping with the changes brought about by the introduction of Industry 4.0 technology. Their assessment of the skills required for each profile showed that such skills can be placed on three levels:

- Broad-reaching skills as a new basis of vocational training
- Context-specific skills
- "Abstract" skills

Each skill level dovetails closely with multiple individual skills needed for dealing with tasks. These can be captured on an Industry 4.0 Competence Radar, providing a powerful point of reference for the breadth of requirements, as well as the way in which required skills relate to situations through context-specific expertise. What this also underscores is that abstract skills cannot be considered beyond the context of specific requirements. Looked at from an overarching perspective, the competence radar provides a template for defining the profile of key vocations in European manufacturing.

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HOW TO KEEP OLD MACHINES GOING

EU PROJECT USES SMART FACTORIES AND CLOSED LOOP STRATEGIES TO EXTEND THE LIFE OF MACHINES
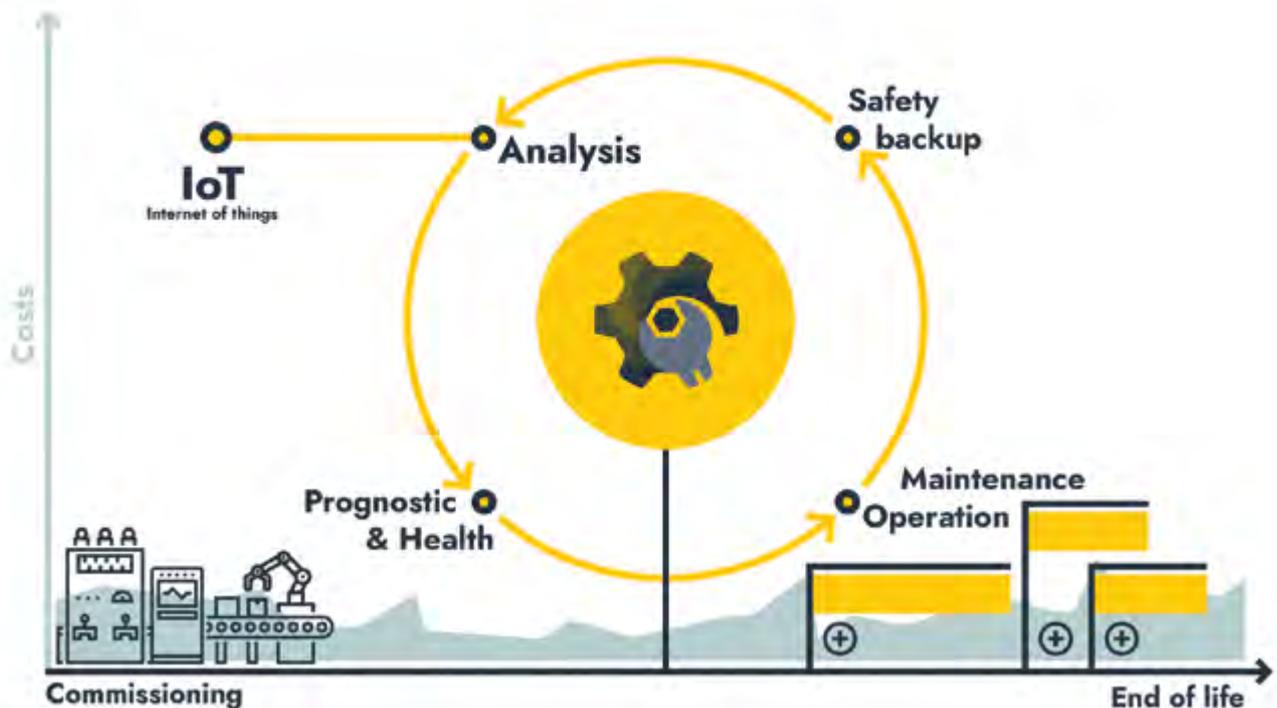
Can European manufacturing improve its productivity and competitiveness by adopting digital solutions and transitioning to closed loop strategies? This is the question being tackled by a consortium of researchers and industrial partners from nine countries, including Harms & Wende and Steinbeis-Europa-Zentrum, as part of the EU-funded project RE-CLAIM. Their aim is to use digital analytics (DA), the Industrial Internet of Things (IIoT), and circular economy strategies to compensate for aging industrial plants and strengthen the economy and environment. Digitally retrofitting old machines should minimize equipment failure and unplanned downtime.

Experts agree that the competitiveness of the manufacturing sector revolves around the ability of companies to prepare themselves for – and survive – changes in the market. This means that companies need to introduce mechanical and digital tools that allow them to avoid machine downtime and shutdowns due to aging machinery. The manufacturing sector should be able to cope with continually changing batch sizes. It also needs to find appropriate and profitable ways to accelerate innovation cycles. Factories capable of forecasting production schedules properly and providing operators with multiple options for monitoring and controlling systems will also

be able to adapt production lines to market requirements.

"By 2025, 15% of all material used in the European economy should be reused. RECLAIM will provide strategies and decision-making tools that accelerate the development and deployment of digital technologies in manufacturing" outlines project coordinator Michael Peschl of Harms & Wende GmbH & Co. KG, one of five pilot factories where the project is being implemented. "This is especially important for ageing equipment that often require time-consuming manual data crunching and analysis to gain any real performance and maintenance insights.

"Steinbeis-Europa-Zentrum has been tasked with ensuring that the findings of the project are put to good us, working up application and commercialization strategies with the consortium, and looking for synergies with relevant national and European projects and initiatives.

CARBON FOOTPRINTS:
A KEY DRIVER OF COMPETITION

Ageing of manufacturing machines and operational processes, as well as factory infrastructure (cranes, tanks, mobile or storage platforms and any other relevant tools), is one of the most critical factors of the production chain efficiency." Ageing influences how well similar companies can compete on the market," say Nieves Murillo, a project manager at Tecnalia, a Spanish research and technology center and partner of the RECLAIM project. According to Murillo, obsolescence is another issue, which is even worse than ageing. This happens when well- functioning machines need to be replaced anyhow because they cannot be used within modern digital production lines as a result of lack of interoperability between industrial computers and human interfaces This drives up costs and puts a strain on the environment. "So far, the impact of ageing machinery on waste generation and carbon footprint has not been studied thoroughly but it is becoming increasingly important. When raw materials, manpower and energy resources are not used efficiently, more waste is produced and higher costs are incurred," says Murillo. "Sustainability is also a key factor in competitiveness. Sustainable industrial processes and waste management are fundamental for ensuring a high environmental protection, which is increasingly perceived as an important aspect in a company performance rating," adds Rosaria Rossini of the Italian Links Foundation, also a research partner in the RECLAIM project.

DIGITAL TOOLS FOR INDUSTRY

Two key factors when it comes to avoiding machine downtime are prediction and prevention. Both require effective tools for maintaining and upgrading machines. "IoT and Smart Factories, together with circular economy, are the pillars for the long-term prosperity of companies," says Murillo.

Predictive and preventative machine maintenance strategy requires a deep understanding of the data. "IoT devices provide the data from the machines while digital analytics allows us to make sense of it," says Rossini. IoT and Data Analytics support the circular economy paradigm through the automated detection of scrap material levels, which helps to improve management and create new business optimization strategies. Applying predictive control on the machines helps to improve their maintenance and performance.

By drawing on DA technology, the RECLAIM project will result in the development of a decision support framework for the ageing machines, which are approaching the end of their 'designed time'. These machines typically break down more often, which leads to loss and delays in production. To provide a framework, analysis and decision-making strategies are being developed. These will be used to assess the "health" of equipment and provide guidance on how to extend the machinery's lifetime.

Another solution developed within the project revolves around the use of digital twins for error diagnosis purposes and predictive maintenance. Not only do twins make it possible to replicate factory environments digitally, they also allow the performance and status of machinery to be monitored and predicted. Operators can be given direct access to all functions required to plan machine overrides or predict potential outages. The tool is highly adaptable and scalable, and it can be adjusted to other specialist fields. The infrastructure has now been developed for the project, and currently more attention is being given to dedicated AI algorithms and simulation environments for pilot applications.

One strength of the RECLAIM system is that it combines smart IoT sensors with industrial computers, control units, algorithms, models, and digital twins. This sophisticated infrastructure can generate module-based solutions that can be adapted to the specific requirements of industrial machines and offer non-intrusive mechanisms for monitoring plant functions.

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COMPANIES NEED TO INTRODUCE MECHANICAL AND DIGITAL TOOLS THAT ALLOW THEM TO AVOID MACHINE DOWNTIME AND SHUTDOWNS DUE TO AGING MACHINERY.

APPLICATIONS FOR NUMEROUS SECTORS OF INDUSTRY

The companies participating in the RE-CLAIM consortium are working on the development and implementation of new tools in five pilot areas. The consortium coordinator, Harms & Wende, is conducting tests on applications in welding. Other sectors of industry include timber processing (Switzerland), textiles (Turkey), robots (Slovenia), white goods (Czech Republic) and shoe production (Spain).

Developing an ultra-flexible architecture based on interchangeable system components for use in welding production – and combining this with remote diagnostics and predictive software – will make it possible to supply customers with made-to-measure machines and services. The companies producing shoes and white goods are being introduced to IoT sensors capable of monitoring the smooth functioning of machines using non-intrusive technology. The sensors they are using can

help reduce the carbon footprint of end products. The producers of household textiles are being given access to machine-learning models in combination with machine sensors to help them optimize bleached products offered in traditional ranges and thus improve the sustainability and environmental friendliness of the textile industry. A further example shows how companies can digitally retrofit aging wooden furniture production: The RECLAIM project allows them to combine applications based on edge computing, data analytics, soft sensors, and AI models.

RECLAIM is initially focusing on five sectors of industry, but the findings will be transferable to many other areas. For example, there are several similarities between the production equipment used in textile bleaching, wood pulp production, and robot cells, and the different kinds of machinery used in the automotive industry. Other sectors that place emphasis on robustness and environmentally friendly production will also be able to use dig-

ital solutions to achieve important goals. In addition, several key industries such as textiles have shifted production abroad to countries offering low manufacturing costs. Introducing smart technology to real-life production set-ups could enhance the competitiveness of textile factories across the EU and restore the important role they play in the European economy.

The project partners expect the first round of applications to be on the market within a couple of years. "We expect that, based on some of the RECLAIM tools, factories could make their decisions 30% faster through adopting the best recovery strategy," says Murillo. "Another important outcome will be automated and digital production lines and machines, with a projected 20% drop in shutdowns due to failing machine components. Furthermore, more time and money will be saved, and machines will last for longer and be more efficient. The machinery effectiveness will increase by 90%, with the consequent reduction in CO_2-emissions."

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THE AUGSBURG JOURNEY – SEVEN STEPS TO A HEALTHY BUSINESS

STEINBEIS EXPERTS PROVIDE SUPPORT WITH THE PROMOTION OF OCCUPATIONAL HEALTH MANAGEMENT

Healthy Work, the core competence center at the Institute for Effective Management, a Steinbeis Consulting Center, helps businesses of all sizes and sectors of industry with programs aimed at promoting the physical, mental, and social wellbeing of workers – a key factor in safeguarding the financial health of a business. To achieve this, a team of experts led by business psychologist Dr. Simon Hahnzog has had success using the Augsburg Journey, a process model for planning effective occupational health management (OHM).

The Steinbeis experts from Augsburg offer a unique blend of consulting skills, innovative digital training, and diagnostic solutions. These are aimed at supporting clients and their employees on every step of the journey toward introducing healthy work practices.

STEP 1 – TAKE RESPONSIBILITY

The main idea of the first step is that senior management should take responsibility for the welfare of the business. Occupational health management must be acknowledged as a key ingredient of company culture and the business strategy – from top to bottom. People should be encouraged and supported, because this is one of the most valuable investments that can be made in safeguarding the future of a company. Assuming the company adopts the right approach to OHM, there are very few areas in business where a return on investment can be expected to achieve a ratio of 1 to 2.2.

STEP 2 – EXPAND COMPETENCE

The second step of the Augsburg Journey is about expanding skill sets within the company. Ultimately, it's not as if any company has never thought about occupational healthcare, otherwise they would have disappeared some time ago. For healthy working practices to remain effective in the future, especially in strategic terms, it's important to train the people who will be responsible for planning, designing, and implementing OHM.

STEP 3 – SET UP OHM

As soon as people have been identified to take responsibility for OHM and they have acquired new skills, a professional occupational health management system

SEVEN STEPS TO A HEALTHY BUSINESS

7. STRENGTHEN PROFITABILITY

5. ASSESS STRESS FACTORS

3. SET UP OHM

6. INTRODUCE MEASURES

1. TAKE RESPONSIBILITY

4. SENSITIZE WORKERS

2. EXPAND COMPETENCE
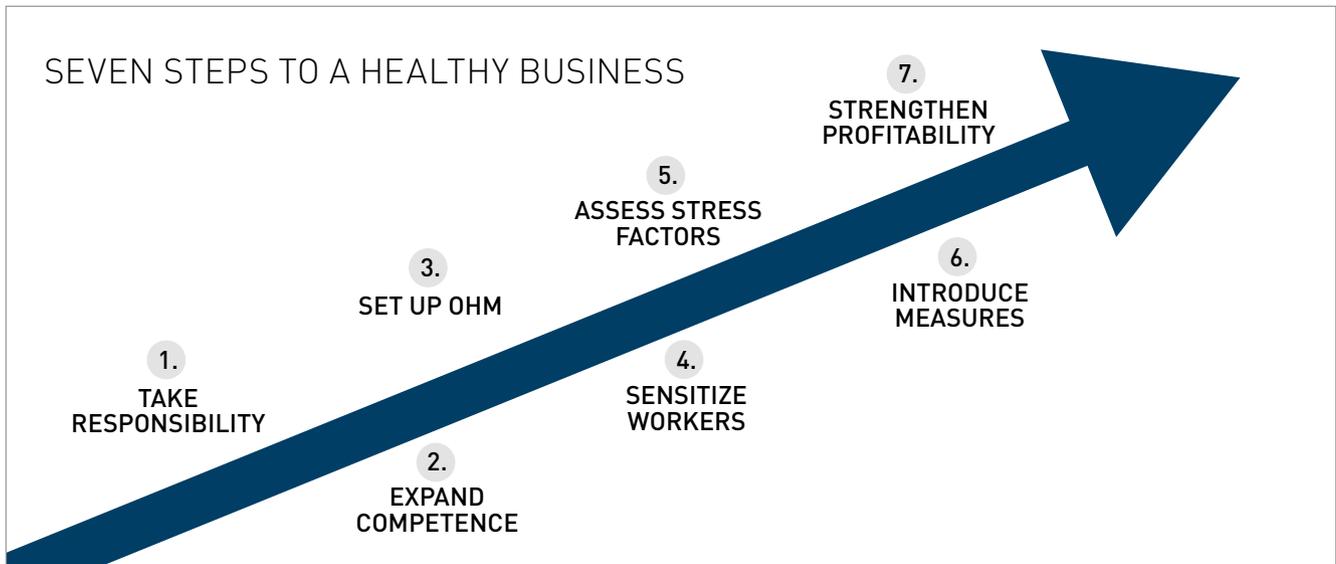
The Augsburg Journey (Dr. Simon Hahnzog)

needs to be set up. In terms of processes, structures, and strategies, this will not differ from other management systems. It is therefore essential to draw on previous experience at the company.

STEP 4 – SENSITIZE WORKERS

Once the OHM system has been set up at the company, it's time to sensitize staff. You can't simply order people to adopt healthy working practices. Instead, everyone has to work together in creating a healthy company. Aside from providing clear information, it's important that everyone is encouraged to actively design healthy practices for themselves and everyone else at the company. The managers at the company play a key role in this respect.

STEP 5 – ASSESS STRESS FACTORS

There are a number of reasons why it is important at this point for a healthy company to assess factors that create stress for people at work. Not only is this a legal obligation in all EU Member States (Council Directive 89/391/EEC on the introduction of measures to encourage improvements in the safety and health of workers at work), but also, much more importantly, to introduce OHM you have to know which measures will be needed in which areas to promote occupational health. Starting everywhere at the same time, like using a watering can, not only wastes energy, time, and money – more often than not it gets you nowhere.

STEP 6 – INTRODUCE MEASURES

Once both physical and mental hazards have been assessed, the first concrete measures for promoting occupational health can be introduced. These measures only achieve their full potential, however, if the company has also previously considered the other steps of the Augsburg Journey.

STEP 7 – STRENGTHEN PROFITABILITY

"If all seven steps are followed with the necessary conviction, and the company prepares, introduces, and implements OHM in the way described in the Augsburg Journey, it has an impact," says Simon Hahnzog from many years of experience. When workers improve their health, they become more active in carrying out their work and they become more reliable, and this also improves the health of the company. A company can then also improve its employer branding, especially if it operates in a difficult labor market, and it will be more successful in recruiting personnel and improving loyalty. In addition, it will also meet compliance guidelines.

THE PORTFOLIO OFFERED BY THE INSTITUTE FOR EFFECTIVE MANAGEMENT, A STEINBEIS CONSULTING CENTER, INCLUDES THE FOLLOWING CONSULTING SERVICES, WHICH ARE TAILORED TO THE AUGSBURG JOURNEY:

- A certification course on occupational health management, designed to prepare people responsible for OHM for the tasks they will be involved in.
- Tangible support from the Steinbeis experts by working alongside clients and offering multi-professional experience in organizational development, change management, and innovation management. On request, the experts will also organize consulting to take place alongside health insurance partners such as Barmer or Techniker Krankenkasse.
- There is an online video tutorial on healthy leadership for sensitizing managers. Participants are taken through practical instruction modules via a tutorial website called Career Training Online, offering a variety of tools and techniques for boosting knowledge in order to fulfill management roles – healthily and effectively.
- Simon Hahnzog shows how to conduct a professional risk assessment of mental workload strain, providing clear examples in a video tutorial. The Steinbeis experts have also posted a video on the Career Training Online website for customers.
- The Institute for Effective Management is also the first company to offer virtual "keep fit trails" in any chosen location. The Steinbeis Consulting Center's solution, GEMARA, is based on Interest, the innovative learning app. Users are offered a selection of different "power journeys" using geotagging to promote their physical or mental health – without major effort – while taking a walk during lunch breaks.

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MEDIATION – QUARTER III EDITION, 2020
HUMOR WORKS
GERNOT BARTH (ED.)

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The journalist and author Otto Julius Bierbaum once said that "humor is when you laugh anyway." Also – or maybe especially – in mediation, a touch of humor can help lighten up some of the most entrenched and conflict-ridden situations. It's important to tread carefully, however, because not all humorous interjections make sense – and not every sparring partner enjoys a smidgen of frivolity.

Edition III/2020 of "Mediation" looks at the topic of "Humor Works" and describes when it can be useful to make a witty remark, even when dealing with conflict. As well as enjoying interviews with former German Federal President Christian Wulff and the cabaret artist, songwriter, and actor Bodo Wartke, the reader hears from Wartke why a good joke helps pull people together. The reader is also offered some interesting pointers on leadership with humor and why, when, and how it makes sense to use humor during mediation.

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MEDIATION – QUARTER II EDITION, 2020
THE POWER OF CHANGE
GERNOT BARTH (ED.)

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Inventions, revolutions, scientific discoveries – all spell change, and in most cases they result in new developments, so they are an improvement. But sometimes we find it difficult to adjust to change. No matter whether it's at work or at home, in most cases it's worth summoning up the courage to accept something new.

Edition II/2020 of "Mediation" looks at the topic of "The Power of Change" as part of a multifaceted approach. Former state minister Julian Nida-Rümelin outlines his vision of digital humanism in an era of internet technology. Readers are also provided answers to the questions of what can actually be achieved with change management, the extent to which agility can drive burnout during change, and what needs to happen in neurological terms for human behavior to really change. Aside from the focal topic, readers are also offered insights into a variety of other fascinating topics and concepts.

99 NEGOTIATIONS – HE WHO PLAYS, LOSES?!
PUBLICATION SERIES OF "MEDIATION" MAGAZINE | VOLUME 5
JONATHAN BARTH

2020 | paperback
€14.90 [Germany]
ISBN 978-3-95663-216-7

2020 | E-Book (PDF)
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ISBN 978-3-95663-227-3

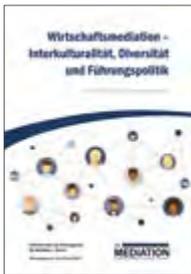The influence of playfulness on the outcome of negotiations – Jonathan Barth examines whether adult playfulness can influence the outcome of negotiations. Research findings clearly indicate that we urgently need more playful people in business. According to the author, not only do they reduce transaction costs in negotiations, they also offer an enrichment to the make-up of teams by boosting the concept of win-win situations. In addition, hiring adult-playfulness-personalities clearly safeguards business ties in the long term. It appears, therefore, that homo oeconomicus has an important counterpart in homo ludens when it comes to appointing team members within companies and other kinds of organizations.

This book is also worth reading for people with no previous knowledge of scientific interviewing techniques, not only because it provides clear pointers on why it might make sense to introduce playful people to companies and organizations, but also because it suggests different ways to allow children to be playful and develop into playful adults.

BUSINESS MEDIATION – INTERCULTURAL FACTORS, DIVERSITY AND MANAGEMENT POLICY
PUBLICATION SERIES OF "DIE MEDIATION" MAGAZINE | VOLUME 6
JONATHAN BARTH, CLAUDIA SCHMIDT (ED.)

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ISBN 978-3-95663-223-5

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ISBN 978-3-95663-228-0

Business mediation has become an important factor within an increasing number of company HR departments in recent years. Some firms are even going one step further and introducing complaints units and internal conflict management processes that allow the organization to systematically identify and address simmering conflicts early. One element of such conflict management systems, which has evolved in Germany in recent years as its own "variation on a theme", is mediation. It is now used in a variety of situations, just with a different label on the packaging, mandated by HR departments or management and named "conflict moderation", "team coaching", or even just "team workshops". One thing such approaches involving external or internal consultants have in common, however, is their aim of finding a solution to existing conflicts by involving all stakeholders. The role of consultants in such processes is to provide support. This has clear overlaps with mediation. To counter the apparent fear of the term "mediation", Volume 6 of the publication series pulls together recent scientific articles on business mediation with an emphasis on management measures, intercultural issues, and diversity. People involved in this area of business provide useful advice on using mediation in organizations.

"SMART CITIES AND COMMUNITIES" AS INNOVATION HUBS
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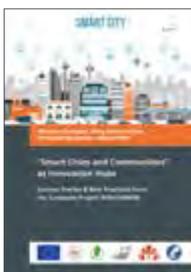
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Smart Cities and Communities projects are innovation hubs for Enterprises, Research and Technology Organisations and Local Authorities they gather. REMOURBAN is one of the "Smart Cities and Communities" projects funded under the European Framework Programme for Research and Innovation Horizon 2020 and can be considered as case study and best practice for any smart city project independently of its funding. This booklet presents the outcome of the exploitation activities in the "Smart Cities and Communities" project REMOURBAN, having applied the Steinbeis-Europa-Zentrum exploitation methodology and market deployment strategy. It also describes to which extent Enterprises, Research and Technology Organisations and Local Authorities can benefit from such a methodology.

PREVIEW

EDITION 03|2020
Feature topic
**The Carte du Jour of the Future:
when algorithms decide what goes on the menu**
Planned publication date: December 2020

Healthy, sustainable, efficient – a description of nutrition in the future. But what's the best way to achieve this with the food and drink we consume, especially given the global population growth? According to a 2019 UN forecast, by 2050 the population will have risen to around 9.7 billion; by 2100 there will be 10.9 billion people on Earth. Given these forecasts, researchers are attempting to address nutritional challenges and outline possible ways forward by looking into approaches such as disruptive innovation and digital technology. These include green gene technology, clustered regularly interspaced short palindromic repeats (CRISPR) in the field of nutrition, individualized foods, meat cultivated in Petri dishes, and much more. In the last edition of TRANSFER Magazine at the end of this year, we take a look at The Carte du Jour of the Future.

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